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Citizen Participation in e-Government Management Tools Development

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Citizen Participation in e-Government: Management Tools Development

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Abstract

Governments around the world now use Information and Communication Technologies (ICT) to improve the delivery of services and information to their users (citizens, businesses or other governmental bodies). In the literature, the application of ICT in this context is known as “e(lectronic)-government”. Similarly to other industries, governments have also seen the evolution of the governance model: ICT has empowered citizens (previously often relegated to passive users) to have more control of the decision-making process and more impact on the tasks of administrations. Therefore, e-government not only makes better service delivery possible but also enables citizen participation. However, despite the reported benefits of participation, challenges remain that impede its proper implementation, such as the lack of strategic view on citizen participation, the lack of consideration for all stakeholders and reluctance from practitioners towards participation. Therefore, this thesis aims to develop three tools for practitioners to manage citizen participation: the CitiVoice Framework, the UParticipate Decision Support Guide and the SmartCity4All Workshop. These tools have been built following the Design Science research methodology. Diverse use cases were employed to evaluate and improve the tools iteratively. In order to develop these management tools, this thesis investigates citizen participation in an integrative manner, and does so in three main ways. First, we seek to provide management tools for use at different governance levels (large-, medium- and small-scale). Secondly, we identify all means by which citizens can participate in different areas (e-government, smart cities, information systems or children’s participation). Finally, we perform this identification for all stakeholders impacted by such participation (citizens as well as project managers, who may be software developers, public agents or political representatives).

The research performed has been broken down into three main steps, linked with the three levels of governance. First, it was necessary to take a high-level view of the research areas to determine the main ways citizens can participate in an e-government setting. In this first step, we identified three main strategic areas of citizen participation: citizens as democratic participants, citizens as co-creators and citizens as ICT users. As the main research output of this step, we designed the CitiVoice Framework that structures and evaluates this participation. This tool makes it possible to manage citizen participation on a large scale, taking smart cities as use cases. Second, after this high-level look, we decided to examine more extensively one specific part of the CitiVoice Framework within the co-creation category: citizens as participants in the development of e-government services. For this step, the main research output is the UParticipate decision support guide. This guide enables project managers to make more sound decisions about the participation of citizens (and other users) in the development of e-government services, according to the various influencing factors. This guide can be used as a tool to support the management of citizen participation on a medium scale, taking the development of e-government services as use cases. Finally, we investigated in-depth the specific “workshop” participation method of UParticipate. We provide an instantiation of that method through the SmartCity4All workshop, and design its content in such a way as to further develop our method. The smart city domain is once again taken as an example to enable citizens to learn about this concept, contribute their ideas and collectively build their solutions. This tool enables citizen participation on a small scale, taking primary and secondary classrooms as use cases.

Keywords: e-government, Citizen Participation, Management Tools, Smart Cities, Design Science

Samenvatting

Overheden over de hele wereld maken nu gebruik van informatie- en communicatietechnologieën (ICT) om de levering van diensten en informatie aan hun gebruikers te verbeteren. In de literatuur wordt de toepassing van ICT in deze context "e-government" genoemd. Net als in andere sectoren (zoals toerisme) hebben de overheden de ontwikkeling van het bestuursmodel gezien: ICT heeft de burgers in staat gesteld om meer controle te hebben over het besluitvormingsproces en meer invloed te hebben op de taken van de overheid. Zo maakt e-overheid niet alleen een betere dienstverlening mogelijk, maar ook burgerparticipatie. Ondanks de gemelde voordelen van participatie blijven er echter uitdagingen bestaan, zoals het gebrek aan een strategische visie op participatie, het gebrek aan aandacht voor alle belanghebbenden en de terughoudendheid van het werkveld ten aanzien van participatie. Daarom is dit proefschrift gericht op de ontwikkeling van drie tools die het werkveld beter in staat stellen om de participatie van burgers te beheren. Deze tools zijn gebouwd volgens de onderzoeksmethodologie van Design Science. Er werden verschillende use cases gebruikt om de instrumenten iteratief te evalueren en te verbeteren. Om deze managementtools te ontwikkelen, onderzoekt deze dissertatie de burgerparticipatie op een integrale manier, en wel op drie manieren. In de eerste plaats willen we managementinstrumenten aanreiken voor gebruik op verschillende bestuursniveaus. Ten tweede identificeren we alle middelen waarmee burgers kunnen participeren in verschillende onderzoek domeinen. Ten slotte doen we deze identificatie voor alle belanghebbenden die door deze participatie worden beïnvloed.

Het uitgevoerde onderzoek is opgesplitst in drie belangrijke stappen, die verband houden met de drie bestuursniveaus. In de eerste plaats was het noodzakelijk om op globaal niveau te kijken naar de verschillende relevante onderzoeksdomeinen om van daar uit te kunnen bepalen wat de belangrijkste manieren zijn waarop burgers kunnen participeren. In deze eerste stap identificeerden we drie belangrijke strategische gebieden van burgerparticipatie: burgers als democratische deelnemers, burgers als co-creators en burgers als ICT-gebruikers. Als belangrijkste onderzoeksresultaat van deze stap ontwierpen we het CitiVoice Framework dat deze participatie structureert en evalueert. Dit instrument maakt het mogelijk om de burgerparticipatie op grote schaal te beheren, met een aantal Smart Cities als use cases. Ten tweede hebben we na dit helikopteroverzicht besloten om één specifiek onderdeel van het CitiVoice Framework te onderzoeken: burgers als deelnemers aan de ontwikkeling van e-overheidsdiensten. Voor deze stap is de belangrijkste onderzoeksoutput de UParticipate decision support guide. UParticipate stelt projectmanagers in staat om meer verantwoorde beslissingen te nemen over de deelname van burgers aan de ontwikkeling van e-overheidsdiensten, afhankelijk van de beïnvloedende factoren. UParticipate kan worden gebruikt als instrument om het beheer van burgerparticipatie op middelgrote schaal te ondersteunen, waarbij de ontwikkeling van e-overheidsdiensten als use cases wordt gebruikt. Ten slotte hebben we de "workshop"-participatiemethode van UParticipate grondig onderzocht. We geven een instantiëring van die methode via de SmartCity4All workshop voor klassen uit lager en secundair onderwijs, en ontwerpen de inhoud ervan zo dat we onze methode verder kunnen ontwikkelen. Het domein van "Smart City" wordt opnieuw als voorbeeld genomen om burgers in staat te stellen dit concept te leren kennen, hun ideeën in te brengen en gezamenlijk aan hun oplossingen te bouwen. Deze tool maakt burgerparticipatie op kleine schaal mogelijk.

Trefwoorden: e-overheid, burgerparticipatie, managementtools, Smart Cities, Design Science, etc.

Résumé

Les gouvernements et administrations du monde entier utilisent désormais les technologies de l'information et de la communication (TIC) pour améliorer les services et informations fournis à leurs utilisateurs. A l'instar d'autres industries, les gouvernements ont également vu évoluer leur modèle de gouvernance: les TIC ont permis aux citoyens (jusqu'alors souvent relégués au rang d'utilisateurs passifs), d'avoir plus de contrôle sur le processus décisionnel et plus d'impact sur les tâches des administrations. Par conséquent, cette utilisation des TIC permet non seulement une meilleure prestation de services, mais aussi la participation des citoyens. Toutefois, malgré les avantages de la participation, il reste des difficultés qui entravent sa bonne mise en œuvre. Ces dernières incluent l'absence d'une vision stratégique de la participation des citoyens, le manque de considération pour toutes les parties prenantes et la réticence des praticiens à la participation. Cette thèse vise donc à développer trois outils permettant aux praticiens de gérer la participation citoyenne. Ces outils ont été conçus en suivant la méthodologie de recherche Design Science. Divers cas d'utilisation ont été menés pour évaluer et améliorer les outils de façon itérative. Afin de développer ces outils de gestion, cette thèse examine la participation citoyenne de manière intégrée et ce principalement de trois façons. Premièrement, nous fournissons des outils de gestion pour différents niveaux de gouvernance. Deuxièmement, nous identifions tous les moyens par lesquels les citoyens peuvent participer dans différents domaines. Enfin, nous procédons à l'identification de toutes les parties prenantes concernées par cette participation.

La recherche a été divisée en trois étapes, liées aux trois niveaux de gouvernance. Tout d'abord, il était nécessaire d'avoir une vue d'ensemble des domaines de recherche afin de déterminer les principaux moyens par lesquels les citoyens peuvent participer. Dans cette première étape, nous avons identifié trois grands domaines stratégiques de la participation citoyenne : les citoyens en tant que participants démocratiques, les citoyens en tant que co-créateurs et les citoyens en tant qu'utilisateurs des TIC. En tant que principal résultat de recherche de cette étape, nous avons conçu le framework CitiVoice qui structure et évalue cette participation. Cet outil permet de gérer la participation citoyenne à grande échelle, en prenant les villes intelligentes comme cas d'utilisation. Deuxièmement, nous avons décidé d'examiner en détail une partie de CitiVoice: les citoyens en tant que participants au développement des services en ligne de l'administration. Pour cette étape, le principal résultat de la recherche est le guide d'aide à la décision UParticipate. Ce guide permet aux gestionnaires de projets de prendre des décisions plus éclairées sur la participation des citoyens au développement des services en ligne, en fonction des différents facteurs d'influence. Ce guide peut être utilisé comme un outil de gestion de la participation citoyenne à moyenne échelle, en prenant le développement des services en ligne comme cas d'utilisation. Enfin, nous examinons en profondeur une méthode de UParticipate : l'atelier. Nous fournissons une instanciation de cette méthode à travers l'atelier SmartCity4All, et concevons son contenu de manière à développer davantage notre méthode. Le domaine de la ville intelligente est une fois de plus pris comme exemple pour permettre aux citoyens d'en apprendre davantage sur celle-ci, d'apporter leurs idées et de construire collectivement leurs solutions. Cet outil permet la participation citoyenne à petite échelle, en prenant des classes de primaire et secondaire comme cas d'utilisation.

Mots-Clés: administration électronique, participation citoyenne, outils de gestion, Villes Intelligentes, Design Science

Dedication

To my grand-parents,

To my parents,

To my sister,

To my girlfriend,

To my closest friends,

That all helped me preciously in their own way.

Acknowledgements

First, I would like to thank my two promotors. Monique, through her continuous support and precious pieces of advice during the course my PhD, is responsible in a large part for the work produced in this thesis. She always took the time to sit down and discuss when I needed it. Her passion for cartoons made our discussions even more interesting and enjoyable. I will always remember her as the first person that gave me a job opportunity and always be grateful for that. Naji, despite having limited time available, was always there at the key moments of my thesis and was also confident enough in me to get me this first job.

I am also lucky enough to have wonderful members in my jury that were all very important to me during this process.

Benoît, although not being officially appointed as my promotor, acted like it from the beginning till the end of the process. From the informal discussions when we shared offices to the meeting at La Sorbonne, the insights he had to share always make me go in directions I never thought of before. However, I must admit, the discussions around cinema and politics as well the train discussion about my favorite kind of horror movie will stick as being the most memorable moments I shared with him.

I was also lucky enough to have my master's thesis supervisor in my jury: Fani. She always gave torough feedback on what I presented in the more sympathetic way possible. I really hope our collaboration will continue in the years to come as it is a pleasure to discuss with her.

I will also always be grateful to Ulf for allowing me to stay at the wonderful University Linköping. From my first encounter with him at AMCIS 2017 in Boston when I was a nervous PhD Student talking for the first time to a professor from abroad to the defense, he was always kind, nice and full of precious pieces of advice. He allowed me to meet wonderful people in Linköping which I hope to see back one day. Ida, Jonathan, Malin, Sofia, Troy and Truls, thank you all for making me feel as welcome as I felt during these two months there.

Finally, Annick, the president of this jury, is also be special for me as she could have been my promotor if the timing of the gods of funding had decided it that way. Despite this missed timing, her pieces of advice before I started the PhD were precious to me.

I was also lucky enough to share this adventure with colleagues from three institutions. In Namur, I was lucky enough to share my first office with Hajer, that never stopped giving me useful advices with the kindness that characterizes her. Then, I switched offices and encountered Antoine that I was able to guide in his first steps in the (non-research) laboratory. Julie, and now, Cécile and Maxime were an absolute pleasure to share office with. I also would like to thank Victor for all the "creative" meetings we were able to share. I also thank Xavier, Gilles, Benoît F., Anne, Pierre-Yves, Paul, Aboubacar, Rabeb, Maxime, Adrien, Cédric, Vincent, Jerôme and all the other that were kind enough to let me bring them to the wonderful Arsenal. Finally, I would like to thank Babette for being such a wonderful help for motivating this faculty crossing bounderies with the students and with each other.

Leuven also had its share of great colleagues: Johannes was a wonderful master's thesis supevisor and colleague. Tom never ceased to make me laugh in the office or in sunny Thessaloniki. And I am now really happy to share the office with Daria and Galina! Faruk, Maria, Sandra, Jochen or Jan are also colleagues I was happy to cross path with and made the daily work of a Walloon guy in Flanders feel like home.

Finally, the FLEXPUB research project also allowed me to meet other wonderful people. Joep is one of the most hard-working man I've ever met but always took time to check on our well-being and happiness within the project. His numerous advices will always stick with me. Maxim, despite his bad hunting habits, is an absolute pleasure to be around. Thank you for making our work so easy on the FLEXPUB project through your hard work. Thomas, thank you as well for your investment in FLEXPUB and for showing to the computer science faculty that people in Law can be nice and funny. Finally, Rink, on top of his passion, networking skills and unstoppable enthousiasm, is probably one of the people that makes me laugh the most with his infamous quotes… "That's cool man"

My work in this thesis also brought me to public organizations where I annoyed a lot of people with my questions. Among these people, Nicolas Himmer was more than welcoming and full of advices. Sophie Marischal and Samuel Notterbaert were also always available when I needed them and I hope our collaboration will continue in the future.

This thesis would of course not have been possible whithout the moments shared with my closest friends. From Guillaume, Thomas, Stefan, Florent, François and Vincent that I met in secondary school, to Maxime, Kathryn, Félix, Sarah, Pilou, Victor, Antoine, Fabian, Pierre, Berlé, Jeanne and Piwi that I met in the university to Dodo, Bibi, Syméon, Carlus, Timoté, Moule, Antoine and Martin that I met within the faculty. I thank all of you for enduring the "little drinks" I wanted to share with you.

I was also lucky enough to share half of this thesis with my wonderful girlfriend Moréna. She is the person I needed for a long time. I will always be thankful for her support and for pushing be to be the best person I can be. Thank you for letting me enter your life and for getting over my mad ideas (Hello Kim!). I love you.

Finally, thank you is not strong enough to express the gratitude I feel towards my family but I will try. Mum, thank you for being so caring and so supporting through all these years and for pushing be to do better everytime. Dad, thank you for making me discover so many things (but especially music and horror movies). Mélanie, thank you for sharing my childhood's mad ideas with me and stay the wonderful person that you are. I would like to thank my godfather and aunt that made me discover the world from a young age and that kep supporting me all the way. And, grand-mother, you are the most caring person I know and thank you for taking so good care of me from the youngest age. I am happy this is written in English so that you won't cry reading it.

On a last note, I want to thank and dedicate a special thought to my grand-father Alphonse. From the smallest age, he tought me how to learn and how to be curious and I will always be grateful to him. He will always be in my heart when I am undertaking this type of project.

Publications

Most of the contributions presented in this thesis are published in peer-review workshops, journals, books or conferences. In this section, we list them and detail how they contribute to the thesis.

CitiVoice Framework

Simonofski, A., Serral Asensio, E., De Smedt, J., & Snoeck, M. (2017). Citizen Participation in Smart Cities: Evaluation Framework Proposal. In *Business Informatics (CBI), 2017 IEEE 19th Conference on Business Informatics* (Vol. 1, pp. 227-236). IEEE.

- *In this paper, we present the theoretical foundations of citizen participation categories in the context of smart cities by means of an extensive literature review. This review makes possible the building the first version of the CitiVoice Framework and its application to the case of Namur.*

Simonofski, A., Serral Asensio, E.., De Smedt, J., & Snoeck, M. (2018). Hearing the Voice of Citizens in Smart City Design: The CitiVoice Framework. *Business & Information Systems Engineering* (1-14), Springer

- *In this paper, we suggest the extended and further validated version of the CitiVoice Framework by applying it to the cities of Mons and Brussels. We expand on the three uses of the framework: evaluation tool, management tool, and comparison tool. Furthermore, the theoretical and practical implications of the framework are further described.*

Simonofski, A., Vallé, T., Serral Asensio E., Wautelet Y. (2019), Investigating Context Factors in Citizen Participation Strategies: a Comparative Study of Swedish and Belgian Smart Cities. *International Journal of Information Management*, Elsevier

- *In this paper, we investigate the context factors that impact citizen participation strategies in two smart cities: Namur and Linköping. Thanks to the identification of these factors, we issue context-specific recommendations to decision-makers about their participation strategy and enable a fairer comparison of cities.*

UParticipate Decision Support Guide

Simonofski, A., Snoeck, M., Vanderose, B., Crompvoets, J., & Habra, N. (2017). Reexamining E-participation: Systematic Literature Review on Citizen Participation in E-government Service Delivery, 23rd *Americas Conference on Information Systems*, Association for Information Systems (AIS)

- *In this paper, we analyze the field of citizen participation in e-government (and more specifically in the development of e-government services) thanks to a systematic literature review. We identify eight main participation methods from literature and used them as a basis for the decision support guide. Furthermore, we also formulate four research gaps that helped us underline the relevance for research of this thesis.*

Simonofski, A., Snoeck, M., & Vanderose, B. (2019). Co-creating e-Government Services: An Empirical Analysis of Participation Methods in Belgium. In Setting Foundations for the Creation of Public Value in Smart Cities (pp. 225-245). Springer, Cham.

- *In this book chapter, we analyze the use in practice and the preference of citizens regarding the eight identified participation methods. This is performed thanks to in-depth interviews with public servants and a questionnaire sent to citizens and public servants. Based on these insights, several recommendations regarding the use of the methods are formulated.*

Simonofski, A., Ayed, H., Vanderose, B., & Snoeck, M. (2018). From Traditional to Agile E-Government Service Development: Starting from Practitioners' Challenges. In 24th *Americas Conference on Information Systems, New Orleans*. Association for Information Systems (AIS).

- *In this paper, we analyze which challenges impede practitioners from implementing agile practices (including user participation) in a governmental context thanks to the organization of three focus groups. They helped us identify the main challenges that organizations face and to use these challenges as an influencing factor in the decision support guide.*

Simonofski, A., Vanderose, B., Clarinval, A., & Snoeck, M. (2018). The Impact of User Participation Methods on E-Government Projects: The Case of La Louvière, Belgium. *Media and Communication*, *6*(4), 175-186.

- *In this paper, we analyze how the city of La Louvière in Belgium applied three previously identified participation methods in its e-government strategy and the challenges that it raised. Also, we suggest four main stages for e-government implementation and formulate hypotheses about the relevance of user participation for each of those stages. These stages are also used as an influencing factor for the decision support guide.*

Simonofski, A., Chantillon, M., Crompvoets, J., Snoeck, M. & Vanderose B. (2019), The Influence of Public Values on User Participation in e-Government: An Exploratory Study, *Proceedings of the 53rd Hawaiian Conference on Information Systems Sciences, Maui.*

- *In this paper, we analyze how public values impact practitioners in their selection of participation methods for the development of e-government services. Through the analysis of four e-government projects, we were able to understand the drivers behind user participation decisions. Furthermore, we formulate recommendations for practitioners to give them guidance about their choice and integrate public values as an influencing factor in the guide.*

Simonofski, A., Melin, U., Lindgren, I., Vanderose, B., & Snoeck, M. (2019) Towards a Decision Support Guide for User Participation in Public e-Service Development. In 25th *Americas Conference on Information Systems, Cancun*. Association for Information Systems (AIS).

- *In this paper, we describe a conceptual model summarizing the impact of four influencing factors (project stage, organizational context, users' characteristics and public values) on user participation decisions. From this model, we then derive a decision support guide that helps project managers from public organizations understand when and how to include users in the development process.*

Crusoe J., Simonofski A., Clarinval A., Gebka E. (2019) The Impact of Impediments on Open Government Data Use: Insights from Users, *IEEE 13th International Conference on Research Challenges in Information Systems*, IEEE

- *In this paper, we select the Open Government Data Portal of Namur as use case to provide further validation of the UParticipate Decision Support Guide. We document how the guide was used by the Data Manager of Namur and how the recommendations were implemented to collect feedback from university students about the portal.*

SmartCity4All Workshop

Simonofski A., Dumas B., Clarinval A. (2019), Engaging Children in the Smart City: A Participatory Design Workshop. In *Proceedings of the 1st ACM SIGSOFT International Workshop on Education through Advanced Software Engineering and Artificial Intelligence (EASEAI '19),*Tallinn, Estonia. ACM,

- *In order to prepare children to become active citizens of their city, we developed a workshop aiming at introducing to younger citizens the concept of the "smart city" in all its complexity (technological and non-technological perspectives). In this paper, we present the results of the first in-school session of the workshop.*

Clarinval A., Simonofski A., Henry J., Vanderose B., Dumas B., (2019), Introducing the Smart City to Children: Lessons Learned from In-School Sessions. *(Submitted to the Journal of Urban Technology)*

- *In this paper, we document the application of the SmartCity4All workshop to 299 children. Through pre-test and post-test questionnaires, we analyze how the perception of children evolved regarding the topics of smart city, participation and smart city solutions development.*

Table of Contents

1. General Introduction

Information and Communication Technologies (ICT) are now a crucial part of our everyday life and may take diverse forms such as websites, sensors or applications. These new technologies have impacted the daily work of all organizations, both public and private. For instance, the service delivery of the tourism industry is now mainly online-based (Buhalis et al., 2011). Furthermore, the governance model of the tourism industry has also been impacted by ICT, since the customers are now able to rent their homes directly through applications such as Airbnb. Indeed, ICT not only induces technical changes within an industry or an organization but, most importantly, also changes their social structures, power relations and practices (Brennen and Kreiss, 2016).

In this thesis, the context of interest is the application of ICT in governmental entities, or "e(lectronic)-government" (Andersen and Henriksen, 2006). In literature, e-government refers to the application of ICT to improve the delivery of services and information by government to their users (citizens, businesses or other governmental bodies). However, similarly to other industries, government has also seen the evolution of the governance model in government: ICT has empowered citizens, previously often relegated to passive users, to have more control of the decision-making process and more impact on the tasks of administrations. E-government not only makes possible better service delivery but also enables citizen participation (Axelsson et al., 2010; Linders, 2012).

Citizen participation lies at the core of the research presented in this document. However, despite the reported benefits of participation, challenges remain that impede its proper implementation. Indeed, research lacks a strategic view on citizen participation and a limited number of participation methods are used in practice. Furthermore, a proper consideration for all stakeholders, not only citizens, also lacks as participation impacts a full ecosystem of actors. Additionally, practitioners still remain reluctant towards participation due to lack of time, resources, methodology or proper context analysis.

Taking these challenges into account, this thesis aims to provide tools for practitioners so that they can manage citizen participation. This topic is currently the source of much discussion within e-government research as well as in related fields such as Information Systems or Smart Cities. In order to develop these management tools, this thesis investigates citizen participation in an integrative manner, and does so in three main ways. First, we[1] seek to provide management tools at different levels (large-, medium- and small-scale). Second, we identify all the means by which citizens can participate in different research fields (e-government, user participation in information systems, children's participation or smart cities). Finally, we perform this identification with all stakeholders impacted by this participation (citizens as well as project managers, who may be software developers, public agents or political representatives).

The research performed is broken down into three main steps, linked with the three levels of management. First, it was necessary to take a high-level view of the research areas to determine the main ways citizens can participate in an e-government setting. In this first step, we have identified three main aspects of citizen participation: citizens as democratic participants, citizens as co-creators and citizens as ICT users. As the main research output of this step, we have designed the CitiVoice Framework that structures and evaluates this participation. This tool serves to manage citizen participation on a large scale; for the purpose, we have taken smart cities as illustrative cases.

[1] This thesis has been written with the "we" pronoun to acknowledge the contributions of all the co-authors of the published papers and the collaboration with the members of the research project through which this research was funded.

Second, after this high-level look, we have decided to examine more extensively one specific part of the CitiVoice Framework within the co-creation category: citizens as participants in the development of e-government services. We chose this category because as it is the most closely related to the practical challenges identified through this research. For this step, the main research output resides the UParticipate decision support guide. This guide enables project managers to make more sound decisions about the participation of citizens (and other users) in the development of e-government services, based on the several influencing factors (public values, users' characteristics, organizational challenges and project stage). This tool helps manage citizen participation on a medium scale; here we have taken the development of e-government services as an illustrative case.

Finally, we investigate in-depth one specific participation method of UParticipate: the workshop. We provide an instantiation of that method through the SmartCity4All workshop, and design its structure and content in such a way as to further develop our method. The smart city domain is once again taken as an example of a domain intended to enable citizens to learn about the smart city, give their ideas and collectively build their solutions. This tool helps manage citizen participation on a small scale, and is based on classrooms as illustrative cases

Contribution

The main contribution of this thesis can be summarized as follows:

This thesis categorizes citizen participation from several research fields (e-government, smart cities, information systems and children participation) and provides an several e-government stakeholders with three tools to manage this participation. More precisely, the CitiVoice Framework (1st Tool) serves to structure and evaluate citizen participation in the context of smart cities. The UParticipate Decision Support Guide (2nd Tool) helps make a decision about situated user participation for the development of e-government services based on several influencing factors. The SmartCity4All Workshop (3rd Tool) introduces the Smart City concept to non-experts, facilitates the participation of young citizens and allows them to design their solutions. This workshop will also fuel and broaden the discussion on citizen participation in smart cities and further develop the CitiVoice Framework.

Figure 1 represents these three main contributions and how they are linked.

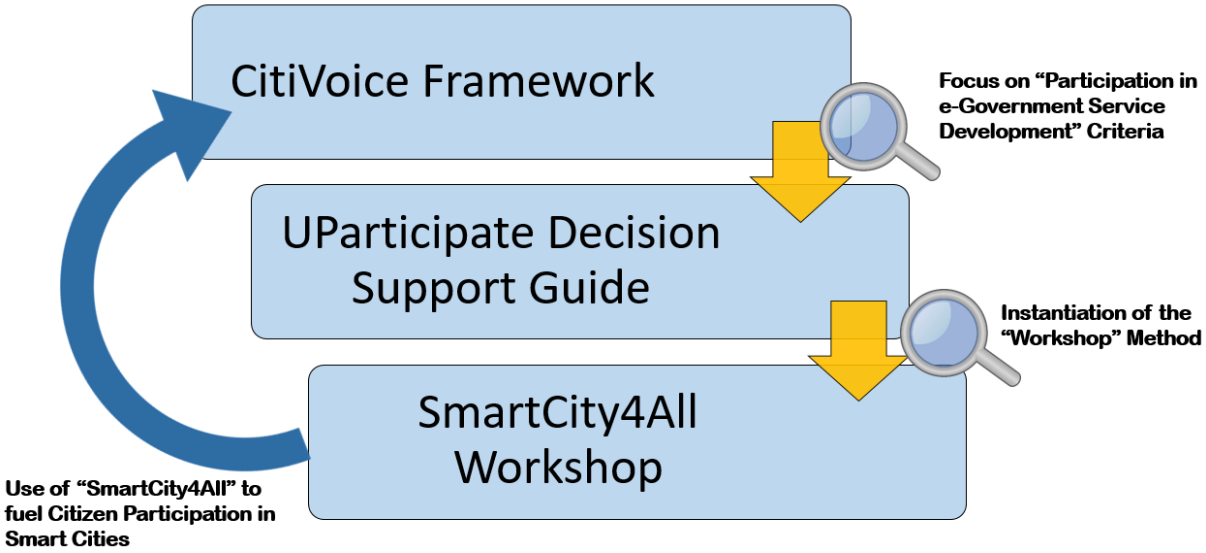


Figure 1. Main contributions of the thesis

Outline

The remainder of the document is structured as follows.

In Part I of the thesis "**Problem Statement and Methodology**", we detail the problem statement and how we intend to tackle it with the appropriate methodologies. The *Background* section exposes the most important concepts that will be used throughout this thesis. The *Research Relevance* section underlines the potential relevance of this thesis for research and practice. The research questions formulated for this thesis are also detailed. The *Research Design* section presents the overall methodology that guided this thesis as well as its underlying methodologies.

Part II of the thesis, "**Results – Management Tools**", consists of the results produced, reflected in three management tools: CitiVoice, UParticipate and SmartCity4All. In the *CitiVoice Framework* section, we take an integrative look at all the different forms of citizen participation in e-government and we reflect them in the CitiVoice Framework. We also detail the use and validation of this framework for several smart city cases. In the *UParticipate Decision Support Guide* section, we take a closer look at a specific criterion of CitiVoice: user participation in e-government service development. After an analysis of different factors influencing this participation, we suggest the UParticipate decision support guide and detail its use in two concrete e-government projects. In the S*martCity4All Workshop* section, we investigate the "workshop" participation method of UParticipate in depth and suggest the SmartCity4All Workshop as a way to introduce the smart city concept to children and facilitate their participation. We also document its application in several classrooms.

In Part III of the thesis "**Closing Comments**", we reflect on the results and the applied methodology. Indeed, in the *Conclusion* section, we position the theoretical and practical implications of the results as well as their limitations. Furthermore, we summarize the contributions of the thesis and present leads for further research

PART I: Problem Statement and Methodology

2. Background

In this section, we describe the theoretical foundations that guide us throughout this thesis. First, e-government, as well as the importance of citizen participation within this concept, are discussed. Next, we move from the e-government research area to a discussion of citizen participation from the perspectives of other related research areas, starting from the seminal paper of Arnstein to the more recent works in the fields of smart cities, information systems and children's participation. These different research areas will be used through this thesis as use cases to test the developed management tools.

2.1. e-Government

2.1.1 Definition

Nowadays, public administrations face two main challenges (Chantillon et al., 2017a). On the one hand, citizens have increasingly higher expectations regarding public services than in the past. They expect better and more individualized public solutions and services, an efficient and effective service delivery, burden reduction, transparency and opportunities for participation. On the other hand, public organizations are limited by their resources and their knowledge of what citizens need. E-government constitutes a potential solution to these challenges and has become a general-purpose word for information technology used by a government. It is also a rapidly evolving subject whose scope evolves as IT changes how citizens and organizations communicate and cooperate. This section aims to establish a clear definition that will be used throughout this thesis.

There has been a profusion of definitions for e-government over the years. Sang et al. (2005) mention that the goal of e-government is to provide quality public services and value-added information to citizens and state that e-government is related to citizens as Customer Relation Management software is to customers. Indeed, both wish to improve relationships between the company/government and its audience. Gil-García and Pardo (2005, pp 187-188) follow a similar approach: they define e-government as "the intensive or generalized use of information technologies in government for the provision of public services, the improvement of managerial effectiveness, and the promotion of democratic values and mechanisms". It is not coincidental that the word "improvement" appears regularly in definitions of this subject as "technology is seen as a tool for long-term system transformation" for e-government (West, 2004, p. 1). This is done by reshaping the classical, hierarchical and linear way bureaucracies work. In this sense, West argues that e-government allows for horizontal collaborations to be set up between different government agencies and functions, which improves service delivery to citizens. In this sense, e-government is not only about digitizing existing processes and establishing online service points, but also about reshaping citizen-government interactions by bundling government functions that were formerly done by separate entities. Gottschalk (2009) defines e-government as "the delivery of government services (information, interaction and transaction) through the use of information technology" (p.75), and distinguishes here between front- and back-office, the former being the interface through which citizens and public servants interact. The latter register the information required to handle these interactions. Yildiz (2007) relates the vagueness of the term e-government to the broad scope: "e-government is a concept defined by the objective of the activity, rather than by the specific technology used, provider of the service/ information, or clear-cut activities of the related actors" (p.654). Hence, as e-government has many faces and possible applications, it is undesirable to propose hard technological criteria for what exactly constitutes e-government. In this sense, e-government could be said to be redrawing government processes in the digital era.

In the seminal paper of (Layne and Lee, 2001), a maturity-based approach to e-government was presented, according to which complexity increases over time. Layne and Lee distinguish four stages: 1) cataloging ("establishing government presence online and presenting information"), 2) transaction

("allowing citizens to transact with government electronically"), 3) vertical integration ("connecting government functions across different levels of government"), 4) horizontal integration ("connecting different government functions across the same level of government"). This approach thus presents what happens from the 'customer' perspective: services are considered to be better, as the interaction points between citizens and public servants are minimized, while the interaction during one session is maximized by offering all relevant and logically connected services via one application. Figure 2 represents this maturity-based approach visually.

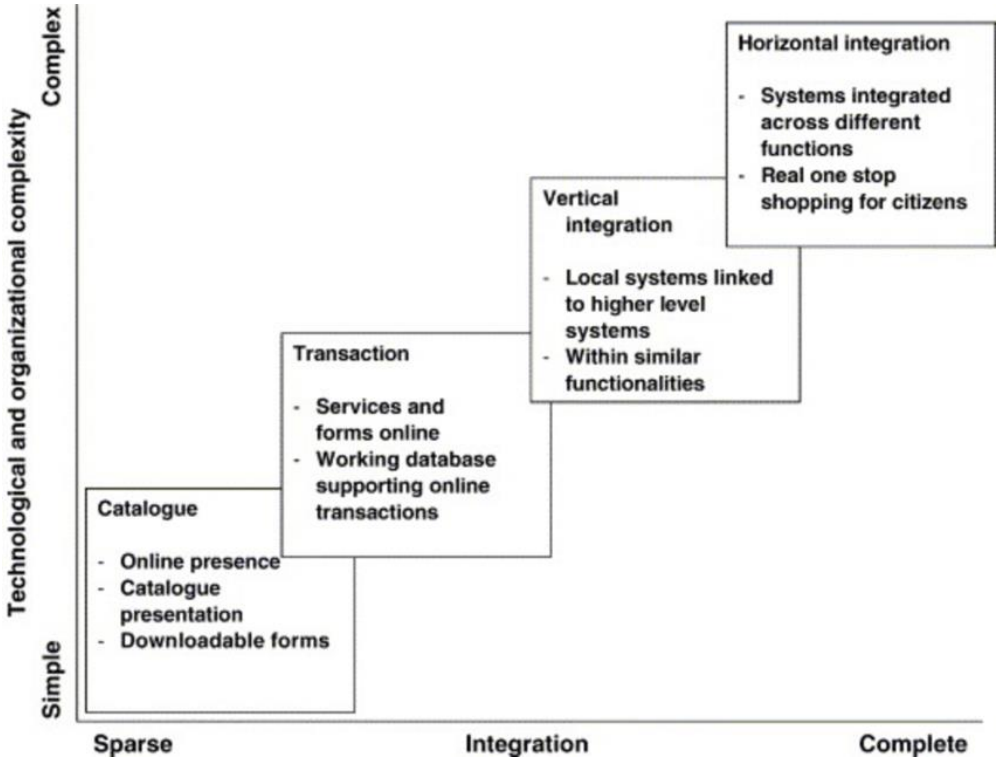


Figure 2. e-Government Maturity Model (Layne and Lee, 2001)

Other papers have improved this model over time by adding or customizing stages (Andersen and Henriksen, 2006). Gottschalk (2009) follows similar reasoning with a focus on interoperability, but judges e-government on its capability to improve collaboration between different services, as collaboration implies that data can be shared more easily and feeds into more services. In (Nam, 2014) the author makes a distinction between the purpose for which e-government is used, namely, service use (using transactional services), information use (looking up information) and policy research (looking up information related to government policies).

The scope of e-government is thus quite broad, as it encompasses the relations between several actors (Nusir and Bell, 2013; Dash and Pani, 2016):

- Government to Government (G2G): the exchange of information, decision making, fund transfer, shared services, revenue and law enforcement between governmental entities
- Government to Business (G2B): services from governmental entities intended for businesses (such as business registration, tax filing, transactions and payments)
- Government to Employee (G2E): services intended for the employees of governmental entities (such as e-payroll or e-training services)
- Government to Citizens (G2C): services by governmental entities intended for the citizens (such as registration/land/revenue services, agricultural services, employment etc.)

This thesis focuses on the G2C relation and can build upon an already large body of knowledge in that area. Based on (Layne and Lee, 2001; Andersen and Henriksen, 2006), we define e-government as:

The use of information and communication technologies (ICT) by governments to improve the delivery of information and services to citizens, business partners, employees and other government entities

However, in this thesis we will not focus on the improvement in service delivery, but on a further stage of e-government: the possibility of citizen participation. This next step has already been discussed in the literature, for example by Nam (2014), ,who explains the concept of "e-government 2.0" to introduce a new domain of e-government, namely using Web 2.0-based interactive technologies to facilitate citizen participation in governmental processes. Another influential author, such as (Linders, 2012) has underlined the need to evolve from e-government to “we-government” and calls for increased participation. In this thesis, we argue that this next step of e-government is essential to examine.

2.1.2 Role of Citizens

Researchers, agencies and supranational organizations have always focused on the role of citizens in e-government: their intention to use the electronic services, the impact of ICT on their trust in government as well as their participation in e-government. Public administration research particularly focuses on the intention to use e-government services by citizens with constructs such as perceived usefulness, compatibility, perceived ease of use and trust in government (Hung et al., 2006; Horst et al., 2007; Bélanger and Carter, 2008). As discussed in the previous sub-section with the article of Layne and Lee (2001), the citizens’ higher expectations were already at the center of the four stages model that describes the logical evolution of e-government over time. Even though participation is not the main focus of their article, Layne and Lee (2001) also advocate for increased participation of citizens in democratic processes through ICT means. However, other seminal articles examine in more depth the participatory approaches by insisting on e-democracy and by advocating for web-based participatory governance, a more accountable and transparent government, increased involvement in core activities and enhanced communication (Ho, 2002; West, 2004; Andersen and Henriksen, 2006). All these extra steps could be considered as an extra fifth stage entitled “Participation” as suggested by other maturity models in the field (Fath-allah et al., 2014).

As Lawson-Body et al. (2014) already nicely expressed, there are two streams of research about the role of citizens in e-government. On one hand, electronic democratization theorists link e-government to e-participation, and the electronic democratic process. On the other hand, economics theorists focus on efficient and effective service delivery through electronic means. This tension between the two streams can be found in other seminal articles on e-government. Ho (2002) criticizes the external focus of public governance by considering the citizen as a customer and recommends an empowerment of the citizens through information technology to consider them as “owners” of services. Welch et al. (2005) state that, even though citizens have higher expectations regarding interactivity, governments often reduce citizens to a passive customer instead of stimulating their participation in public affairs. In his review of the e-government literature, Yildiz (2007) suggests examining more deeply the processes of participation in e-government projects instead of the outputs of the projects. He also suggests linking the research to mainstream public administration research to examine the appropriate role of the citizens in e-governance. In their empirical evaluation of government-to-citizen relationship, Tolbert and Mossberger (2006) identify two paradigms for the government-to-citizen relationship: entrepreneurial (which is customer- and service-oriented) and participatory (which focuses on accountability, transparency, responsiveness). Chadwick and May (2003) identify three models of interaction between states and citizens. First, the managerial model focuses on the improvement of service delivery. Second, the consultative model facilitates the communication of citizens’ opinions to the government. Third, the participatory model focuses on the interaction between citizens and government, with participation in

decision-making. They conclude that the democratic possibilities of the Internet are likely to be marginalized if the managerial model becomes dominant.

The proactive role of citizens and their participation in this paradigm are often characterized as “e-participation” in the scientific literature. However, e-participation is often reduced to the democratic participation of citizens in decision-making or policy design by means of ICT (Sæbø et al., 2008). As a result, the e-participation research area is often confused with the e-democracy research area, although the two fields do not entirely share the same theoretical background. In this thesis, we advocate for a reconsideration of other under-investigated forms of e-participation, such as participation in e-government service delivery. Even though Sæbø et al. (2008) characterize e-participation as the inclusion of citizens in the planning and/or development stages of e-government services, when discussing the concept of e-participation they focus only on the democratic participation of citizens. Medaglia (2012) continues this characterization but clearly states in defining the limitations of his study that he focuses on issues of ICT for democratic decision-making and not on all participatory processes. In another contribution to the systematization of research in e-participation, Susha and Grönlund (2012) try to enlarge the scope of this research area by clearly distinguishing political e-participation (that is closely linked to e-democracy) and other forms of participation.

An evaluation of the background to e-government reveals two conceptions of citizens in e-government throughout the different research streams: some authors consider citizens as customers and some authors consider citizens as participants. In line with this distinction, this thesis suggests taking an integrative look at all forms of citizen participation in several research areas.

2.2. Different Perspectives on Citizen Participation

In this section, we take detail several perspectives on citizen participation from related research areas. We focus first on the theorization of participation, with a focus on the seminal paper of Arnstein. Next, we explore three other research areas that will be used throughout this thesis as use cases to validate the management tools: smart cities, information systems development and children's participation. These use cases have been selected to ensure the integrative nature of this thesis in terms of scales of participation (large, medium and small-scale) and thus, of participation methods applied and stakeholders involved.

2.2.1 Theorization of Participation

In the literature on public administration, citizen participation constitutes a process that gives citizens the opportunity to influence the decision-making and administrative tasks of government (Callahan, 2007) and is central to the concepts of co-creation and coproduction (Galvagno et al., 2014). Citizen participation is also stressed by the Open Government movement, which argues that citizens should be at the center of public life via transparency of government, participation, and collaboration among citizens (Lee and Kwak, 2012).

However, before going in-depth into the topic of citizen participation in different research areas, it is first necessary to define what exactly participation means. In order to do so, we rely on one of the founding papers that theorized participation: Arnstein's Participation Ladder. Figure 3 is a representation of this ladder.

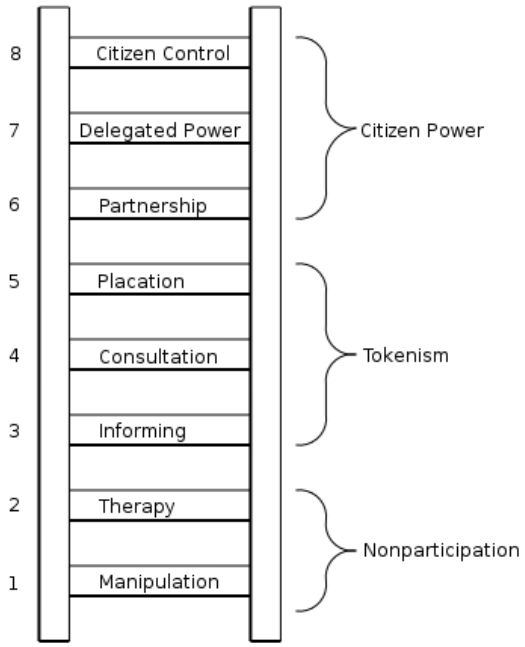


Figure 3. Ladder of Participation (Arnstein, 1969)

In her seminal attempt to conceptualize citizen participation, Arnstein (1969) argues that participation is not a binary concept but ranges from a spectrum that goes from non-participation, going through tokenism and finally citizen power:

- Non-Participation: In this side of the spectrum, Arnstein argues that some policy-makers organize citizen participation activities with no intention to take their opinion or ideas into

account. These activities aim only at manipulating citizens or organizing therapy sessions where citizens can share their problems, without concrete follow-up.

- Tokenism: On this end of the spectrum, citizens' opinions and ideas are heard and processed by the policy-makers. However, the final decision of whether to take them into account is still out of citizens' hands.
- Citizen Power: On this end of the spectrum, citizens themselves have the capability to perform tasks that were once in the hands of policy-makers. In its extreme form of "citizen control", the role of the policy-makers is reduced to zero. An example of citizen control can be found in the neighborhood watches.

This theoretical framework is still heavily relied on to analyze citizen participation. For instance, Cardullo and Kitchin (2019) focused on Dublin's initiatives and reworked the original ladder into a broader scaffold. The transformation of a ladder into a scaffold is done by adding extra columns. The first column is about the roles that are expected of or adopted by the citizens. Sixteen roles have been identified along a spectrum ranging from passive with little control to active and responsible. An added dimension is the manner in which citizens are involved. Furthermore, the political discourse through which the various roles and participation methods are justified is added. Finally, the modality determines how the citizens are positioned with regard to the city. This modality takes on two forms: bottom-up and top-down. An overview of the total scaffold can be found below in Figure 4.

<table>
<tr><th colspan="2">Form and Level of Participation</th><th>Role</th><th>Citizen Involvement</th><th>Political discourse/ framing</th><th>Modality</th><th>Dublin Examples</th></tr>
<tr><td rowspan="3">Citizen Power</td><td>Citizen Control</td><td>Leader, Member</td><td rowspan="2">Ideas, Vision, Leadership, Ownership, Create</td><td>Rights, Social/Political Citizenship, Commons</td><td rowspan="3">Inclusive, Bottom-up, Collective, Autonomy, Experimental</td><td>Code for Ireland, Tog</td></tr>
<tr><td>Delegated Power</td><td>Decision-maker, Maker</td><td rowspan="2">Civic Hacking, Hackathons, Living Labs, Dublin Beta</td></tr>
<tr><td>Partnership</td><td>Co-creator</td><td>Negotiate, Produce</td><td rowspan="2">Participation, Co-creation</td></tr>
<tr><td rowspan="3">Tokenism</td><td>Placation</td><td>Proposer</td><td>Suggest</td><td rowspan="4">Top-down, Civic Paternalism, Stewardship, Bound-to-succeed</td><td>Fix-Your-Street, Smart Dublin Advisory Network</td></tr>
<tr><td>Consultation</td><td>Participant, Tester, Player</td><td>Feedback</td><td rowspan="2">Civic Engagement</td><td>CIVIQ, Smart Stadium</td></tr>
<tr><td>Information</td><td>Recipient</td><td rowspan="3">Browse, Consume, Act</td><td>Dublinked, Dublin Dashboard, RTPI</td></tr>
<tr><td>Consumerism</td><td>Choice</td><td>Resident, Consumer</td><td>Capitalism, Market</td><td>Smart building/ Smart district</td></tr>
<tr><td rowspan="2">Non-Participation</td><td>Therapy</td><td rowspan="2">Patient, Learner, User, Product, Data-point</td><td rowspan="2">Steered, Nudged, Controlled</td><td rowspan="2">Stewardship, Technocracy, Paternalism</td><td>Smart meters, Mobile/locative media</td></tr>
<tr><td>Manipulation</td><td>Dublin Bikes, Smart Dublin</td></tr>
<tr><td colspan="5"></td><td>Traffic control</td></tr>
</table>

Figure 4. Extension of Arnstein's Ladder (Cardullo and Kitchin, 2018)

However, Arnstein's Ladder has also had its share of critiques over the years. The strict hierarchy in which Arnstein's higher rungs are preferred to lower ones is not always desirable (Hurlbert and Gupta, 2015). The required amount of citizen participation should be based on the context and specificities of the examined policy problem. This critique de-romanticizes the idea of full citizen participation, and facilitates a broader vision depending on the context of the examined problem. Similarly, Hayward, Simpson, & Wood (2004) criticize the idea of failure or illegitimate action when full citizen control is not achieved behind Arnstein's Ladder. Additionally, this one-on-one relationship between non-participation and citizen control is being criticized for implying a constant in policy problems (Bishop and Davis, 2002). However, policy problems are inherently unique, and therefore call for different levels and types of participation.

Inspired by this, in another application of Arnstein's Ladder to the participation methods in various health-care systems, Tritter & Mccallum (2006) run into some difficulties and summarize these critiques in three factors: missing rungs, reverse effects of applying the model and missing ladders.

First of all, missing rungs refer to certain key factors that have not been included in Arnstein's model. The ladder is an oversimplification in which user empowerment is seen as the sole aim, although in healthcare different methods are necessary to meet the needs of the different users. In addition, it leaves out the pre-conditions on which users will become involved, such as trusting in the system. The ladder also fails to recognize the different forms of participation needed or the different range of users involved. A selected number of people will be involved in a very intensive manner, while a broader range of users will participate in a more limited way. Moreover, the role of citizens in framing the problem, rather than just designing the solution - which is said to be the most important rung - is missing from Arnstein's ladder. Finally, Arnstein leaves out the balance between the intensity of participation and the proportion of participating citizens.

Secondly, the use of Arnstein's ladder in a health-care environment will produce certain reverse effects. First, it could promote decisions that are based on the 'tyranny of the majority', with participation being considered as a prerequisite no matter the problem tacked. Furthermore, the ladder does not take the representativeness or depth of participation into account. Therefore, it may lead to a service provision creating an appropriate offer for a certain group of people while others are being left out.

Finally, they criticize the fact that the ladder's focus is on the user's power in decision-making. It has no regard for different types of user involvement. For example, in a healthcare system "user roles vary from participation in decisions about treatment and care, service development, evaluation, and research and teaching" (p 163). After recognizing this gap, they propose to adapt the model by introducing different ladders for different types of user involvement.

In order to structure citizen participation and to develop tools to manage it, we will rely on the theorization of Arnstein but also take into account the numerous critiques that call for an additional framework to be developed.

2.2.2 Smart Cities

In recent years, we have seen that both research and practice have tried to identify what the next stage of e-government will be by focusing on all stakeholders as well as on the shift in governance which it enables. In this context, smart cities emerge as a more locally-embedded paradigm referring to the design of innovative solutions to tackle issues of public interest by including all the city's major stakeholders (government, the private sector, NGOs, citizens). In this use case, as with e-government, we will focus on the stakeholder-orientation of this concept rather than on its technological implications. Indeed, Scholl and Scholl (2014) underline the need for the e-government paradigm to evolve towards innovation and collaboration with stakeholders in order to tackle the challenges that modern cities aim to face.

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) (Caragliu et al., 2011). The main dimensions linked to the smart city concept are shown in Figure 5. In the 21st century, the concentration of the population in relatively few large cities keeps increasing. In 1950, only 30% of the world's population lived in urban areas, in 2014, this number had increased to 54 % and it is predicted to reach 66% by 2050 (United Nations, 2014). Besides the number of citizens, the average size of cities has also increased. At the end of the 20th century, this trend was already present and led to new challenges for the governments in order to tackle its negative effects: traffic congestion, waste management, pollution and energy consumption, access to resources, crime, etc. (Cocchia, 2014).

Thesmart city trend emerged as a possible solution to these issues and was adopted in 2005 by a number of technological companies such as IBM, ABB, HP, Siemens, Ericsson or Cisco (Harrison and Donnelly, 2011). They offered complex information systems to integrate the operation of an urban infrastructure. At that time, smart cities very much relied on technologies such as the Internet of Things, Cloud Computing or embedded networks of sensors and devices to solve urban issues (Schaffers et al., 2011; Perera et al., 2014).

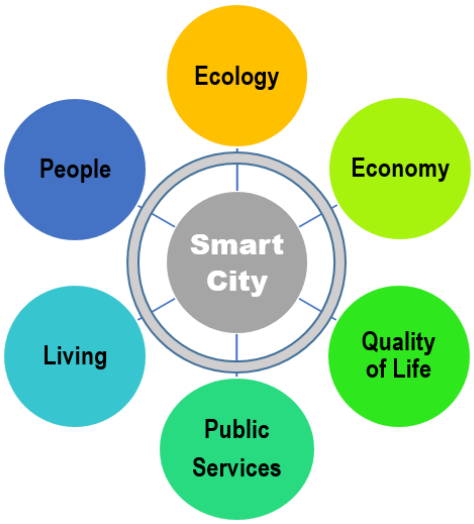


Figure 5. Smart City Dimensions (Caragliu, 2011)

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 and Rosenthal-Sabroux, 2014). In research into smart cities, many authors have underlined the importance of discussing citizen participation in a smart city.

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 by which to make possible such participation. 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): “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).

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 et al., 2015), the input they can provide and how it can be gathered need further research. In their integrative

framework, (Gil-Garcia et al., 2016) 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 (Schaffers et al., 2011; Perera et al., 2014). 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 (Nam and Pardo, 2011a; Albino et al., 2015). This key role of citizens in smart cities will be key when considering this use case.

2.2.3 Information Systems Research

One way to implement e-government is to develop e-government services that provide added value to the users. In this use case, we analyze e-government services through the lens of Information Systems Research (ISR). Furthermore, we focus particularly on the relevance of user participation in the development of these information systems.

In ISR, the participation of end-users in the design of systems has often been considered as an important factor for system quality (Hartwick and Barki, 1994). User participation can help the requirement engineers in formulating better requirements. Therefore, user participation should be considered when working on requirements, especially when there is uncertainty in the project (El Emam et al., 1996). In other words, research shows that the participation of users forms a major success factor for software projects (Johann and Maalej, 2015). Nevertheless, user participation can been considered as counterproductive in certain cases (Axelsson et al., 2010). For example, In case of working with groups, different groups can show completely different behavior which may make the interpretation of those results harder (Lombriser, 2015).

In the private sector, e-services are very common and companies are delivering their e-services to a large number of users. The private sector understands that high user satisfaction and the way a user responds to a system are some of the most important requirements. Therefore, user satisfaction has become an important aspect of research into information systems (Shang, 2014). At the same time, the internet opened opportunities to put the customer at the center of marketing, resulting in a customer-centric marketing approach, or customization (Wind and Rangaswamy, 2001). Companies who are using customization try to change their perspective to that of the customer. This entails their exchanging their information with the customer. Henceforth, the customer has to make an effort. The company for its part has to be more transparent toward the customer, while the customer must be "willing to share their attitudes, preferences, and purchase patterns with the company on an on-going basis" (Wind & Rangaswamy, 2001, p. 28).

Such insights from ISR in the private sector partially apply to systems developed for the public sector as well. In a government setting, the service would be delivered in a user-centered approach (Shang, 2014). Governments try to improve the way they interact with citizens by increasing the quality of service as a result of making the government more accessible through e-government. Therefore, government must re-evaluate how it handles information, resulting in a challenge that is not purely technical (Kumar et al., 2007). More recently, the digitalization of governmental services is also discussed under labels such as digital government, digital services and public e-services (Lindgren and Jansson, 2013). E-government services are defined as the electronic way of delivering services (Kvasnicova et al., 2016). Several definitions have been proposed, and all have in common that e-government services are services delivered through online means by governmental entities. Hassan et al. (2011) define e-service in both a broad and a narrow way. In the broadest sense, they agree with what is written above, stating that "e-service is defined as the provision of service over electronic networks such as the internet"(p.530). Narrowed down to a governmental context,, "e-service refers to the delivery of information and improved services online through the internet or other digital means to all stakeholders (citizens, businesses, and other members of the society). It is viewed as the means of holding the

government accountable to its citizens" (p.530). In this thesis, we consider e-government services as interactions between a government organization and its users, through the use of ICT, in order to deliver information and service. Ideally, e-government services create value for both users and the supplying organization, as well as for the wider society (Lindgren and Jansson, 2013; Jansen and Ølnes, 2016).

Analyzing e-government services through the ISR lens allows us to analyze an ecosystem of stakeholders with their own motivations, barriers and possible outcomes regarding participation. Regarding the ecosystem view, we use the term “stakeholders” to describe this extended group. This is consistent with the article by Lindgren (2014) that advocates broadening the scope from people using the system to include the people affected by the system. In line with this stakeholders approach, Oostveen and Van Den Besselaar (2004) try to extend the concept of users to several categories of e-government: citizens as end-users, citizens with a political agenda, public servants, administrative management, technical management and politicians. Papers generally focus on citizens as end-users (who can be labeled “users”, or “citizens”), but some authors also take the perspective of public servants (Lindblad-Gidlund, 2008) and software developers (Billestrup and Stage, 2014).

Regarding motivation and barriers, Wijnhoven et al. (2015) identify 8 motivational factors (pro-social behavior, pastime, career, change, aims, leaning, reciprocity, reputation, fun, ideology, money), and find that citizens’ motivations to participate differ depending on the nature of the project. Holgersson and Karlsson (2014) conclude that the citizens’ willingness to participate is determined by their use of public e-services, satisfaction with public e-services, personal incentives, available time, social commitment and earlier experience of systems development. Industrial democracy is another key driver because it empowers citizens as well as public servants in e-government projects (Følstad et al., 2004). Several papers also discuss barriers that prevent the participation of citizens from being effective. However, the barriers differ depending on the participation method (Holgersson et al., 2012). Some authors underline traditional Information System (IS) participation barriers such the lack of ICT skills on the part of citizens but also of public servants (Anthopoulos et al., 2007; Holgersson et al., 2012) whereas others state that there is a need to convince citizens that they can add value in service delivery even though the project seem complicated to them (Olphert and Damodaran, 2007; Wijnhoven et al., 2015). There are also barriers that are specific to the e-government context, such as the large, dispersed and heterogeneous user base constituted by citizens, and their potential lack of trust in government (Chan and Pan, 2008; van Velsen et al., 2009). The risk of not including all groups of citizens, especially disadvantaged ones, is particularly underlined (Linders, 2011; Axelsson, 2013). Furthermore, the absence of competition for e-government services does not provide any incentives for software developers and public servants to focus on the user-friendliness or inclusion of users. The lack of knowledge of the processes and regulations of the public domain also prevents the effective participation of citizens (Holgersson and Karlsson, 2014).

Despite these barriers and the multiplicity of stakeholders, there are many positive outcomes from the participation of citizens in e-government service development. Some outcomes are related to the traditional IS school of user participation in system design: improved intention to use e-government services (Anthopoulos et al., 2007), better alignment between system and requirements (Olphert and Damodaran, 2007), gain in accuracy, usability, usefulness (van Velsen et al., 2009), capacity building (Olphert and Damodaran, 2007), industrial democracy (Axelsson et al., 2010; Holgersson and Karlsson, 2012), improved user interface (Holgersson et al., 2012), and user satisfaction (Sørum, 2011). However, some articles state that participation has other e-government specific outcomes: trust in e-government services (Anthopoulos et al., 2007), enabler of civic and democratic participation (Oostveen et al., 2004; Olphert and Damodaran, 2007; Linders, 2011; Holgersson et al., 2012), and promotion of innovation in society (Linders, 2011).

Throughout this thesis, we make the distinction between the notions of participation and of involvement that comes from the well-researched field of user participation in information systems (Schuler and

Namioka, 1993): participation relates to the activities that the citizens perform, whereas involvement relates to a psychological state of personal relevance that the citizens feel (Hartwick and Barki, 1994). In so doing, we will not focus on the pre-conditions and outcomes of participation in order to concentrate fully on the participation methods in this use case.

2.2.4 Children's Participation

The third use case presented in this thesis refers to the participation of children in the context of smart city debates. By children, the UNICEF means every person below the age of 18 or below the age at which they legally reach majority (which might be 16 or 21, for instance) (UNICEF and UN General Assembly, 1989). There are many different ways and models to describe children's participation, as it may be in different degrees. Both Checkoway et al. (1995) and Chawla (2001) give a more or less compact definition of the concept. Checkoway et al. (1995) define youth participation as "a process of involving youth in the institutions and the decisions that affect their lives. It includes initiatives to organize groups for social action, plan programs at the community level, and develop community-based services and resources (…) It is a process through which young people solve problems and plan programs in the community" (Checkoway, Pothukuchi and Finn, 1995, p. 134). On the other hand, Louise Chawla defines it as follows: "Children participation is a process in which children and youth engage with other people around issues that concern their individual and collective life conditions. Participants interact in ways that respect each other's dignity, with the intention of achieving a shared goal. In the process, the child experiences itself as playing a useful role in the community. Formal processes of participation deliberately create structures for children's engagement in constructing meaning and sharing decision making" (Chawla, 2001, p. 1).

This concept is thus closely related to citizen participation in general. However, there is an increased focus on the role of children within a community at the local level for small-scale issues. Furthermore, there are extra motivations to focus on this sub-group of the citizenry. An important driver to invest in child participation are children's rights. One institution advocating child participation is, of course, the United Nations. In Article 12 of the Convention on the Rights of the Child it explicitly proclaims that children need to be provided the opportunity to be heard. As a reason for children's participation, Chawla (2001) mainly invokes children's rights. However, while covering the expectations for children's participation, she mentions effects that can be seen as reasons in themselves to partake in more participation. She divides the expectations into three different categories (Chawla, 2001):

- For the children themselves (including a more positive sense of themselves, developing skills, preparing them for "a lifelong pattern of participation").
- For children's communities (including improved quality of life, amongst other things).
- For the organizations that serve children (program and policy development that is sensitive to children's priorities).

Hart (1992) also uses the metaphor of the participation ladder for citizen participation in his work but uses his own categories. The entire ladder, as shown in Figure 6, counts nine rungs, divided into two main parts: non-participation and degrees of participation (Hart, 1992).

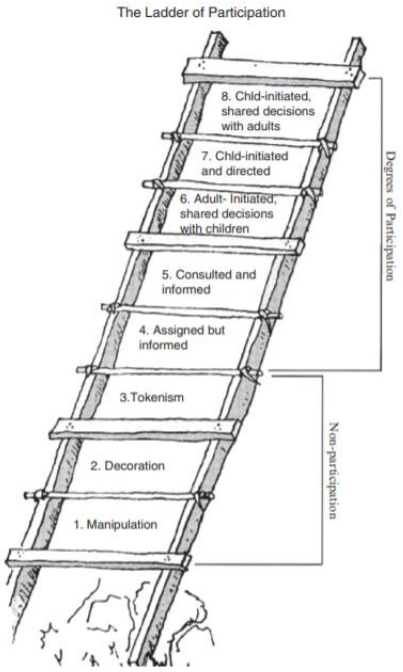


Figure 6. Participation Ladder (Hart, 1992)

As participation is widely discussed in the context of smart cities in this thesis, there is a fundamental distinction to be made when talking about children's participation in that context. Under-age citizens will need to have at least a basic notion of how the smart city is contributing to their lives and how they may contribute to the smart city. Thus, children's participation can refer to the children's partaking in educational programs about their future participation, when they are grown-up and full-fledged citizens of smart cities. This introduction of the smart city concept to children has not been implemented yet. However, children's participation in smart cities has become noticeable during the last couple of years, although children are very rarely expected to participate actively. The Smart Project in Genova, for example, installed a heating system in public schools aimed not only at reducing energy consumption and CO2 emissions, but also at educating children and their parents in a smarter use of energy (Dameri and Rosenthal-Sabroux, 2014). However, their participation may come with some issues, as is the case, for example, with children's smart mobility (Sergeyeva and Laktukhina, 2016). Awareness is a keyword when it comes to current children's participation. It will not only make them familiar with the pros and cons of what the smart city is offering them already, but it may also inspire them to be participating citizens in later life. Intensive education will be needed to prepare children in urban areas for their future role as smart citizens, as has been proved valuable in the case of Singapore. The Ministry of Education in Singapore launched its Masterplan for IT in Education in 1997, which is intended to ensure that not only is every school-going child computer literate, but also trained in creative thinking (Mahizhnan, 1999). This does not apply only to the largest or wealthiest cities, as the concept of the smart city has become increasingly relevant for all kinds of cities around the world (Caragliu et al., 2011; Granier and Kudo, 2016). It is consequently desirable that children (especially in urban areas) are familiar with the concept, at least to a certain degree.

Despite the previous examples, the introduction of children to smart cities and these innovative participation opportunities remain isolated in modern smart cities. We will make sure to fill this gap in this thesis through this use case.

3. Research Relevance

In this section, we underline the relevance of this thesis for research as well as practice. First, the relevance for research is identified and described in the area of e-government research by means of a Systematic Literature Review (SLR). Second, the relevance for practice is identified in concertation with the research project FLEXPUB, through which this research is funded.

3.1. Relevance for Research

In order to underline the relevance of this thesis for research, we have chosen to perform an SLR about citizen participation in e-government that is extensively described in (Simonofski et al., 2017b). The methodology applied to the reviewas well as the gaps it identified are reported in this section.

3.1.1 Systematic Literature Review: Methodology

We follow the guidelines of Kitchenham and Charters (2007) by describing the research protocol that guided us through the review process. In this section, we present our methodology for planning, conducting and reporting the SLR.

3.1.1.1. Planning the Review

Aim of the Review: This SLR aims at identifying the pre-conditions, methods and outcomes of the participation of citizens in e-government. We choose to frame the aim of the review around the pre-conditions/methods/outcomes of participation in such a way as to be consistent with the analytical themes of the agenda-setting article of Axelsson et al. (2010) : What are the motivations and barriers to participate in e-government from the citizens' perspective? What are the most fitting methods to include citizens in e-government? What is the impact of citizen participation in e-government and what dimensions are impacted? Through these three analytical lenses, research gaps can be more easily identified.

Search terms: The guidelines of Kitchenham and Charters (2007) to frame the research questions suggest using the PICOC (Population, Intervention, Comparison, Outcome, Context) criteria to generate search terms. However, as the PICOC Criteria are tailored to the software engineering domain, they are not optimally suited to producing keywords for e-government. After several tests in relevant digital libraries, we decided to combine keywords about "e-government" and "participation" in two groups through an "AND" conjunction. For the final search terms, we decided to focus on the "Population" and "Intervention" criteria from PICOC to narrow the scope of the articles reviewed. The following search terms were used in the three digital libraries: ("Electronic government" OR "e government" OR "egovernment" OR "digital government" OR "Open Government" OR "Public e-service") AND ("Participation" OR "Involvement" OR "Engagement" OR "Inclusion" OR "Collaborative" OR "Co Creation" OR "Coproduction" OR "Participatory" OR "Cooperative" OR "Co-Design" OR "Centric" OR "Centered" OR "Requirements" OR "Sourcing" OR "Crowdsourcing" OR "Agile" OR "Smart" OR "Open Data" OR "Social Media")

Search for primary studies: In order to search for relevant papers, we applied the keyword search to the titles of the papers for the different libraries. First, we searched the Web of Science library. This search yielded 197 hits for the search in the title. Second, we searched Scopus, which returned 386 articles. The combination of these two libraries allowed us to obtain a complete view of Journal articles and Conference Proceedings with relevant e-government tracks, such as ICIS, AMCIS, HICCS or ECIS. We completed the search with a final study of the Google Scholar library and by applying forward/backward citation analysis on the selected articles. This search yielded another set of 253 articles.

Study selection criteria: All selected articles are published in English and contain relevant discussions about the participation of citizens in e-government service delivery. We decided to leave out all articles that do not document participatory approaches. As a result, even though they perform participatory research (through surveys with citizens for instance), publications that focus on citizen's trust in e-services or their intention to use e-services were left out in order to focus solely on participation. We also excluded the grey literature in order to focus on Journal and Conference papers exclusively.

Study quality assessment checklists and procedures: The inclusion or exclusion of the articles was based on reading the abstract. But in case of doubt, the entire paper was reviewed.

3.1.1.2. Conducting the Review

The initial review yielded 50 articles. The total set of papers was divided into a set of 19 core articles and a remaining set of 31 articles that introduce additional methods to include citizens in e-government. These papers are closely related to research fields that would require a separate detailed analysis. We focus on this first set here, so as to keep a consistently broad overview in this SLR for the purposes of this thesis. The other 31 articles consist of 3 articles that introduce the crowdsourcing paradigm for e-service delivery, 4 articles that detail the inclusion of disabled citizens in service design, 3 articles that explain the use of Geographical Information Systems (GIS) in the context of civic participation, 7 articles that detail the use of Open Data by citizens, 7 articles that focus on Web 2.0, and 7 articles that detail customized ad-hoc methods.

Table 1 lists the 19 analyzed papers that helped identified the research gaps for this thesis.

Table 1. Papers reviewed in the SLR

Reference	Description	Research Design
Anthopoulos et al.,2007	Discuss benefits of "bottom-up" design of e-services with publics servants and citizens.	Case Study
Axelsson and Melin,2008	Explore focus groups as participation methods for e-government service design.	Action Research
Axelsson et al.,2010	Application of concepts and theories from user participation in Information Systems (IS) research to e-government.	Action Research
Axelsson,2013	Applying an ethical perspective on stakeholder participation in e-government.	Action Research
Billestrup and Stage,2014	Analyze how software providers are developing e-services that should be usable for all citizens.	Interviews
Chan and Pan,2008	Examine the current strategies of user engagement in e-government	Case Study
De Róiste,2013	Examine the benchmarking literature to include users in e-government evaluation	Case study
Følstad et al.,2004	Adapt human-computer interaction methods for e-government.	Interviews
Holgersson and Karlsson,2012	Explore how business employees can fulfil the goals of three user participation schools in e-government development.	Interviews

Holgersson and Karlsson,2014	Explore how citizens are willing and able to fulfill the user-related goals of the three user participation schools in the context of e-government service development.	Interviews
Karlsson et al.,2012	Identify objectives, benefits and challenges when applying existing participation approaches for e-service development.	Literature review
Lindblad-Gidlund,2008	Analyze public servants' view of relations between citizens and e-government.	Survey
Linders,2011	Provide a typology to analyze the ICT-facilitated citizen coproduction initiatives.	Literature review
Lindgren,2014	Advocate for a broadening in participation from users to stakeholders.	Literature review
Olphert and Damodaran,2007	Consider e-government as a socio-technical system and explore the conditions, processes and benefits of a participatory approach for e-government development.	Case study
Oostveen and Van Den Besselaar,2004	Use participatory design principles to involve users in the design of a prototype of an infrastructural system.	Case Study
Sørum,2011	Analyze the impact of user testing on website quality and user satisfaction.	Survey
van Velsen et al.,2009	Describe a user-centered requirement engineering method for the design of e-government services.	Case Study
Wijnhoven et al.,2015	Analyze the citizens' motivation to participate in open government initiatives that range from participation in the political to the administrative domain.	Survey

3.1.1.3. Reporting the Review

In order to structure the analysis of the 19 core articles, we use the template analysis technique from King et al. (2004), which allows us to analyze the occurrence of themes in textual materials. This template analysis also helps us model the research field visually. The main themes for analysis are the research design of the article, the stakeholders that the article discusses as well as the pre-conditions, participation methods, and outcomes of participation.

3.1.2 Research Gaps

After performing the SLR at the start of the process for this thesis, we are able to identify research gaps that this thesis will attempt to fill by means of future research in this domain. These four gaps will guide us to formulate the research questions and strengthen the existing body of knowledge:

Research Gap 1 (RG1) – Lack of a formalization of citizen participation categories: A major problem with the research field of "citizen participation" is its lack of integrative analysis for all the different forms participation can take. Indeed, citizen participation refers to the participation of citizens in all forms, but is often reduced to the democratic participation (often referred to as e-participation or e-democracy when online tools are used). Further research should be performed to determine other forms of participation that could be identified. Furthermore, the need for appropriate evaluation tools and

metrics is emerging to structure and evaluate this participation, but there is still a gap in scientific literature regarding this emerging need (Lombardi, 2011).

Research Gap 2 (RG2) – Lack of integrative methodology and narrow scope for participation methods: Even though the necessary formalization of Gap 1 can help to structure the exploration for enablers of citizen participation, it will not give complete information about the implementation of each participation category into participation methods. Furthermore, we were able to identify a number of methods. However, these methods were not integrated into a complete methodology potentially usable by policy-makers. There are indeed few insights into the analyzed paper about which method to use in which context. Furthermore, regarding the participation methods themselves, a striking observation is that almost all methods detailed in analyzed papers focus on small-scale participation. This finding has two implications. First, regarding small-scale participation, there is only limited consideration of other innovative methods to realize citizen's participation in the e-government domain: creativity in requirements engineering, agile software development methods tailored to e-government, gamification, etc. Secondly, even though small-scale participation is necessary to define the emerging research area, it is essential to enable large-scale participation due to the large heterogeneous user group in e-government.

Research Gap 3 (RG3) – Lack of an understanding of "the citizens": We adopt the point of view that there are four main groups of stakeholders in the area of citizen participation research: public servants, political representatives, software developers and citizens. In this thesis, we seek to analyze participation by integrating all stakeholders. However, the term "citizens" is often used without proper definition. We suggest investigating this abstract term in future research. When the term "citizen" is used, it is often linked to the "end-user" concept. Regarding the participation of citizens as end-users, the question of "Who to include?" is crucial: their profile, their digital literacy, their skills or their representativeness are all issues that will impact the implementation of participation.

Research Gap 4 (RG4) – Lack of consideration for all stakeholders: The research designs of the reviewed articles show that researchers include citizens in their research, even if used as an abstract term. However, we think that future research could go further in that direction: participatory research should be applied to all stakeholders. As we stated above, citizens are essential within citizen participation, but public servants, software developers, and political representatives are also impacted by this change in governance. As little is known about their drivers, opinion and operational barriers for participation, an extension of the research domain to all stakeholders would be beneficial to truly reach an integrative analysis. In line with the possible negative effects of participation (Gap 2), pre-conditions for participation are, in that respect, essential to tackle and could be identified by considering this extended group of stakeholders. We found little research on the ideal setting to enable participation (e.g. public servants' competencies, political representatives' motivation, etc.).

In this thesis, we focus mainly on the first two research gaps, by formalizing citizen participation categories and developing management tools based on that formalization. These two gaps are alos in line with the practical challenges detailed in the next section. However, the last two gaps are transversal to our work, as we take into account all stakeholders and sub-groups of citizens when developing the tools.

3.2. Relevance for Practice

As stated in the previous section, we can identify research gaps in scientific research regarding the participation of citizens in e-government. However, we need to map these gaps to practical challenges. In line with this consideration, this thesis is closely related to the FLEXPUB research project and to the concrete implementation of e-government in Belgium. Thanks to this practical foundation, we can identify practical challenges to be tackled in this thesis.

3.2.1 FLEXPUB Research Project

This thesis is part of the BELSPO BRAIN-be research project 'FLEXPUB: Next Generation of Flexible Public Services – The Geospatial Case'. This project is funded by the Belgian Federal Public Service BELSPO, responsible for Belgian federal scientific policy. This 4-year research project (2016-2020) involves the KU Leuven, UNamur, and the National Geographic Institute. Its aim is twofold: to design a strategy for flexible geospatial e-government services in Belgium and to create a blueprint for enabling flexibility and innovation in the public sector. The thesis will mainly contribute to one essential aspect of the project: the processes for including different stakeholders in the development of e-government services.

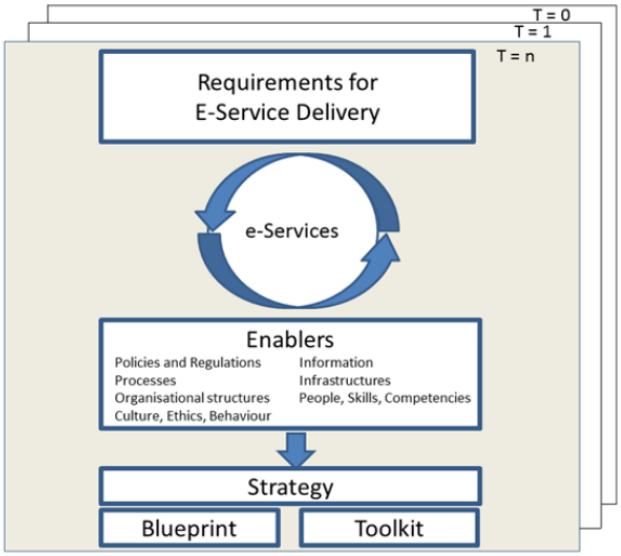


Figure 7. Methodology of the FLEXPUB project

Figure 7 presents the methodology of the FLEXPUB project that will result in the formulation of a geospatial e-government service strategy and a blueprint for adaptive and innovative government. In line with the principles of design science research (Hevner et al., 2004), these activities are undertaken in parallel and iteratively. Starting with a baseline measurement (T=0), an initial solution (policy) will be formulated (T=1). Through the repetition of the design cycle (T=2, …, T=n), results will be repetitively validated and improved based on the outcomes of the case studies used for validation. The methodology can be divided into well-defined steps:

- Starting-point of research is the baseline measurement of e-government in Belgium in 2016 (T=0). This baseline measurement consists of a web survey and in-depth interviews with key stakeholders.
- The baseline measurement results form part of the research necessary for the determination of the requirements for e-service delivery. For this research, it is essential to identify and meet key stakeholders that share common requirements to e-service delivery.

- On the basis of the determined requirements for e-service delivery, key enablers need to be identified as factors enabling the achievement of these requirements. In this context, the enablers of COBIT framework are applied in a comprehensive and systematic way. COBIT stands for Control OBjectives for Information and related Technology and aims to research, develop, publish and promote authoritative, up-to-date, international set of generally accepted information (technology) control objectives for day-to-day use by business managers, IT professionals and assurance professionals (Isaca, 2013). Even though they are more tailored to the private sector, the enablers of COBIT fit into the methodology of FLEXPUB, as these enablers give a holistic view of the aspects that need to be tackled. On the basis of COBIT, the following (slightly modified) categories of enablers are investigated in detail: Policies and regulations; Processes; Organizational structures; Culture, ethics and behavior; Information; Infrastructures (with associated architectures and standards); and People, skills and competencies. As stated above, this thesis focuses on the "Processes" enabler but will also discuss the impact of Culture and the importance of People within these processes.
- The "e-services" research activity will validate the policy options and enablers' findings. This validation is based on a thorough and detailed analysis of a selected number of case studies.
- The research results of the previous activities provide the necessary input for the federal strategy for the delivery of public geospatial e-services and also feed the blueprint for adaptive and innovative governments. Finally, the FLEXPUB toolkit contains operational and useful tools derived from the previous research activities that will be disseminated in the relevant organizations.

On top of these validations cycles and predefined steps, intermediate results of the project are presented twice a year to a follow-up committee. This committee (composed of representatives of public organizations from all levels as well as private organizations) gives feedback and helps to refine the outputs of the project to fit to the practical challenges of practitioners.

3.2.2 E-government in Belgium: Practical Challenges

The case of Belgium is particularly interesting for this research, as this country has already taken significant steps to achieve e-government. At European and Belgian levels, there is a political will to digitalize the governance of Belgium. This will is implemented by public administrations such as the new Federal Public Service "Strategy and Support"[2] (BOSA) or private organizations such as Smals. Furthermore, many other projects such as the G-Cloud will have an impact on the electronic governance of Belgium. In this context, numerous concrete actions have been undertaken such as the adoption of the Law on federal service integrators, the federal service bus and the development of many e-government services (Tax-on-Web, MyPension, etc.).

Despite the multiple efforts to enable e-government in Belgium, a lot of challenges remain due to the complex structure of this country. The Multi-Level Governance structure with the federal, regional, provincial and local levels have an impact on the implementation of e-government. Furthermore, e-government services must satisfy the requirements of different actors (citizens, employees, administrators, politicians, private sector) with different and sometimes conflicting goals. In order to identify the challenges related to e-government in Belgium, we conducted several interviews with public servants in order to understand their requirements regarding future e-government service delivery. In order to have a complete view of e-government (and to analyze the difficulties of multi-level government), we focus on all levels of government:

- European Level (DG Connect, Eurocities, DIGIT, …)

[2] https://bosa.belgium.be/fr

- Federal Level (Federal Public Services (FPS), Agency for Administrative Simplification, Research Institutes, Privacy Commission,…)
- Regional Level (Service Integrators, Service Public Wallonie, Agence du Numérique,…)
- Provincial Level (IT Departments)
- Local Level (Vlaamse Vereniging van Steden en Gemeenten, Union des Villes et Communes de Wallonie,…)
- Private Sector (Smals, iMio, vICTor, CIVADIS,…)
- Public/Private Organizations (BPOST, Proximus,…)

Although e-government is developing quickly, there are still many challenges that need to be resolved. Savoldelli et al. (2014) refer to these challenges as the "e-government paradox": governments have invested substantial sums of money in e-services, yet the adoption rate is still low.

Figure 8 gives an overview of challenges encountered in Belgium with respect to e-government. These challenges have been identified within FLEXPUB. They are classified in accordance with a model that is based on the COBIT model. In this way, every challenge is put in a specific domain, thereby making it easier to gain a complete overview and to define success factors. We use the annual report of FLEXPUB as a basis to explain these challenges (Chantillon et al., 2018b).

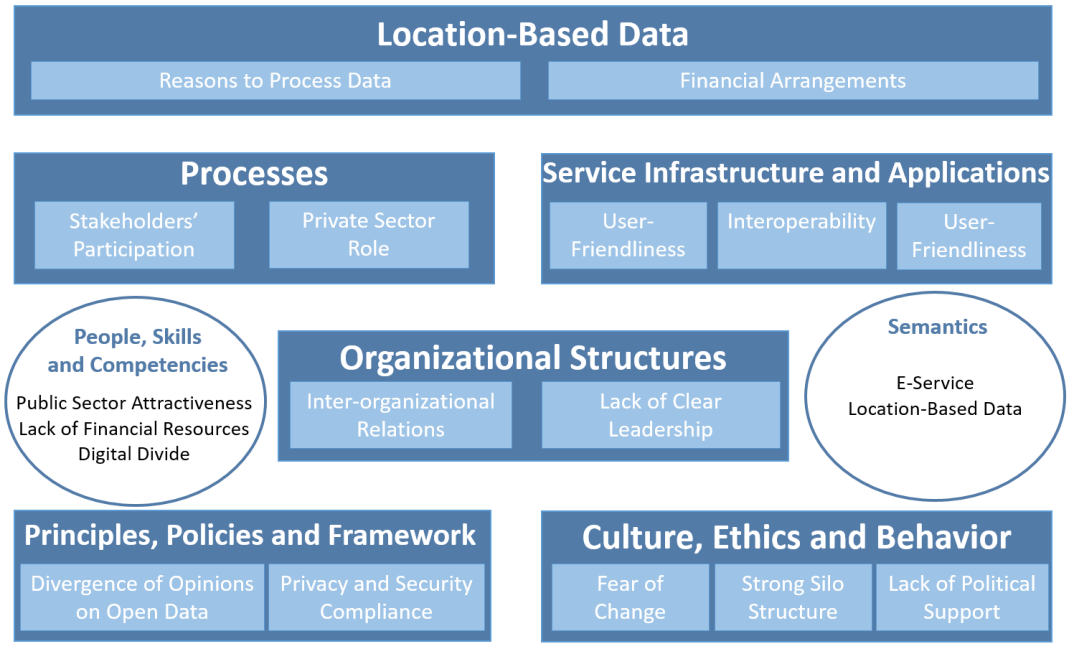


Figure 8. e-Government Challenges in Belgium identified by FLEXPUB

The seven domains are the following: information, processes, service infrastructure and applications, organizational structures, "people, skills and competencies", "principles, policies and framework", and "culture, ethics and behavior". In this thesis, we focus on the Stakeholders' Participation challenge within the "Processes" enabler, but we refer the interested reader to the results of the FLEXPUB research project for more information (Chantillon et al., 2017b). Within the Stakeholders' Participation challenge, we have identified two mains practical challenges that this thesis intends to tackle.

In the interviews conducted throughout the FLEXPUB research project, we were able to identify that practical challenge 1 consists in a lack of effective user participation in the development of e-government services in Belgium. There is no user-centric approach (where users can be the citizens or public servants in other administrations), because e-government services are often developed for internal use. This can lead to e-government services never used after their development. This practical challenge is even more substantial when the users are the citizens, given their number, their heterogeneity, the

difficulty of mobilization and the complexity of integrating them into existing processes through different participation methods. **Practical Challenge 1 (PC1)** can thus be summarized as "**Difficult overview for stakeholders to identify participation possibilities**."

Practical challenge 2 deals with the difficult implementation of citizen participation strategies even when stakeholders are convinced by their benefits. Indeed, since policy-makers are driven (by the hype of the smart city paradigm, for instance) to engage in such strategies, they often implement it without proper methodology, proper analysis of the context of the administration or consideration for implications. For instance, "Betterstreets" is an application that enables citizens to report incidents or problems (such as a hole in the street) to their administration. However, this has led to a decrease of satisfaction in some cities, as citizens did not see a quick intervention by the city services in response to these incidents due to a lack of effective collaboration in the administration. **Practical Challenge 2 (PC2)** can thus be summarized as "**Lack of end-to-end methodologies to implement participation**".

3.3. Research Questions

In order to tackle the research gaps and practical challenges identified in the previous sections, we have designed a set of research questions to contribute to the existing body of knowledge. The main research objective is to examine in an integrative way how to manage citizen participation in e-government. The integrative nature of this thesis consists of three perspectives:

- We develop management tools for citizen participation at three management levels: large-scale, medium-scale and small-scale. Large-scale management in a participation project refers to projects impacting a full ecosystem of actors, numerous users and being under the constraints of numerous context factors. Medium-Scale management refers to participation projects targeting fewer users, having fewer actors involved and being impacted by fewer constraints. These projects can range be at organization level or department level. Small-Scale management refers to participation projects directly targeting a small group of citizens. For each of these levels, we take one concrete participation project as an example (smart cities for large-scale management, e-government service development for the medium scale and children's participation for the small scale).
- When developing the tools, we gather insights from different, and sometimes disconnected, research areas such as smart cities, e-government, user participation in information systems and children's participation.
- When testing and validating the tools, we will involve not only the regular citizen but also the larger stakeholders' ecosystem that consists of political representatives, public agents, software developers and project managers.

As this main research objective is quite broad, we have divided it into the following research questions. First, we identify in an integrative way how citizens can participate in e-government. In that respect, we will tackle Research Gap 1 by looking at citizen participation at a higher level and bridging the gap between all kind of participations. This will also help policy-makers to structure their strategies around this formalization, and thus tackle Practical Challenge 1. As a result, we formulate this first Research Question (RQ):

- RQ1: How to structure citizen participation in e-government?

Since we advocate for an extension of the participatory methods in Research Gap 2, we consider the use of all participation methods to enable participation, and map them to Practical Challenge 1. These methods could be integrated into usable management tools in order to respond to Practical Challenge 2. Therefore, we formulate the following research question:

- RQ2: How to appropriately manage citizen participation on different scales ?

This research question constitutes an umbrella question that will be refined into sub-research questions depending on the use case selected for each scale. For the management of participation on a large scale, we have selected the use case of smart cities and formulated the following question:

- RQ2a: How can a city enable the participation of its citizens so as to become a smart city?

For the management of participation on a medium scale, we have selected the use case of local e-government service development projects and formulated the following question.

- RQ2b: How can the project managers' decisions related to user participation in e-government service development be supported, taking several influencing factors into account ?

For the management of participation on a small scale, we have selected the use case of children participation in classrooms and formulated the following question:

- RQ2c: Can a workshop impact children's understanding of the smart city concept?

After these research questions focusing on the management tools, we focus on two transversal issues: the abstract role of citizens (Research Gap 3) and the lack of consideration for other stakeholders (Research Gap 4); we formulate the following research question that is transversal to the different tools developed:

- RQ3: Which stakeholders should be considered when managing citizen participation in e-government?

Table 2 provides a mapping between the formulated research questions and the research gaps and practical challenges previously identified.

Table 2. Mapping between Research Questions, Research Gaps and Practical Challenges

RQ	RG1	RG2	RG3	RG4	PC1	PC2
RQ1	X				X	
RQ2		X				X
RQ2a		X				X
RQ2b		X				X
RQ2c		X				X
RQ3			X	X		

4. Research Design

In order to answer the research questions defined in section 3.3, we follow the guidelines from different research methods. In section 4.1, the overall methodology that guides the different research activities of the thesis is briefly described and will be discussed in more depth later in the thesis. In section 4.2, the underlying research methodologies that fuel this overall methodology are described.

4.1. Overall Methodology

Figure 9 represents the overall methodology adopted in this thesis. It should be noted that this section presents only the overall methodology that guides this thesis based on the general research methodologies presented in the next sub-section.

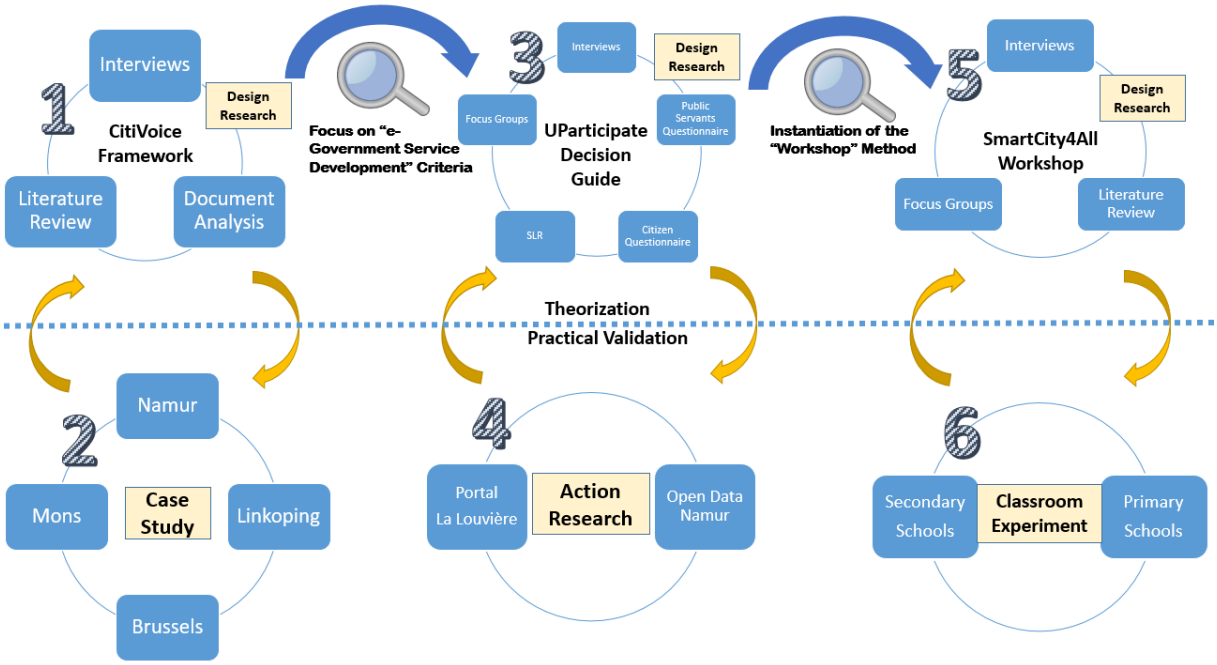


Figure 9. Overall methodology of the thesis

In the research design of this thesis, we rely heavily on different research methodologies. Thanks to design science research (Hevner et al., 2004), we iteratively build the management tools (CitiVoice, UParticipate and SmartCity4All) thanks to the different research activities. Each of these activities make it possible to refine the different artifacts (constructs, metrics or guidelines) of the tools. One of the validation cycles of the design science research relies on the testing of the results in a real-life environment through case studies, action research or experiments. For CitiVoice, the framework is iteratively tested through four case studies, with no intervention from the researcher. For UParticipate, it is tested through two action research activities where the researchers worked hand-in-hand with practitioners. For SmartCity4All, it is tested through several classroom experiments in primary and secondary schools.

In sum, the research design consists of six main quadrants:

- **Theorization of Citivoice (1)**: In this first part of the research, we identify the different main participation categories and reflect them in the CitiVoice Framework. The framework is built following design science research, with three design cycles: Literature Review, Document Analysis and In-Depth Interviews.

- **Practical Validation of CitiVoice (2)**: In this second part of the research, we perform one extra validation cycle where CitiVoice was improved thanks to the application to the case studies of Namur, Brussels and Mons and Linköping.
- **Theorization of UParticipate (3)**: In this third part of the research, we focus on one specific participation criterion of CitiVoice: the citizens as participants in the development of e-government services. This focus allows us to align with medium-scale management considerations, whereas the framework was more theoretical on the large-scale. Consistent with design science research, UParticipate is built iteratively thanks to a cycle of several research activities: a systematic literature review, interviews, a questionnaire sent to public servants, a questionnaire sent to citizens and focus groups.
- **Practical Validation of UParticipate (4)**: This part of the research refers to the validation of UParticipate by applying it to two action research activities where we got the chance to test it in real-life conditions (for the e-government portal of La Louvière and for the Open Data portal of Namur).
- **Theorization of SmartCity4All (5)**: In this part of the research, we focus on one specific small-scale participation method of UParticipate: the workshop. We develop a workshop aimed at popularizing the smart city concept among children and getting them to participate in their city. It is built through several design activities: in-depth interviews, group discussions and literature review.
- **Practical Validation of SmartCity4All (6)**: In the last part of the research, we tested the SmartCity4all Workshop in different classrooms. This testing took the form of an experiment where we handed out a pre-test and a post-test questionnaire in order to monitor the evolution the various children's perception of smart cities and participation.

Thanks to this overall methodology, we intend to answer the research questions formulated in Section 3.3. Regarding RQ1 ("*How to structure citizen participation in e-government?*"), CitiVoice will structure the participation research fields in different strategic areas. Regarding RQ2 ("*How to appropriately manage citizen participation on different scales*"), CitiVoice will be applied to several cities that implement large-scale smart city projects. Indeed, such large-scale projects involve a large ecosystem of actors (private, public, civil society) and impact a large number of citizens. Furthermore, several context factors impact the decisions of policy-makers when they develop a strategy at that scale. For medium-scale participation, UParticipate will be validated using e-government service development projects. Such development projects constitute our use cases for medium-scale projects, as they can be considered as a sub-parts of an overall smart city strategy. Furthermore, fewer stakeholders and users are involved and the focus is on the organizational level. Regarding small-scale participation, SmartCity4All will be in classrooms that constitute our use case for small-scale projects. Indeed, the workshop method only allows for the participation of a small group of citizens. The contributions for the specific sub-questions RQ2a, RQ2b and RQ2c will be address extensively in the dedicated when validating the respective tools.. Regarding RQ3 ("*Which stakeholders should be considered for citizen participation in e-government?*"), the three previously mentioned tools will be developed and validated in close collaboration with relevant stakeholders for participation.

4.2. Underlying Research Methods

Since the goal of the research is to develop three management tools that aim to address research gaps but also practical challenges, we chose to rely on the design science research approach. As Hevner et al. (2004) theorized it, the design science research approach helps develop a tool while ensuring its relevance to the knowledge base (the "Rigor Cycle") as well as to the environment (the "Relevance" Cycle). Design science research is applied as an overarching methodology to develop CitiVoice, UParticipate and SmartCity4All. Figure 10 shows a visual representation of the design science research methodology.

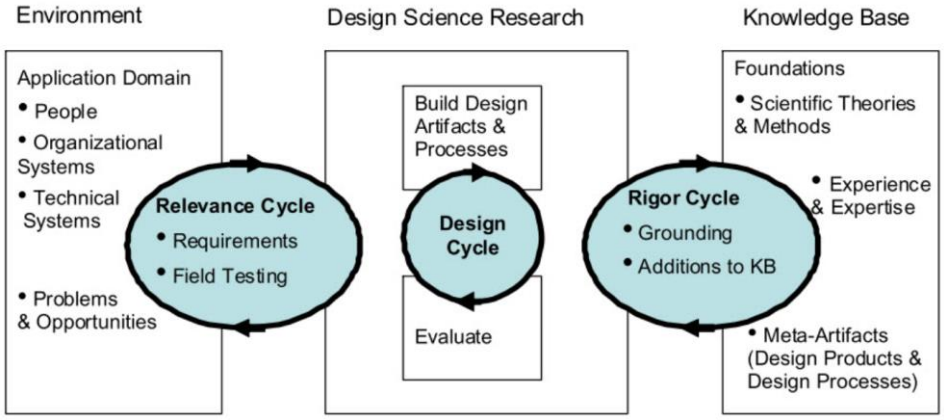


Figure 10. Design Science Research Methodology (Hevner et al., 2004)

Having this overall goal and methodology in mind, we wanted to ensure consistency and harmony of the choices made within the overall methodology presented in 4.1 and in the different cycles of design science research. In order to ensure this consistency, we will use the research "onion" as presented by Saunders et al. (2009). Figure 11 shows this onion and indicates that, before collecting data, the researcher has to make a number of choices through different layers.

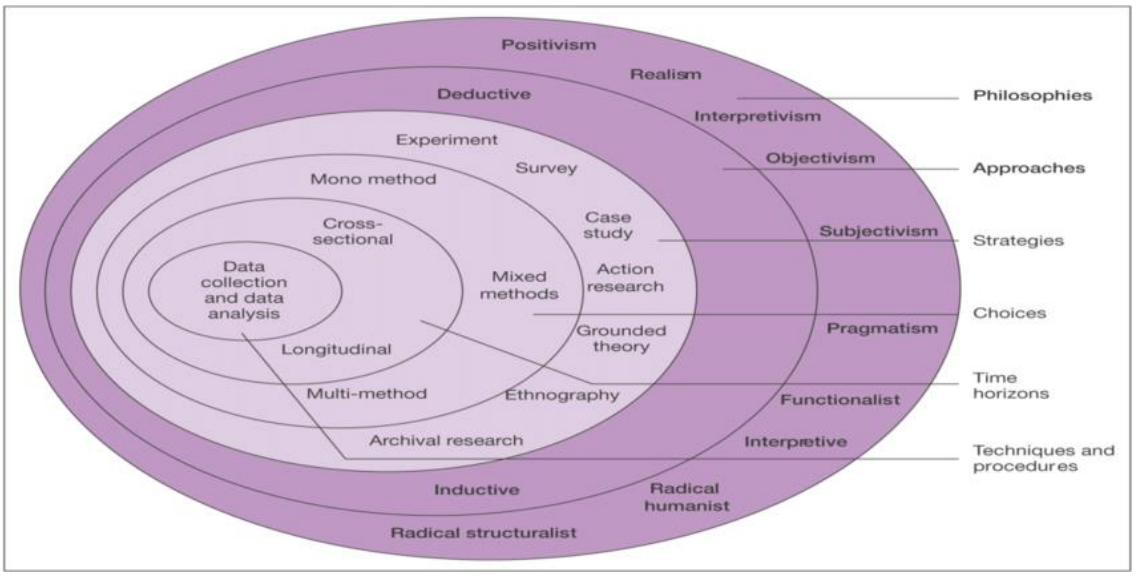


Figure 11. Research Onion (Saunders et al., 2009)

4.2.1 Philosophy

The research philosophy expresses the way the researcher understands the world through his or her research. As the goal of this thesis is to develop tools for practitioners to be able to manage citizen participation in different settings, the adoption of the pragmatic approach seems more appropriate. The approaches, research choices and data collection techniques chosen were those that seemed the most relevant to understanding the phenomena of interest (smart cities, e-government service development or children's participation). In line with the care for practical relevance, the choice of the design science research approach was made in order to ensure theoretical relevance as well.

4.2.2 Approaches

In this research, we chose not to choose between deductive and inductive approaches but opted for a third path: abductive research. This choice is consistent with the interplay between theory and practice necessary for the theoretical and empirical validations of the three tools.

Abductive research is an approach to data collection and analysis that entails iteration between identifying facts or concepts in the empirical data, and deciding on the most promising explanatory reasons to go forth with exploring (Schurz, 2008). Thus, it can be viewed as an interplay between inductive and deductive reasoning. For instance, in the development of CitiVoice, all of the researchers had prior knowledge of citizen participation and smart cities (having performed an extensive literature review on the matter). Thus, a purely inductive approach would not have been possible as we drew from this previous knowledge during the research process (Thornberg, 2012).

4.2.3 Strategies

In terms of research strategies, and in line with the pragmatic philosophy, three strategies were chosen based on the use case of interest: Case Study for CitiVoice, Action Research for UParticipate and Experiment for SmartCity4All. These strategies are chosen to validate the tools in a practical setting.

4.2.3.1. Case Study Research

Case Study research (Yin, 2013) was used to analyze the four cities in the context of CitiVoice. This approach, with no intervention from the researcher in the actions of the cities, was the most appropriate as the main use of CitiVoice is to serve as an evaluation tool.

4.2.3.2. Action Research

By contrast, UParticipate, being a decision support guide, will mainly be used by practitioners during an e-government service development project. Therefore, we chose to use Action Research (Brydon-Miller et al., 2003) to validate it in two main use cases: Open Data portal development in Namur and e-government portal development in La Louvière. In these two cases, the researchers worked collaboratively with the practitioners to test the guide.

4.2.3.3. Experiment

Regarding SmartCity4All, an experimental approach was chosen in order to test the workshop in different classrooms (with different education levels, maturity in IT, etc.). By monitoring the audience variables and adjusting the workshop when necessary, we were able to draw relevant conclusions on the use of this tool. These experiments were performed following best practices in educational research (Ehrenberg and Lindquist, 2006; Cobb et al., 2007; Creswell, 2013).

4.2.4 Choices

Regarding choices, we opted to follow a multi-method approach. As stated by (Gil-Garcia and Pardo, 2006), multi-method approaches are valuable in order to observe a complex phenomenon and particularly helpful for e-government research. Furthermore, as stated by (Johnson et al., 2007), the combination of qualitative and quantitative analysis make it possible to have informative, complete, balanced, and useful research results. While questionnaires allow us to collect focused quantitative data, the qualitative method is more effective for covering a complex topic in detail (Baarda et al., 1996; Boyce and Neale, 2006). Everytime a combination of method is used in the thesis, we explain clearly how the different results are combined.

Indeed, the research performed often consisted in the combination of several qualitative data collection techniques. For instance, in order to develop CitiVoice, we relied on document analysis and interviews to allow for triangulation of data. In the same line of thought, two questionnaires are combined with in-depth interviews when developing the "Participation Methods" element of UParticipate. This combination of methods, depending on their pragmatic relevance for the examined use case, constitute design cycles for each of the three tools.

4.2.5 Time horizons

In this thesis, we used only cross-sectional research, since the timespan of the research is only four years. The latter time span is not long enough to qualify as longitudinal research. However, we expand on the longitudinal possibilities of studying these tools in the further research sections throughout this thesis.

4.2.6 Techniques and Procedures

We do not expand on the different data collection techniques used in this thesis, but refer the reader instead to the methodology part of Sections 5, 6 and 7 in Part II of the thesis for further information about them. However, we do list the main techniques used throughout this thesis. The main data collection activities for this thesis were semi-structured interviews, document analysis, focus groups, literature reviews and surveys.

4.2.6.1. Semi-structured Interviews

Interviews were used to gain information from smart city, e-government and educational practitioners in order to develop, respectively, CitiVoice, UParticipate and SmartCity4All. This helped us gain complete and precise information about what practitioners expected from these management tools. Furthermore, the interviews were also relevant to the activities undertaken to validate these tools, notably by helping us understand how the interviewees would use them and to collect feedback from them about the tools. The interviews were semi-structured in nature to follow the abductive reasoning (Drever, 1995).

4.2.6.2. Literature Reviews

Three literature reviews were performed before engaging in the development of the three tools, so as to better grasp the research gaps that these tools could fill. The selected papers also enabled us to develop a first version of these tools.

4.2.6.3. Document Analysis

Document analysis was performed in the context of CitiVoice to present a first version of the Framework when studying internationally recognized smart cities around the world that have successfully implemented citizen participation.

4.2.6.4. Focus Groups

The focus groups were used in two settings. First, three focus groups with public servants were organized to fuel elements in the UParticipate Decision Support Guide. Second, more informal group discussions were organized with education experts to comprehend their expectations and ideas about the SmartCityforAll workshop.

4.2.6.5. Surveys

Surveys were used in two settings as well. First, two questionnaires were sent to public servants and citizens to fuel elements in the UParticipate Decision Support Guide. Second, a survey was completed by the students before and after each session of SmartCityforAll to monitor the evolution in their perception.

PART II: Results – Management Tools

5. CitiVoice Framework

Smart cities are taken as use cases for large-scale projects and considered as socio-technical systems with citizens as their end-users. In this regard, we situate ourselves in the line of research of Vácha et al. (2016) that adapts systems engineering methodologies to collect users' needs, to plan, and to monitor smart city projects. Despite the crucial role of citizens in smart cities (as discussed in Section 2.2.2), to date only a few papers have tried to take a holistic view of the different ways to enable this participation. The goal of this section is to find out how citizens can contribute to the transformation of a city into a "smart" city and to provide a framework to structure and evaluate this participation. Furthermore, as discussed in Section 3.1.2., there is still a research gap regarding the evaluation of citizen participation in the context of smart cities (Lombardi, 2011). Based on our observation in practical cases, this gap 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".

On top of helping us manage participation on a large scale (RQ2), this section tackles these issues by trying to answer the following research question (RQ2a): '*How can a city enable the participation of its citizens so as to become a smart city?'* To answer this question, we will tackle the following research sub-questions: What are the different means of citizen participation in a smart city? And: How can citizen participation in a smart city be evaluated? Building on the formalization of citizen participation by Berntzen and Johannessen (2016) and Simonofski et al. (2017a), we suggest a framework for evaluating citizen participation in smart cities that will be detailed, refined and validated here. This framework constitutes the first Management Tool presented in this thesis: the CitiVoice Framework. This framework and its uses are then refined by means of four case studies: Namur, Brussels, Mons and Linköping.

This section is structured as follows. Section 5.1 describes the methodology applied to performing the extensive literature review and to building the CitiVoice Framework. In section 5.2, the different enablers of citizen participation are studied in depth and transformed into the criteria of the framework. CitiVoice is then applied to several smart cities in section 5.3 to demonstrate its three different uses. Section 5.4 suggest a further holistic evolution for CitiVoice, fueled by an additional literature review. Finally, the relevance of context factors when analyzing smart cities is discussed in Section 5.5.

5.1. Methodology

The methodology we applied to designing the CitiVoice Framework is represented visually in Figure 12 and is further described in this section. In order to design the framework and its criteria, we followed the guidance of the design-science research paradigm, consisting of three research cycles: Relevance Cycle, Design Cycle and Rigor Cycle (Hevner et al., 2004).

In the *Design Cycle*, the smart city literature was first analyzed through an extensive review of papers found in well-regarded scientific electronic databases (Google Scholar, Scopus, ScienceDirect, Web of Science) (Falagas et al., 2008). In order to be considered for review, the articles had to include at least one of the following terms in their title and/or abstract: "citizen", "participation", "involvement", "engagement", "empowerment", "e-inclusion" and "e-participation". In order to obtain input from other areas of research, these search terms were used with and without combination with "smart city". This intellectual core was then extended through backward and forward snowballing. To be considered for the review, articles had to discuss insights about the implementation or evaluation of citizen participation. This review allowed us to identify relevant criteria to construct an initial version of the framework to structure citizen participation in smart cities. Thus, the criteria were considered as artifacts and refined in two validation steps. The validation methods were observational in order to study the criteria in a real-life environment. In the first validation step, the framework was applied to the evaluation of Ghent and Amsterdam. The input data for these cities originate from secondary sources: the official websites of the

cities (Gent City, 2014; Amsterdam City, 2015), official documents of the city council, newspaper articles, and scientific literature (Baccarne et al., 2014; Dameri, 2014). Based on this first validation step, the framework was improved: the categories were modified to better reflect reality and criteria were modified to be more easily usable. For instance, thanks to the example of the "Ghent Living Lab", the Living Lab category was refined, as it is not only its presence but also the activities it organizes that really enables citizen participation.

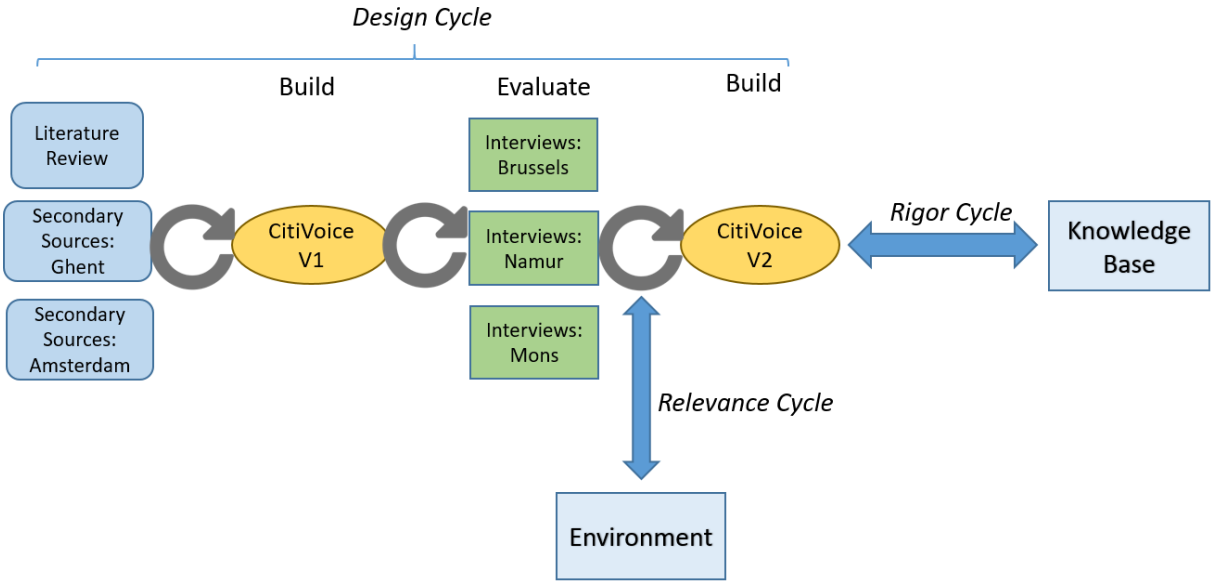


Figure 12. Design Science Research Methodology for CitiVoice

Since we found that for some criteria, no public information is available in secondary sources, we opted for the multiple case study of three Belgian smart cities in the second validation step. For these cities, all required information was collected through in-depth interviews with relevant stakeholders in charge of the implementation of the smart city strategy. These stakeholders were selected from different functions so that we would have different perspectives (see Table 3). After understanding the current actions that they implement regarding citizen participation, the framework was also presented to the stakeholders for validation. In that regard, the 12 interviews also constituted an improvement phase in which the different elements of the framework were refined. Indeed, the interviewees pinpointed key points from their experience that could not have been as extensively identified in literature, e.g. the essential presence of a group facilitator to support participation. These interviews were performed in a semi-structured manner, in accordance with best practices in the literature (Drever, 1995). Some questions were predefined and grouped by general themes concerning the main categories of citizen participation and the concrete implementation of the smart city strategies of the different cities. However, the interviews remained open in order to explore new ideas and to be able to discover other relevant themes. The interview guide can be found in Appendix 9.1. On average, the interviews lasted between one and two hours each and in most cases were performed face to face.

Table 3. List of Interviewees for CitiVoice

N°	City	Function	Relevancy for Citizen Participation
1	Namur	Academic	Living Lab responsible
2	Namur	Political Representative	Supporter of Smart City Strategy
3	Namur	Political Representative	Supporter of Smart City Strategy
4	Namur	Public Servant	Smart City Manager
5	Namur	Public Servant	Expert on Smart Governance
6	Mons	Public Servant	Living Lab Responsible
7	Mons	Public Servant	Communication Manager
8	Mons	Private Sector	Digital Platform Developer
9	Mons	Political Representative	Supporter of Smart City Strategy
10	Brussels	Public Servant	Smart City Manager
11	Brussels	Public Servant	Citizen Participation Manager
12	Brussels	Political Adviser	Citizen Participation Expert and Entrepreneur

Through the validation steps of the design cycle, we reached a saturation of findings, as the interviews did not lead to further modification of CitiVoice in the last iteration (cases of Brussels and Mons). We made sure that the smart cities studied are heterogeneous enough to limit the threats to validity (see Table 4). These interviews allowed us, in the *Relevance Cycle*, to ensure that the design of the framework will add value to the environment and application domain in the. Through the *Rigor Cycle*, we ensure that CitiVoice contributed to the knowledge base. However, these theoretical contributions, as well as potential threats to validity and reliability, will be discussed below.

Table 4. Cities Selected to Design CitiVoice

City	Size	Maturity of Smart City	Country
Namur	Small	Low	Belgium
Mons	Medium	Low	Belgium
Brussels	Medium	Medium	Belgium
Amsterdam	Medium	Advanced	Netherlands
Ghent	High	Advanced	Belgium

5.2. Formalization of Participation Categories

This section presents the elements of the CitiVoice Framework extensively. CitiVoice consists of three main categories of citizen participation. In order to make sure that this categorization is as complete and unbiased as possible, in our design of these three categories we rely heavily on previous work on the topic (Callahan, 2007; Berntzen and Johannessen, 2016; Simonofski et al., 2017b)

First, citizens can be democratic participants in the decision-making process of the city. 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 public servants and citizens). The criteria in this category are aimed at verifying that citizens' opinions do indeed have an impact on decision-making.

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. Thanks to previous studies about co-creation methods, we were able to collect and analyze the main co-creation methods dedicated to ensure that citizens' ideas and expertise are collected in an effective way.

Finally, in the post-implementation phase, 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. As stated before, ICT was for many years considered the main element in smart cities. The profusion of literature has allowed us to compare smart city infrastructures and analyze how they can support participation (Anthopoulos et al., 2016).

Figure 13 summarizes the suggested framework, with the proposed criteria organized hierarchically into categories and sub-categories. We decided to map the sub-categories to the broader categories in a one-to-one fashion. This choice constitutes an oversimplification of reality as, for instance, online platforms could be used to enhance democratic participation. However, thanks to this mapping, the evaluation and comparison uses of the guide are facilitated as it will be explained in Section 5.3.

The different elements of CitiVoice are detailed in the following sub-sections.

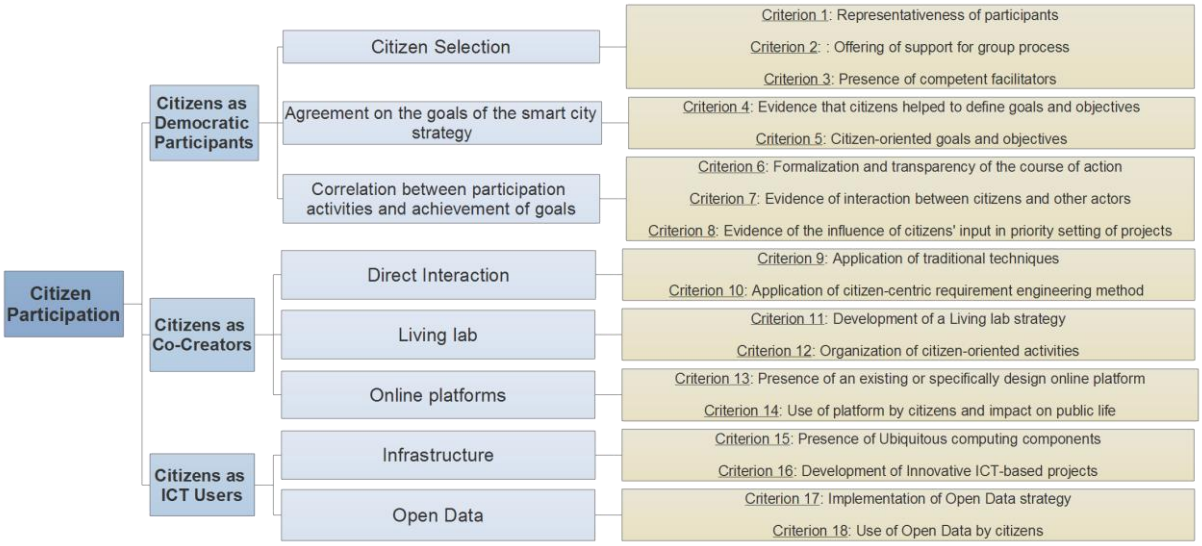


Figure 13. CitiVoice Framework

5.2.1 Citizens as Democratic Participants

Seeing citizens as direct democratic participants in a smart city has several advantages (Irvin and Stansbury, 2004). By being involved in the decision process, citizens can learn about difficult technical problems and become experts in matters of public relevancy. Moreover, public servants also learn from citizens about the reasons why a policy might be unpopular and how to avoid this happening. Democratic participation of citizens is also cost effective, as it reduces the chances of litigation or, in a smart city, useless investments that will not be helpful or used by the public. This section introduces the way in which citizens can have an impact on the decision-making process of smart cities.

5.2.1.1. Citizens' Selection

In practice, the implementation of democratic participation by citizens faces numerous challenges. First, the group of citizens involved in the process must be sufficiently representative of the population. For instance, the selected group may be biased towards people whose life is more heavily influenced by the decisions taken regarding the smart city strategy. The criterion "*Representativeness of participants*" focuses on the number of citizens involved and the description of their profiles in order to avoid overrepresentation of a certain class, gender, neighborhood, and so on. Basic statistics about the population can help ensure the representativeness of each sub-group.

Secondly, the participation process can be costly in terms of resources, money, and time (Irvin and Stansbury, 2004). These challenges can lead to an overrepresentation of a certain social group that has the time and money to participate (Weber, 2000). In order to reduce the time- and money-consuming nature of the decision-making process, the criterion "*Offering of support for group process*" has been added. Such support can reward the citizens through financial as well as other kinds of social benefits ("Citizen of the week" awards, free training courses, etc.). The time-consuming nature of the decision-making process and, thus, the challenge of underrepresentation of people who lack time can also be addressed by the introduction of e-voting systems (Zissis and Lekkas, 2011).

The criterion "*Presence of competent facilitators*" has been added to check that the participation activities are handled by competent and unbiased group facilitators who will ensure the objectivity and relevancy of debates. Since many citizens may not be used to participate in these kinds of meetings, facilitators should also ensure that each voice is heard, by using facilitating techniques such as those described in Mahaux and Maiden (2008).

5.2.1.2. Agreement on the Goals of the Smart City Strategy

The main pitfall when including citizens to the decision process is that this will be done in a purely instrumental manner. Governments might include citizens in the process only in order to obtain a more cooperative public, in the hope of facing less resistance when the discussed project is implemented (Irvin and Stansbury, 2004). Similarly, administrations may resort 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 labeled 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). When participation is a means to a specific end, counting the number of people involved does not suffice to evaluate participation. Proper evaluation then requires having an agreement on the goals of the specific participation program, like "select the best ideas from a specific online participation platform" or "develop smart lighting in a city in order to meet at best the citizens' expectations". The criterion "*Evidence that citizens helped to define*

goals and objectives" is aimed at ensuring that the citizens contributed to the definition of the goals. Furthermore, the criterion "*Citizen-oriented goals and objectives*" stipulates that the goals of the smart city should be citizen-oriented and take the human capital of the city into account. This step is essential because it will ensure that CitiVoice is not used in a purely instrumental way, as a simple check-list of initiatives.

5.2.1.3. Correlation between participation activities and achievement of goals

In order to avoid the instrumentalization of citizen participation, 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). The criterion "*Formalization and transparency of the course of action*" is aimed at ensuring that the course of action has been formalized and is transparent, so that the decision-making process is clear to all actors involved. Secondly, the criterion "*Evidence of interaction between citizens and other actors*" requires evidence that the smart city actors have decided to include citizens in the decision-making process of their strategy. Lastly, the criterion "*Evidence of the influence of citizens' input in priority setting of the projects*" is intended to ensure that citizens were more than just passive actors. By prioritizing the smart city projects according to citizens' input, the decision-makers ensure that citizens, their quality of life, and their participation are at the core of the smart city strategy.

5.2.2 Citizens as Co-Creators

The traditional approach to innovation in cities consisted in urban planners making centralized decisions based on their own ideas. In recent years, however, and in the smart city context, a new model has emerged that takes advantage of citizens' input and ideas (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.

5.2.2.1. Direct Interaction

There are some general 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). The criterion "*Application of traditional techniques"* stipulates that these techniques should be used by the smart city to gather input from citizens.

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. A citizen-oriented approach (van Velsen et al., 2009) advises researchers to conduct semi-structured interviews to explore the critical needs of citizens for the potential system. Other approaches such as the application of the agile paradigm (Schön et al., 2016) and the crowdsourcing paradigm (Adepetu et al., 2012) to the traditional requirements engineering method also provide new methods to collect citizens' needs in a more optimal way. The criterion "*Application of citizen-centric requirement engineering method*" checks the involvement of citizens in the requirement engineering method used by the city when developing e-government services or applications labeled as "smart". This criterion can be extened to other phases where the input of the citizens is welcomed (such as the testing or ideation phase).

5.2.2.2. Living Labs

Another popular technique is that of 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). The living lab methodology means 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 ultimately in the 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 et al., 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.

The criterion "*Development of a Living lab strategy*" is used to determine whether the living lab strategy is aimed at putting the citizen at the center of its implementation. The description of strategy and planning does not suffice: this framework entry needs also to consider the citizen-oriented activities the living lab potentially organizes such as the exploration of ideas for smart cities, the vulgarization of technology, collaboration workshops, etc. Thus, the criterion "*Organization of citizen-oriented activities*" is added, which verifies that the living lab was built to enhance citizen participation in the smart city.

5.2.2.3. Online Platforms

In the light of time or space constraints, citizen participation can be enhanced by two means: centralized platforms and social media analysis (Berntzen and 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, etc. (Criado et al., 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 and Young, 2012). This kind of system could be applied in a smart city context to stimulate citizen input.

The criterion "*Presence of an existing or specifically designed online platform*" is used to determine whether the Online Platform(s) used by the smart city is (are) described. These platforms can be of any type (hybrid systems, social media, centralized platform, application…). Furthermore, the smart city can use an existing or a specially designed one. The criterion "*Use of platform by citizens and impact on public life*" stipulates that the platform should have a real-life setting. This can be ensured by monitoring the number of citizens involved in the platform and its impact on public life (how many discussions led to a concrete project? How many ideas or complaints were considered?).

5.2.3 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 and 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. This section describes how the participation of citizens can be stimulated under the umbrella term *ICT*.

5.2.3.1. ICT Infrastructure

Technological advances make possible a “ubiquitous computing” infrastructure (Friedewald and Raabe, 2011), a term that is closely related to the concepts of sensors and the internet of things. It refers to the embedding of wireless, intercommunicating microprocessors, etc. in objects of everyday life such that these objects can record and modify the environment. The criterion “*Presence of ubiquitous computing components*” lists all computing elements that could effectively lead to an increased participation of citizens.

The critical factor is to put these technological developments at the service of citizens. These developments are still too abstract for most citizens, who are interested mainly in applicable solutions (Schaffers et al., 2011). The criterion “*Development of innovative ICT-based projects*” is added to ensure that innovative or new citizen-oriented applications can be mapped to the framework. These applications range from Augmented Reality systems (Gutierrez et al., 2013), through Citizen Science platforms (Khan and Kiani, 2012) and Public Displays (Du et al., 2017) to any innovative application that makes citizens feel surrounded and supported by technology as well as motivated to engage in other applications.

5.2.3.2. Open Data

Open Data refers to all publicly produced data that is disseminated without restrictions (Janssen et al., 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. The criterion “*Implementation of Open Data strategy*” concerns the city’s policy on the availability of public data.

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 on any scale (neighborhood, city, or even country). The criterion “*Use of Open Data by citizens*” applies to the different uses of the available datasets by citizens.

5.3. Applying CitiVoice

We improved CitiVoice by applying it to the smart city designs of three Belgian smart cities (Mons, Namur and Brussels). In this section, we demonstrate the three uses of the framework with an extra focus on the case of Namur:

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 in accordance with all the criteria of the framework.

It 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 to be guidelines for implementation.

It 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 for differentiation of the means by which different smart city strategies can ensure citizens' participation and for designing new means based on this comparison.

5.3.1 Evaluation Tool

CitiVoice takes as input all information that demonstrates the fulfilment of a criterion. For example, the text describing the construction of a living lab does not suffice: it is its usage by the city and the citizen-oriented activities organized in the context of the living lab that will define it as a participation enabler. The evidence for criteria can be gathered by 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 yet fully implemented it (for example, a project is budgeted and planned or at the beginning of its lifecycle without any concrete effects yet). In this state of implementation, the criterion holds the possibility of improving the participation of citizens or already influencing it at a minor level. "1" means that the criterion is fully implemented and has a clear effect on citizen participation. Table 5 shows the evaluation of citizen participation in "Smart Namur" according to CitiVoice. This evaluation was performed in 2017.

Table 5. Evaluation of Namur with CitiVoice (2017)

	Evaluation Criterion	Namur	Score
Citizens as Democratic Participants	**Citizen Selection**		
	Representativeness of participants	No assurance for representativeness of citizens	0
	Offering of support for group process	No support	0
	Presence of competent facilitators	No group facilitators	0

	Agreement on the goals of the smart city strategy		
	Evidence that citizens helped to define goals and objectives	The goals were not defined by the citizens.	0
	Citizen-oriented goals and objectives	The political will to transform Namur into a smart city aims to include the population in public life through digital means.	0.5
	Correlation between participation activities and achievement of goals		
	Formalization and transparency of the course of action	The course of action is not made available to the citizens.	0
	Evidence of interaction between citizens and other actors	“One-way” interaction: citizens are informed of the advancement of the smart city but have no opportunity to influence it	0
	Evidence of the influence of citizens’ input in priority setting of the projects	No opportunity for the citizens to influence projects.	0
Citizens as Co-Creators	**Direct Interaction**		
	Application of traditional techniques	“Smart Namur” is promoted via conferences. Direct interviews and focus groups are planned in the context of applied research by the University of Namur.	0,5
	Application of citizen-centric requirement engineering method	The e-government services are developed only internally.	0
	Living lab		
	Development of a Living lab strategy	The TRAKK is a multidisciplinary and co-creation space that aims	1

		to promote creative projects in the Namur region (TRAKK, 2014).	
	Organization of citizen-oriented activities	The TRAKK is at the beginning of its lifecycle and is used by companies in the digital industry, developers and the creative class.	0.5
	Online platforms		
	Presence of an existing or specifically designed online platform	An online platform will be launched by the BEP and another one will be deployed by the city of Namur.	0.5
	Use of platform by citizens and impact on public life	/	0
Citizens as ICT users	**Infrastructure**		
	Presence of ubiquitous computing components	A budget has been assigned by the European Regional Development Funds to set sensors in the city (L'avenir, 2015). Projects in the area of mobility are targeted.	0.5
	Development of Innovative ICT-based projects	The city of Namur plans to develop intelligent "bus stops" using "augmented reality".	0.5
	Open Data		
	Implementation of Open Data Strategy	Namur is about to launch a portal that will provide relevant information to all citizens, even the non-developers.	0.5
	Use of Open Data by citizens	/	0

5.3.2 Governance Tool

In order to make smart cities as citizen-oriented as possible, the guidance of CitiVoice allows the issuing of more concrete recommendations for a specific city. In this case, the recommendations are made after an evaluation of Namur with the framework. However, the different criteria could also be used as a

checklist beforehand by any interested stakeholder (e.g. the smart city manager) to guide his or her actions regarding citizen participation.

First, Namur should formalize its course of action to stimulate the democratic impact of citizens. This formalization will summarize, for all ongoing or future projects, the clear authority in the decision-making process, and the possibility of including citizens depending on the technicity of the project. Thereafter, the city needs to reflect on the inclusion of citizens so that they can contribute to the priority-setting of future projects and contribute their ideas about the implementation of the ongoing projects. Secondly, Namur should design an online portal to include the formalization of the future course of actions in order to be transparent. Each step might include a link for interested citizens, so that they can offer their perspectives or ideas. The city should also draw up a clear statement of its the goals and objectives and include structured information about its ongoing and future projects. Lastly, it should include or redirect to an online participation platform. Thirdly, the city of Namur should use its living lab as a hub for citizen participation. The co-creation space of Namur (the TRAKK[33]) currently does not yet reach all the citizens of Namur. However, the TRAKK could explore citizens' ideas about the smart city, make them aware of new technologies and help them engage in digital activities such as educational activities (facilitation of the use of Open Data for citizens, introduction to programming), brainstorming activities (workshops to build a concrete proposal for issues of the city), or competitions (hackathon, serious gaming, neighborhood games). Finally, the city of Namur should reflect on the use of ubiquitous computing. Questions about the placement, applications and potential value of "smart furniture" for citizens need to be considered and can be answered through direct interaction with the citizens and through the testing of applications in the TRAKK. This research might lead to the conclusion that an investment in "smart furniture" will be irrelevant and too costly for the potential usage.

5.3.3 Comparison Tool

In order to facilitate the visualization of citizen participation in smart cities, we have made use of a radar graph (see Figure 14). This graph allows for a straightforward comparison of the forms of citizen participation in which 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 make it possible to monitor in which directions (Democratic, Co-Creation or ICT) investments are made to stimulate participation.

[33] https://www.trakk.be/

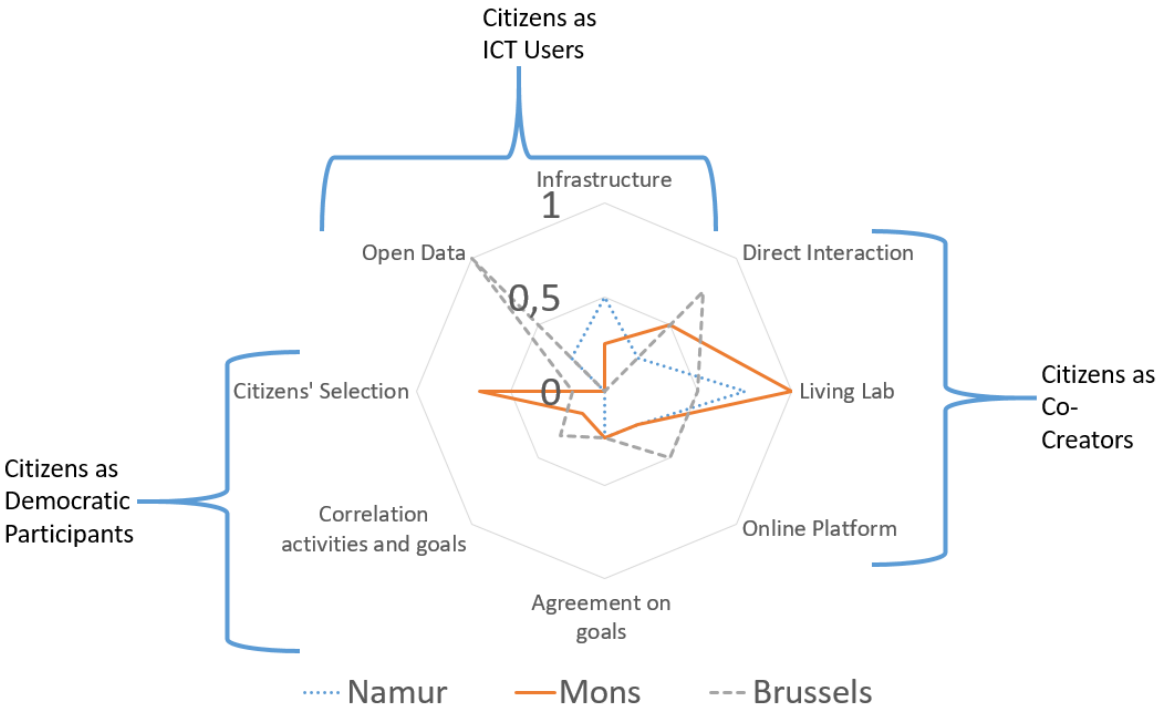


Figure 14. Participation Dashboard for Namur, Mons and Brussels using CitiVoice

The comparative analysis of different cities could also help generate new methods of citizen participation thanks to the identification of different best practices within one specific category. In this section, we will not reflect extensively on that potential use, since that 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 the collection of 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 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 “Citizens as Co-Creators” and the impact of “Citizens as Democratic Participants”. Currently, citizens are generating ideas that do not always have a concrete impact on the city’s strategy.

5.3.4 Discussion

During the design of the CitiVoice Framework, we reduced the potential threats to validity and reliability of the framework. As regards the validity, we ensured the content validity of the framework by extracting the framework categorization from 3 different sources: an exhaustive study of the literature, an analysis of secondary sources, and in-depth interviews with relevant stakeholders of Belgian Smart Cities. As

such, the three main categories of CitiVoice (described in Section 5.2) provide a holistic view of citizen participation. In addition, the structure of the framework is flexible enough to be extended with new criteria and dimensions, given that the smart city domain is innovative and still developing. Note that citizen participation strategies can be implemented in several ways from different perspectives. CitiVoice's categories are complementary in order to reflects this diversity of choices and the different participatory opportunities that a city can invest in. Furthermore, the three categories of CitiVoice should be considered as independent of each other, as one city could invest in one category and without influencing the two others. Of course, certain correlations could be identified, but this will be discussed in the theoretical implications. This strategic look at citizen participation investments opportunities (or "Dashboard" view) represents a theoretical novelty on the part of CitiVoice, and will be further discussed in this Section. In order to ensure the construct validity of the framework, we ensured that each criterion does in fact measure one of the three participation categories. Therefore, we relied heavily on previous studies to formulate criteria that measure the category.

As regards the reliability of the framework, we ensured that CitiVoice measures citizen participation consistently and precisely, using the different validation steps of the design cycle. We applied the framework to 5 different cities with high heterogeneity in their smart city strategy maturity (see Table 4) and we reached saturation in the final step, i.e. through application to Brussels and Mons. Furthermore, the interviews were conducted with stakeholders from different backgrounds and thus different perspectives on citizen participation (see Table 3). Finally, we limited subjective perception of data by validating with the stakeholders themselves the evaluation of their city.

Having discussed the validity and reliability of CitiVoice, we will now reflect on its theoretical and practical implications.

5.3.4.1. Theoretical Implications and Further Research

The first theoretical implication lies in the theory-building of metrics to evaluate participation. Indeed, the application of the CitiVoice Framework to smart cities uses a very simple evaluation metric, uniform for all criteria. This application enables the evaluation and comparison of several smart cities. Although this simplicity facilitates the use of CitiVoice, it may be necessary to have individual and more precise metrics for each criterion, in order to provide a more specific evaluation that would limit threats to validity. This involves the further elaboration of theories on citizen participation, as no ready-made set of metrics is available today. The metrics could, furthermore, be scaffolded according to a maturity model for evaluating each criterion. For example, the evaluation of the "Implementation of Open Data Strategy" or the "Use of Open Data by Citizens" criterion could build on the work performed by (Lee and Kwak, 2012). Furthermore, extensions of CitiVoice are possible. For instance, mechanisms to automate the measurement of the suggested criteria of CitiVoice will require further theory-building. Some citizen data, e.g. the number of projects submitted to online platforms, could be gathered automatically in the process to complete information about some criteria (e.g. "*Use of platform by citizens and impact on public life*"). As Smart Cities introduce more and more new technological devices in cities, this automatic evaluation constitutes a promising lead for further research.

The second implication of the framework resides in making the term citizen participation for smart cities more explicit and tangible. Indeed, we were able to identify and validate three main participation categories. The theoretical novelty of this identification is that we consider citizen participation as a policy area in which investments can be made in different directions. The "dashboard" way to look at citizen participation (especially demonstrated in the comparative use of CitiVoice) differs from "sequential" ways of looking at citizen participation. In a sequential process of participation, the first step would be to install an ideal setting for participation, then to consult citizens for ideas and finally to take their ideas into account during decision-making. In that way, we differ from the sequential process of participation often depicted in the literature by looking at the phenomenon as a Dashboard with different

investments to be made. Some cities would prefer to invest in co-creation projects, whereas other would prefer ICT infrastructure projects. The possible correlations between the participation categories would constitute a very interesting avenue for further research. The analysis of the three Belgian cities reveals that democratic participation seem to be under-investigated. This finding should also be validated and further explored in future research. However, this theoretical novelty also introduces an inherent limitation, as CitiVoice does not capture the pre-conditions of participation. However, this first step is important as well for the participation of citizens to be effective: the citizens must be informed and have the capacity to participate, the administration must be ready to integrate the new stakeholder and the citizens must be motivated to participate. Each of these pre-conditions might require further research, as it will probably influence the participation activities that the city will implement.

Finally, CitiVoice also makes a theoretical contribution to finding gaps in the literature, e.g. by discovering that some criteria are under-investigated in current research. Given that there are numerous smart cities and this field is continuously and rapidly evolving, future research is needed determine if there are other perspectives from different research areas or other smart cities that are relevant to refining and improving each category.

5.3.4.2. Practical Implications

CitiVoice also has practical implications, as it allows stakeholders to make better decisions about participation. As evident from the diversity of profiles of the interviewees, citizen participation is in fact not only about citizens but also impacts a multi-stakeholder ecosystem that includes:

- Public Servants: The integration of citizens' input is a challenge for public servants, who need as a result to rethink their internal processes. Administrations tend to have a hierarchical functioning which can be incompatible with the networking approach of working with citizens. It is not surprising, therefore, to see participatory projects fail if the internal functioning of the cities is not ready to integrate this additional layer of complexity.
- Political Representatives: Political representatives show two contradictory attitudes to citizen participation in smart cities. On the one hand, they sometimes push the administration to engage in smart city projects because of their visibility. On the other hand, sometimes they are not fully committed to taking 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 of the usefulness of citizens' comments.
- Software Developers: A strong tendency in Belgian smart cities is to assign responsibility for implementing the smart city strategy to the Software Developers of the administration. This constitutes both an opportunity and a threat. It is an opportunity in so far as it allows a re-use of the best practices from e-government strategies and ensures that the two areas are not disconnected. The threat consists in falling back on the technology-oriented conception of smart cities.

With CitiVoice, we also point out some practical implications for all the aforementioned stakeholders. After the interviews conducted for this study, stakeholders from two cities (Brussels and Namur) underlined the usefulness of the framework for guiding them in their strategy (for Brussels, for a participatory budgeting project and for Namur, for a Living Lab project). 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, etc.) and to truly implement activities that will have an impact on decision-making in order to avoid manipulation and go beyond simple consultation. As far as Co-Creation goes, CitiVoice provides an inventory of co-creation methods to guide the interested stakeholder. This inventory enables stakeholders to develop a multi-channel strategy to reach the whole population. Finally, for ICT use, the

framework enables stakeholders to invest in or redirect ICT infrastructure investments to really think about the potential value they have for citizens.

The three uses of the framework also have practical implications in line with the three applications of CitiVoice described in Section 5.3. When used as an evaluation tool, stakeholders can use the framework as a 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 of 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. Using CitiVoice as a governance tool ex ante makes it possible to guide stakeholders in 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). Finally, the comparison of several Belgian smart cities with CitiVoice led to the formulation of consolidated guidelines for the formulation of the smart city strategy of Namur Especially as regards the automation of data collection, a dashboard summarizing this comparison (depicted in Figure 14) will allow stakeholders to take empirically-grounded decisions with this information.

5.3.5 Contribution

To answer the research question *"How can a city enable the participation of its citizens so as to become a smart city",* CitiVoice contributes on several levels. First, a critical state-of-the-art evaluation was performed in order to describe enablers of citizen participation in the smart city. New means of participation were also examined through the study of other areas of research. Three main means of participation were identified: citizens as democratic participants, citizens as co-creators and citizens as ICT users. This state-of-the-art evaluation serves as a solid theoretical basis to stimulate research into new means for participation. Secondly, a framework to structure and evaluate citizen participation in smart cities was designed based on the aforementioned state-of-the-art: the CitiVoice Framework. This framework can be helpful in different ways. For instance, CitiVoice was applied as an evaluation tool to the case of three Belgian smart cities: Namur, Mons and Brussels. Furthermore, structuring the participation in Namur yielded some governance recommendations to make "Smart Namur" more citizen-oriented, and also provided some general recommendations for smart cities. Another interesting result of the exercise was the comparison of several smart cities based on the main categories of the framework. Thanks to the guidance of the framework, a structured comparative tool was suggested with which to compare best practices among different smart cities. Finally, we expect CitiVoice to have relevant implications for research, given that it provides a structuring tool to analyze citizen participation in smart cities. Both the findings of the literature review and CitiVoice itself are expected to help future interested researchers to tackle other aspects of citizen participation in smart cities. We also expect CitiVoice to have implications for practice, as the framework constitutes an interesting evaluation, governance, and creativity tool that could influence ongoing and future smart city strategies, as is currently the case in Namur.

5.4. Towards a Holistic Evaluation

In this section, we present a further expansion of the CitiVoice Framework, fueled by additional literature sources. This expansion was performed in the context of a master's thesis with which we closely collaborated (Meers and Storme, 2019). The initial idea was to expand CitiVoice with Arnstein's Ladder (1969) and other Arnstein-based frameworks. This entails adding a ladder structure like that of Arnstein's ladder to CitiVoice. This improvement is expected to reduce one key limitation of CitiVoice: the lack of complexity in some of the dimensions and the use of the 0/0.5/1 scale to evaluate smart cities.

In this expansion, scales sourced from the literature were added to CitiVoice. For each level of the framework, an appropriate scale was researched on which to score smart city initiatives. This search has been performed in an exploratory manner on Limo, Google Scholar and Scopus. Although we do not claim that the scales presented in this section are the best fit for an expansion of CitiVoice, they do nevertheless constitute a solid basis for other researchers to build upon.

For each level (for example 'Living Lab'), the search keywords were the level itself, together with other (variable) keywords that would search for a scale or range, such as "ladder", "maturity", "topology", "types", "design" and "range". Sometimes keywords such as "citizen" and "participation" were used to search specifically for frameworks that focus on citizens. All the papers we found in this way were examined as to their use of a classification and whether they focused on citizen participation. If multiple candidate papers were found, the choice for the framework eventually used was made based on the ease of creating a range from it. More information on the search and the decision to use a particular approach can be found in each range/scale.

In Figure 15 below, we suggest a tentative holistic framework based on CitiVoice. The following sub-sections will give more details about each row of the framework. We tried to be as faithful as the selected references for the rows of the framework to show the scientific underpinning possible to extend CitiVoice. However, in future research, modifications and discussions about the rows can be possible as the ranking of the elements within the rows only reflect the research from the selected papers.

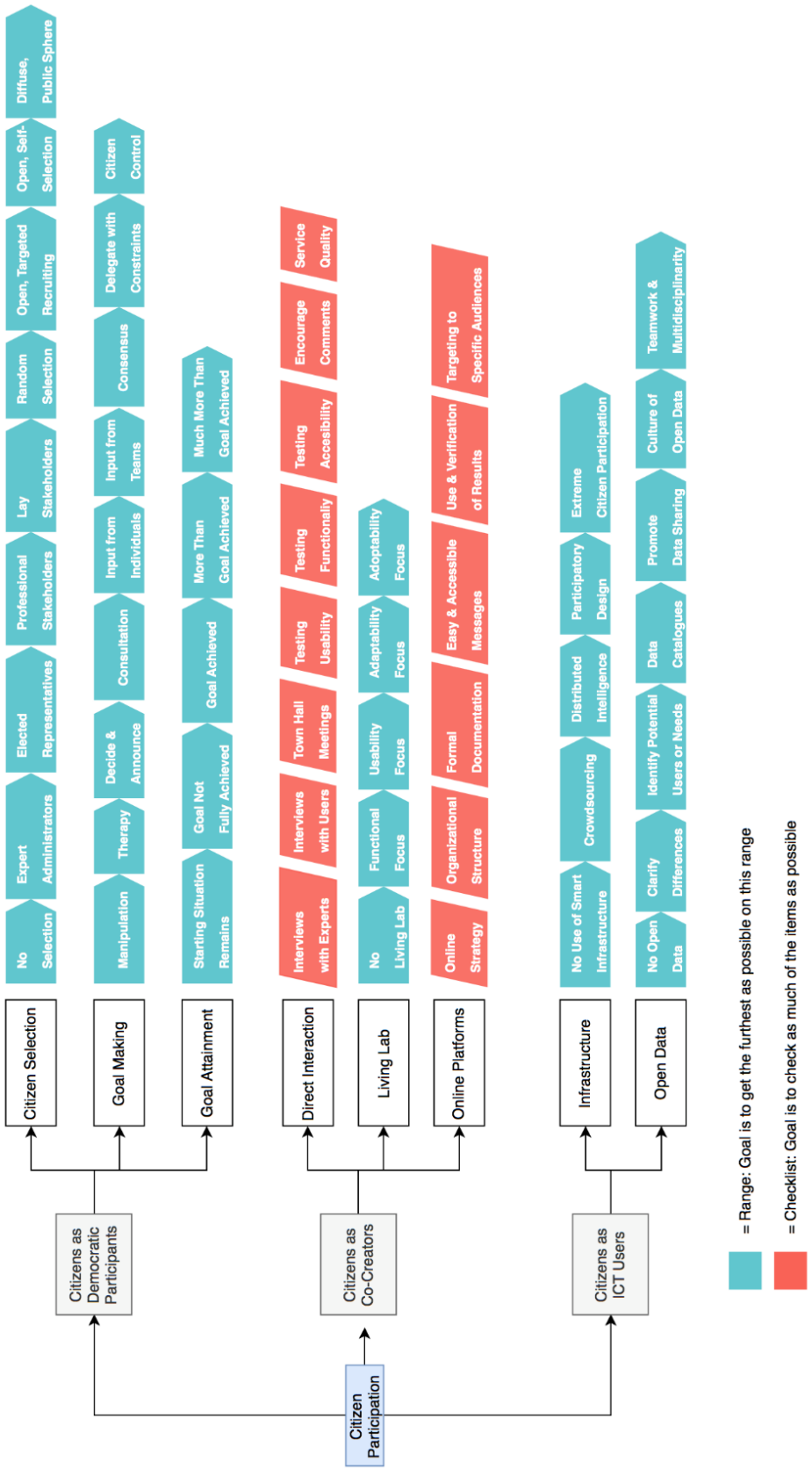


Figure 15. Extension of CitiVoice using Ladder Structure

5.4.1 Citizen Selection

For the Citizen Selection range in CitiVoice, the “Democracy Cube” of Fung (2006) is very useful for distinguishing between different types of citizen selection. This range is shown in Figure 16. These types are classified from exclusive in terms of numbers of stakeholders involved at one end to inclusive at the other end. In this way, eight different types of citizen selection can be categorized. This specific framework was chosen because of its clear simplicity and the fact that it is already presented in the format of some kind of range/scale.

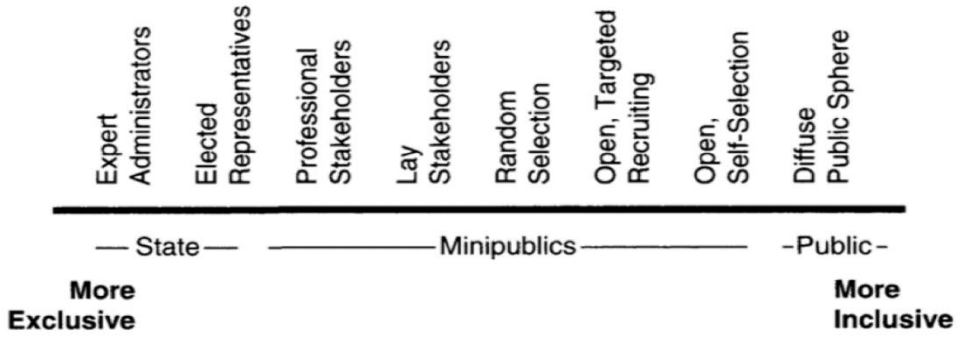


Figure 16. Democracy Cube (Fung, 2006)

The “Lay Stakeholders” rung refers to “unpaid citizens who have a deep interest in some public concern and thus are willing to invest substantial time and energy to represent and serve those who have similar interests or perspectives but choose not to participate.” (Fung, 2006, p. 68). The other categorizations are obvious in definition. Between the two extremes of “State” and ”Public”, ”Minipublics” are defined. These are discrete groups of people who discuss public issues amongst each other. All together, we believe these eight categories are able to capture the broad possibilities within citizen selection, or as Fung calls it, “participant selection”. However, we chose to add an additional possibility at the beginning of our range for “No Selection”. It is indeed possible that no initiatives are taken for selecting citizens in a specific city. This results in the following range, with nine different steps:

5.4.2 Participative Goal-Making

Straus (2002) developed a framework in order to show the different levels of participation in the decision-making process. This model, shown in Figure 15, can also easily be used in order to determine the level of involvement in goal making, which is in essence a kind of decision-making. No positive or negative connotation is assigned with each level of the framework as delegation might be more appropriate in some cases and consultation in others. Each step further to the upper right corner of this framework requires more involvement from the participants and gives them a greater feeling of ownership over this specific decision. This framework was chosen over others because it could easily be mapped to Arnstein’s principles, which will be shown below.

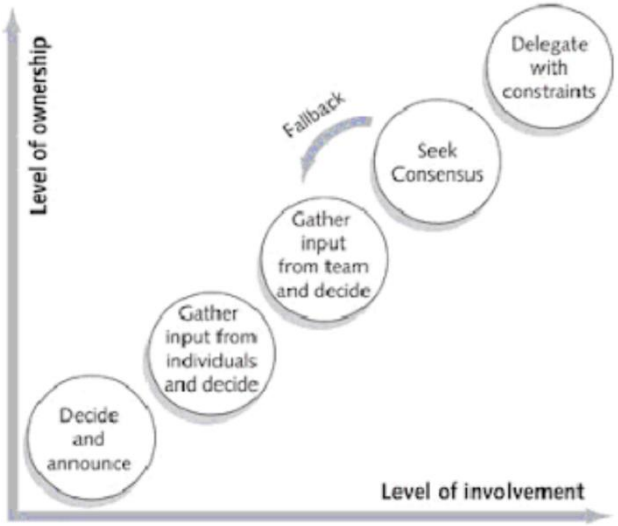


Figure 15. Levels of Involvement in the Decision-Making Process (Straus, 2002)

Of course, full participation is not needed for every minor decision. A simple “Decide and announce” from the facilitative leaders is sufficient in some cases. Straus’ model is very easily mappable to Arnstein’s (1969) concepts. The ”Decide and announce” step corresponds to “Informing” on Arnstein’s ladder. In this rung there is as good as no input from the participants, it is a purely one-way communication. The following rung on Arnstein’s ladder, “Consultation” is missing from Straus’ framework. In this step, some input from the participants is gathered, but this is often done more in light of ”window dressing” than really with the goal of actually using the participants’ input. The next step in Straus’ framework involves contacting stakeholders individually to gather information. Based on this process, a decision is made. In Straus’ following step, the difference is that input is gathered from different teams, not from individuals. These two steps together account for the “Placation” rung in Arnstein’s ladder. Straus’ fourth step, consensus, means that every stakeholder had an opportunity to give their opinion and an agreement is reached in which all support the decision made. Arnstein calls the consensus level “Partnership”: there is a real negotiation between leadership and citizens. In the last step of Straus’ framework, full decision-making power is delegated to the stakeholders, as long as the ultimate decision they make complies with the constraints set by the leadership. Arnstein calls this step ”Delegated Power” and this is the second highest rung on the ladder, where the citizens or participants have the dominant decision-making power.

As becomes clear in the explanation, Arnstein’s “Non-Participation” dimension is missing from this range, as is the highest rung in the ladder: citizen-control. We believe that this highest rung, which requires citizens to be in full charge of all managerial aspects, is a rather idealistic point to achieve in reality. However, we chose to add it to the range nonetheless, because this was a very important goal according to Arnstein. Furthermore, we added “Manipulation” and “Therapy” at the beginning of the range. These are the two items in Arnstein’s Non-Participation dimension which have a rather negative connotation. They feign some form of citizen participation, with the sole purpose of showing that some initiatives are being undertaken, but genuine citizen participation is never the real goal. This results in the full range below:

5.4.3 Goal Attainment

Originally, Kiresuk & Sherman (1968) developed their Goal Attainment Scaling as a general method for evaluating comprehensive community mental health programs. However, the simplicity and clearness

of their method makes it possible to use the scaling for many other applications, as is the case in our framework. Their scaling is shown in Figure 18.

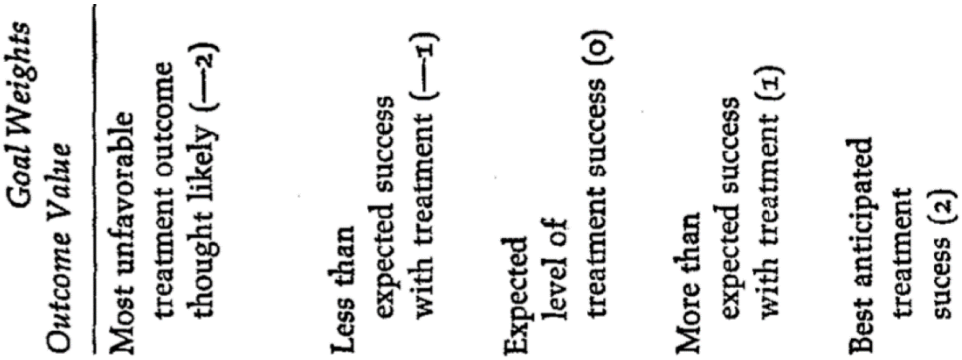
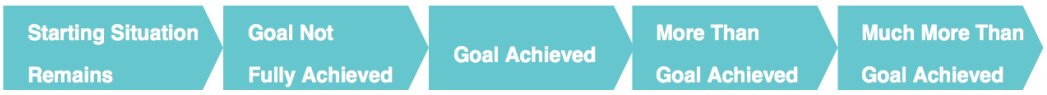


Figure 18. Goal Attainment Scaling (Kiresuk & Sherman, 1968)

The goal is predefined and, depending on the actual outcome, there are five possibilities, as shown in the figure above. The predefined goals are one of the possible steps in the previous range about “Goal Making”. When the predefined goal is achieved, a score of 0 is given. If the actual result was worse than the predefined goal, a score of -1 means that the outcome is slightly worse than the goal, but better than the starting situation. A score of -2 means that the actual result equals the starting situation and finally, a score of -3 means that there is some kind of deterioration and the final result is worse than the starting situation. Of course, the outcome might also be better than expected: a score of +1 means that more than the desired outcome, i.e. the goal, was achieved. A score of +2 means that a lot more than the predefined goal was achieved.

This results in the following range:



5.4.4 Direct Interaction

In Simonofski’s Evaluation Framework (2017), two criteria are listed in order to evaluate the “Direct Interaction” dimension. First, a sufficient number of general techniques in order to gather citizen input must be in place (Johannessen, 2010). Secondly, different types of requirement engineering are possible. Of course, a requirements engineering method in which citizens are involved is preferred. According to van Velsen, van der Geest, ter Hedde, & Derks (2009), such a citizen-oriented requirements gathering method is best achieved by interviewing the citizens, which is one of the general techniques. All these approaches are listed below.

- Interviews with experts
- Interviews with users
- Town hall meetings
- Testing usability
- Testing functionality
- Testing accessibility
- Encouraging real-time comments and suggestions
- Developing and adhering to measures and standards of service quality

We chose to rely on the approaches mentioned in CitiVoice, in order to put a limit on a large number of direct interaction methods. The more of the techniques listed above that are used in order to gather citizen input, the better. In this way, it is possible to organize the list of general techniques into a checklist. There is no real hierarchy possible within these general techniques, so the sole goal is to implement as much of them as possible. The following figure is used in the framework, the different shape and color should make it clear that this is not a range or a scale, but a checklist:

5.4.5 Living Lab

In order to assess a city's use of living lab, we will use a range based on a framework by Pallot et al. (2010). This framework was chosen because of its simplicity and link to citizen participation. Pallot et al. (2010) were the only ones to create a classification that can be used for living lab initiatives and that also includes the manner in which citizens are involved. In addition, the framework does not place a value judgement on the characteristics of a living lab initiative and acknowledges that different projects have different needs. This is in line with the identified criticisms of Arnstein's Ladder.

This framework classifies living lab initiatives according to four dimensions, as shown in Figure 19:

- Interaction mode: human-computer or interpersonal
- Research type: observation-based or participative
- Evaluation focus: this is a range over four types of goals
- Collaboration style: structured/symbiotic or unstructured/mass

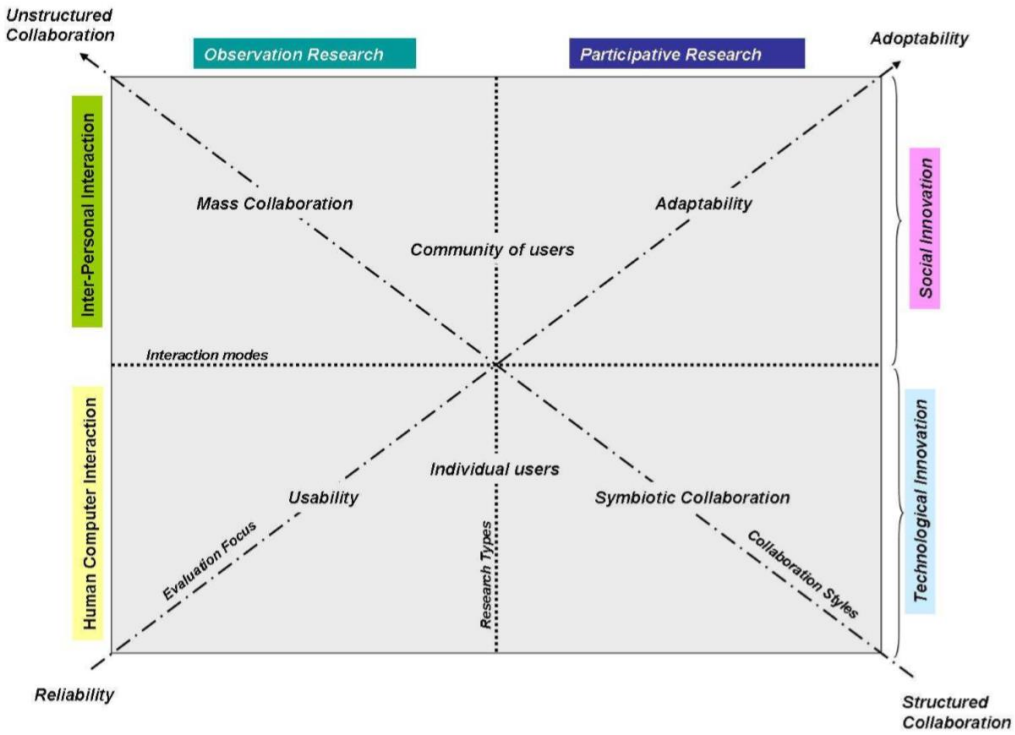
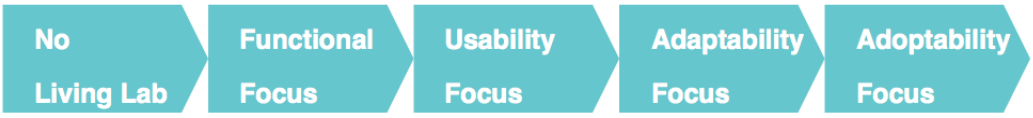


Figure 19. Living Lab Research Map (Pallot et al., 2010)

Out of these four dimensions, we are particularly interested in the "evaluation focus" of a living lab. The focus determines the extent to which input from citizens is used in the development and is therefore fit to assess citizen participation. In addition, the research type and interaction mode also determine the

extent of citizen participation. However, it can be argued (and can also be deduced from the visual representation of the framework) that the range of the evaluation focus covers the different levels in research type and interaction mode.

The evaluation focus starts with a functional test, which simply tests the workings of a living lab. Next, a usability analysis has a slightly higher participation rate, since it tests for the user friendliness and ergonomic design. This is followed by adaptability, which represents the degree of user friendliness where the living lab can recompose its infrastructure according to the users' needs. Finally, the highest level of participation is achieved when the focus is placed on adoptability, meaning users can create new features themselves within the lab. To these four levels we add the possibility of no living lab implemented, which results in the following range:



5.4.6 Online Platform

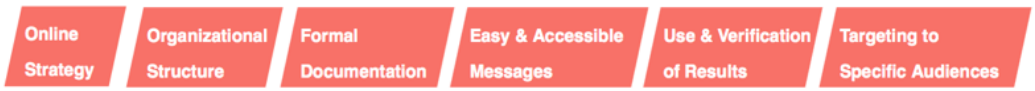
To create a range for the implementation of online platforms, we identified two papers that cover citizen participation in online platforms. One of these papers created a framework that classifies public policies into four quadrants. Their classification was determined based on "information needed for effective participation' and 'the nature of the participants (inexperienced or sophisticated)" (Farina et al., 2014). Depending on this classification, this framework gives some guidelines on information restructuring, participation mechanisms, registration and intensity of moderation necessary to facilitate the participation of each group on an online platform. Even though this is an interesting approach to citizen participation, the complexity created by the different situations asking for different principles was impossible to capture by a simple, linear range (Farina et al., 2014).

The second paper we found by Sandoval-Almazán et al. (2017) lists 17 principles to foster citizen engagement on social media. An online platform can be created on social media, but also using of a centralized platform. However, several of these principles on social media can be transferred to the context of a centralized platform. These principles are rather simple but cover a broad range in the use of an online platform. That is why we have chosen these principles to create the range used to assess citizen participation in an online platform.

A city's use of an online platform can then be scored on how many of these principles it adheres to. To create a range, we summarize the six principles that are valid for both social media and centralized platforms.

- A clear definition of the online strategy
- A formal organizational structure of roles and tasks on the online platforms.
- Formal documentation of all online activities, responsibilities, policy and guidelines
- Easy and accessible messages
- Use and verification of results
- Targeting to specific audiences

The more of these principles implemented for online platforms, the better. Just as we did for direct interaction, we organize these principles as a checklist. Again, no real hierarchy can be found in these principles, and so a city should aim to implement as many principles as possible.



5.4.7 Infrastructure

In CitiVoice, infrastructure (defined as the technologal devices used in the city to foster participation) can be split into two criteria: Innovative ICT-based projects and Presence of ubiquitous computing components. One framework, by Haklay (2013), addressing these crtieria was found that introduced a classification of the degree to which citizens were involved in citizen science projects. Since this classification was very interesting and easy to apply, it could easily be generalized to citizen participation thanks to the ICT infrastructure of the city in general. This classification is shown in Figure 20.

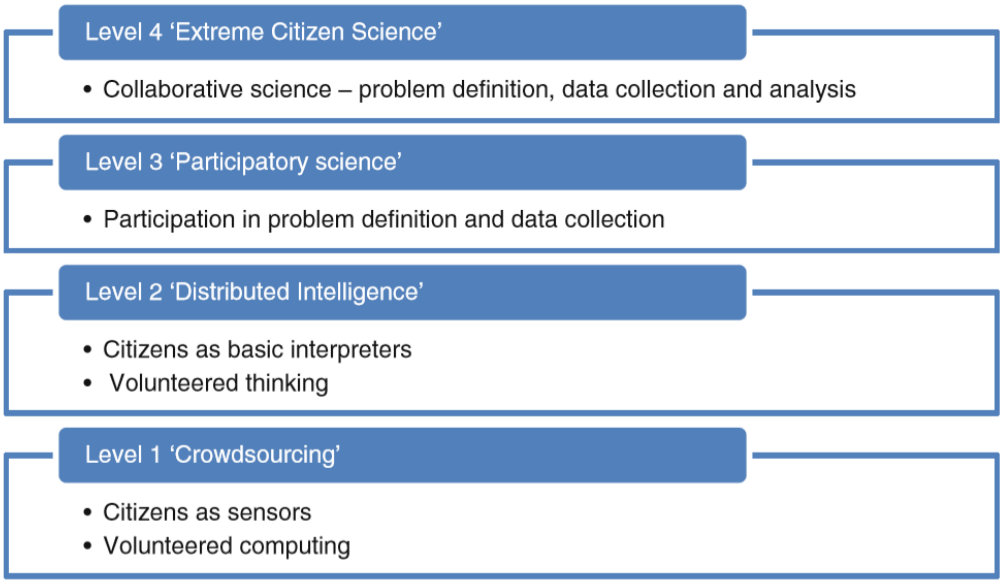


Figure 20. Levels of Participation (Haklay, 2013)

The framework defines different levels similar to Arnstein's Ladder. These range from citizens as simple sensors to citizens as collaborators on a project. Contrary to Arnstein, Haklay clearly states that a certain level in this framework contains no value judgement. However, he does acknowledge the benefits of trying to move the highest level.

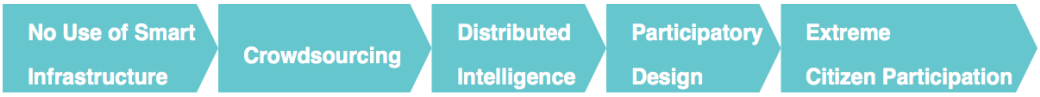
In the first level, the participants are included in a passive way. At this level, a complete understanding of the project is unnecessary. Haklay argues that many citizens would like to be included in the project without having to fully understand the science behind it, making this level not necessarily inferior to higher levels. The next level makes use of the cognitive ability of the participants. Participants will receive some basic training after which they will collect data or provide some interpretation. The training can then be used as an indication of the quality of the participants' work. Further up the scale, participants can set the problem definition and determine the data collection method themselves (with possible help from experts). However, the assistance of experts is still required for analyzing and interpreting the results. Finally, we find collaborative science at the top of the framework. At this level, a full integration of professional and non-professional scientists is achieved in order to decide on the problems, the data collection and interpretation. Citizens can choose their own level of participation, from start to finish.

Moreover, this level opens up the possibility for citizens to carry out the entire project by themselves, without the involvement of any scientists.

This framework can be slightly adapted to assess a city's initiatives in infrastructure. A range can be created:

- Level 0: No use of smart infrastructure
- Level 1: Crowdsourcing
- Level 2: Distributed intelligence
- Level 3: Participatory design
- Level 4: Extreme citizen participation

The possibility of not using any smart infrastructure is added to the bottom of the range. The other four levels correspond to the levels in the original framework.



5.4.8 Open Data

To score open data initiatives, we searched for a framework that also highlights the importance of citizen participation. Only one such framework could be identified. This framework looks into six principles on how to create an open data platform and stimulate its use (Sandoval-Almazán et al., 2017b). These principles are grouped into a cyclical process that is represented in Figure 16.

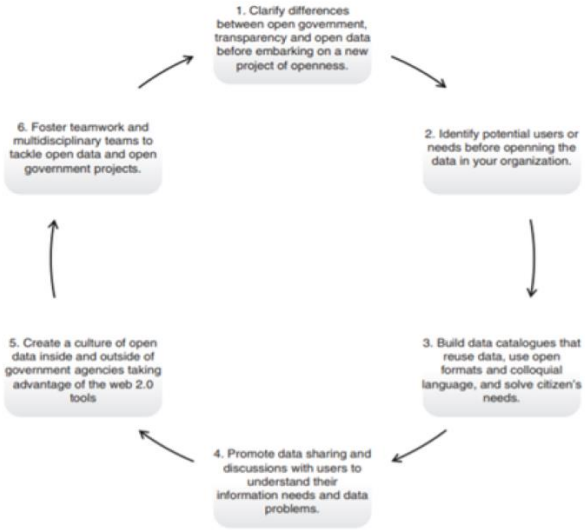


Figure 16. Open Government Ecosystem Model (Sandoval-Almazán et al., 2017b)

The cycle starts out by clearly defining open government, transparency and open data. Given their subjective meaning, their definitions have to be clarified before embarking on a new project. The second principle stresses the importance of identifying the potential users and needs before openng up data. This identification can be used to support the prioritization of data to be released. Without careful planning, the process will be very time-consuming and costly without being effective, leading to open data that lacks value and relevance. Thirdly, a well-built data catalogue is the stepping stone for open government. Therefore, a format should be used that maximizes reusability and colloquial language. An open format allows for easier access and more dynamic interaction. In addition, government data is typically full of technical terms that are not clear to the citizens. To provide greater understanding,

accessible translation and description of these terms should be provided. The fourth principle points out that open government is only a reality when it becomes a public good that creates public value. This only happens when the public uses the data for non-governmental purposes. The fourth principle is added to foster this public use. Easy access to the data provided is essential. However, if the end-users are not aware of the data system or how to use it, the system will have only a limited impact. This is why the fifth principle points to creating a culture of open data, open government and transparency. This culture will be able to introduce the concept of open government, data and access to the public which will improve the public's usage of the data. Finally, an open government needs well-functioning teams to implement the technologies as well as the policies, programs, etc. The sixth principle states that this teamwork and multidisciplinary teams should be fostered.

Given the iterative nature of this process, an organization or city does not have to be at a certain step, but this framework may help to identify where they are and what they should do next. In scoring a city's open data initiatives, we will examine how many of these principles have been implemented and how far along in the cycle. In this range, we have summarized the principles in a few words to provide for a clearer presentation. In addition, we have added to the bottom of the range the possibility that a city has no open data initiative.

5.5. Relevance of Context Factors

As we have established by now, too often, smart cities have not reached their objectives because they assumed what citizens' needs were and pushed technological solutions without taking into account the specificities of their territory and the people living in it (Dameri, 2014). Numerous participation methods have been put forward to enable the participation of citizens in smart city design. These methods have been referenced in the CitiVoice Framework (Simonofski et al., 2017a) and their evaluation has been extensively discussed in the previous section. This inventory of methods is an essential first step towards participation but does not suffice, as cities each have specificities that need to be taken into account to design a citizen participation strategy that is truly tailored to the context factors of the city such as values, organization, size, country specificities, etc. By context factors, we mean elements from the environment that might influence the decisions of stakeholders about a specific project. For instance, a city like New York does not have the same challenges and resources as smaller rural cities. Taking into account context factors is essential in order to provide policy-makers with appropriate recommendations that help them in their effort to integrate the input of citizens when developing smart cities. These factors, in this thesis, have been elicited with the policy-makers directly so that they are in line with their practical challenges.

The goal of this section is thus to identify the context factors that impact citizen participation strategies in two smart cities from different countries in Europe. In order to reach that goal, we performed a qualitative case study of two European smart cities, Linköping (Sweden) and Namur (Belgium), similar enough to be comparable but with enough differences to draw relevant conclusions on context factors. The contribution of this study is thus twofold: (1) analyze the citizen participation strategies in two European cities and (2) derive context factors that impact these strategies. By understanding the context factors and their impact on citizen participation, we aim at formulating better context-specific recommendations to policy-makers about citizen participation in smart cities. These recommendations are then applied to the case of Brussels (Belgium).

The remainder of this section is structured as follows. In the Research Motivation section, we further explain the importance of citizen participation in smart cities and detail the research gaps that this study aims to address. In the Research Method section, we explain how we analyze both cities by means of the qualitative study. In the Results section, we first present the citizen participation strategies of both cities and then detail the inferred context factors. In the Discussion section, we reflect on the importance of the identified context factors and formulate recommendations for practitioners that aim to be city-specific. This section also details the inherent limitations of the research. In the Contributions section, we summarize the contributions of this study and their implications for research and practice.

5.5.1 Research Motivation

Context factors are essential elements to examine for every aspect of a smart city strategy. Cities differ in terms of size, characteristics of the population, degree of rurality, etc. Therefore, one smart city strategy may not be replicable as-is to another city as a lot of context factors have to be taken into account. In a very influential paper, Gil-Garcia, Zhang, & Puron-Cid (2016) stated that there are "*several ways to be smart, and several interesting combinations that could be applicable for each context and situation and create different results*" and underline the need to perform more research in that direction. Meijer, Gil-Garcia, & Bolívar (2016) also stress the importance of contextualization for smart city governance but mention that the analysis of such factors is still rare. Indeed, there is a lack of comparison of strategies and practices in this regard. Only a few studies compared smart cities so as to draw conclusions from different contexts (Odendaal, 2003; Dameri, 2014; Berntzen and Johannessen, 2016).

The understanding of these factors will impact the technological choices of the city, the way they communicate to their citizens, the size of the projects but also the citizen participation strategy. In this study, we have chosen to focus on participation as it is essential to successfully develop smart cities. Two studies tackle the importance of specific context factors for citizen participation in smart cities: Cardullo & Kitchin (2019) examine citizen participation in Dublin, focusing on the impact of the neo-liberal view of the city on the implemented actions, while Foth (2018) examines the evolution of urban informatics depending on the maturity of the relationship between the city and the citizenry. This importance of contextualization for participation is further underpinned within the IS field. Participation is also considered as a success factor for IS development (Hartwick and Barki, 1994) but research has also shown that this participation could lead to negative effects if the context of interest is not properly considered (Heeks, 1999; Holgersson et al., 2018). However, none of the above-mentioned studies attempts to formalize the context factors that impact participation.

5.5.2 Research Method

Due to the limited number of previous studies into context factors that impact citizen participation in smart cities, we have chosen to conduct a qualitative study of two cases because this allows for an exploratory study (Benbasat et al., 1987). We chose not to present hypotheses about context factors in order to be truly exploratory and to refine the context factors iteratively during the data collection process. Instead, we used an abductive approach.

In this study, two case studies were analyzed: Namur (Belgium) and Linköping (Sweden). Namur is a city with 110 939 inhabitants where the service industry is dominant (presence of a university, commercial activities, etc.). In March 2013, city representatives declared their willingness to engage in a smart city strategy and have carried out several actions since. Linköping has a population of 160 407 (as of Q3 2018). The city focuses on ICT and knowledge development (with a university and several large IT- and technology-focused businesses), manufacturing and a growing service sector. Linköping recently created a central job position for digital transformation and smart city development in order to coordinate and push projects forward. These cities were deemed to be suitable cases, as they are comparable in terms of size, stakeholders involved, location (European nations), technological development and type of participation methods implemented, while still different enough to allow us to spot context differences between cities that might otherwise have been overlooked.

Between November 2018 and January 2019, two researchers collected empirical data through a combination of six in-depth interviews with key stakeholders (cf. Table 6) and relevant official documents, agendas and internal documents provided to us by interviewees. We were also able to draw knowledge from interviews conducted in both cities in previous research projects. The complementary data sources allowed for triangulation and corroboration of the data extracted in the interviews from other sources. The interviews were semi-structured (Drever, 1995) and we based the questions on the three participation categories from CitiVoice. The complete interview guide can be found in Appendix 9.1. These stakeholders were selected from different functions to have different perspectives on the smart city. The interviews were limited to three for each city as the interviewees stated that these were the three main functions involved in the smart city strategy at the city level. We also kept the functions of the interviewees comparable for each case: one person in charge of the overall strategy, one person in charge of urban issues and one person in charge of data valorization. At the end of each interview, we asked for suggestions of additional potential interviewees, limiting the selection to these three functions.

The abductive research process was implemented as follows. First, as we wanted to ensure that questions were asked about relevant citizen participation activities, we used the CitiVoice Framework (Simonofski et al., 2017) as a starting point for this line of questioning, which had been previously validated on numerous smart cities (Simonofski, Serral, De Smedt, & Snoeck, 2018). To the best of our knowledge, CitiVoice is currently the most exhaustive list of concrete participation activities spanning all

three categories in a smart city context. Second, we purposely left questions regarding context factors open-ended in the initial stage. Thanks to an intensive use of probing ("Why did you choose to perform this action?", "Which factors influenced your choice?", etc.), we were able to infer a first identification of the context factors relating to their citizen participation strategies. Third, using an abductive approach, in the following interviews we iteratively adapted the interview guide based on the need to complete the information about the citizen participation activities, as well as to expand our understanding of context factors. This iterative identification of citizen participation activities and context factors embedded in previous theoretical frameworks and data collection respectively allowed us to implement the abductive reasoning for this study.

Table 6. Interviews performed in Namur and Linköping to identify Context Factors

N°	City	Function	Relevancy
1	Namur	Smart City Manager	Coordination of smart city strategy and responsible for participation platform
2	Namur	Living Lab Manager	Responsible for participation of citizens in Urban Planning.
3	Namur	Data Office Manager	Responsible for the Data Management of the City and for the Open Data platform
4	Linköping	Digital Transformation Manager	Responsible for coordination of digital transformation projects in the city
5	Linköping	Comprehensive planner	Works in comprehensive planning at the city's planning and development office
6	Linköping	Communicator	Works on communication of participation activities to citizens

In order to analyze the results concerning citizen participation, we mapped the insights discussed in the interviews to the CitiVoice comparison framework (see Appendix 9.2 for more details). This study is a prerequisite for the context factor analysis. In order to extract the relevant context factors, the interviews were analyzed with process and initial coding (Saldaña, 2014). We started the analysis by summarizing the interviews and recording them in memo documents. Next, we skimmed the interview to grasp its overall content and highlighted the important sentences based on the goal of this study. The codes were then inserted into a table to summarize the different context factors mentioned by the interviewees. After each interview, we were able to iteratively categorize and compare the factors (see Section 4.2 for more details). The official documentation helped us to outline the context of each city as they provided a frame of reference for local policies, agendas and strategies. The documentation also served as a resource for additional information regarding topics that were discussed during interviews. However, no additional context factors were derived by using these documents. Thanks to the diversity in the profiles and backgrounds of the interviews, the analysis performed by multiple researchers and the triangulation with the official documentation, we were able to limit the subjective perception in the data.

5.5.3 Results

5.5.3.1. Comparative Analysis of Citizen Participation Strategies

In this section, we analyze the citizen participation strategies in Namur and Linköping. A comparison of the cities illustrates how a specific participation activity can be implemented differently and for different reasons with respect to the different context factors. The full information about the respective participation strategies can be found in Appendix 9.2. Figure 17 shows the links between the stakeholders in charge of the smart city strategy and the participation activities they implemented.

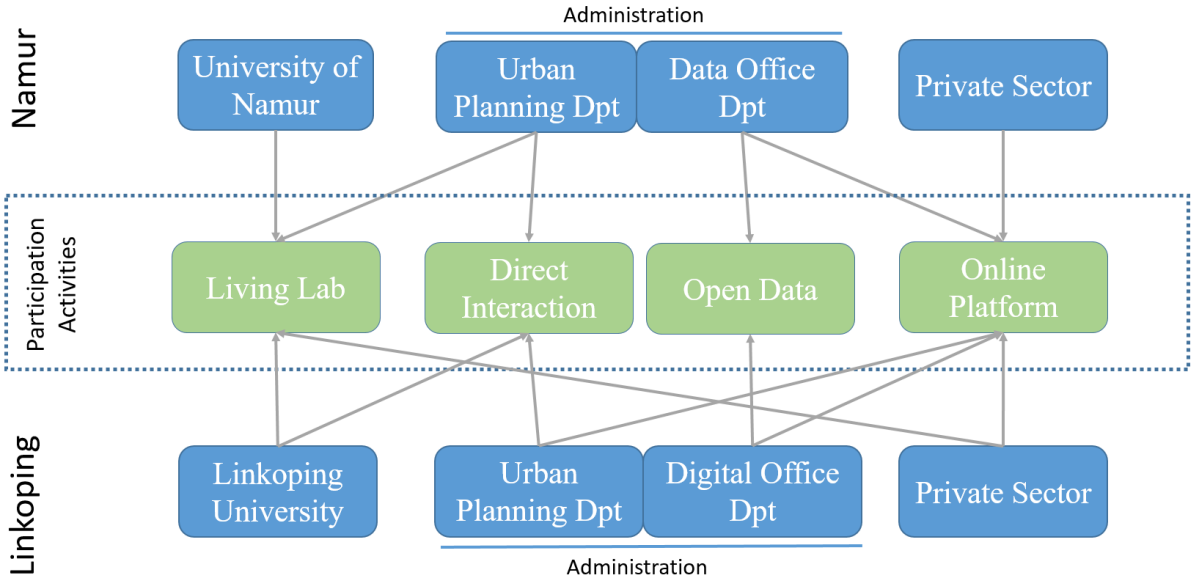


Figure 17. Stakeholders and Participation Activities in Linköping and Namur

In terms of *stakeholders involved* in Namur, the administration coordinates the participation activities with the university and the private sector as occasional support. Participation is much more difficult to represent simply in Linköping, since the actors involved perform more diverse actions autonomously. The stakeholders are in fact comparable in the two cities, but the implementation of participation activities is much more distributed in Linköping.

Furthermore, in terms of *participation areas*, the analysis of both cities with the CitiVoice Framework shows that there are investments in the "Co-creation" and "ICT use" aspects of participation, but investments in "Democratic participation" (monitoring of impact on decision-making, efforts to ensure repetitiveness of citizens, etc.) is lower. The analysis shows that both cities try to gather citizens' input (through several methods such as Living Labs, Direct Interaction techniques such as meetings or interviews, Open Data or Online Platforms), but little consideration is given to the impact of this input on the decision-making process.

Finally, in terms of *methods used*, Online Platforms are heavily used by diverse stakeholders in both cities. Furthermore, the direct interaction techniques (group discussions, town hall meetings, etc.) remain widely used methods as well. Also, Linköping enables the private sector to implement participation (e.g. through formal collaboration in the living lab), whereas Namur confines it to the public organization. Open Data portals are developed in both cities by the administration's digital/data offices.

This analysis shows that the two cities are comparable in terms of stakeholders involved and participation activities performed. This homogeneity is ideal for our study; it will allow us to understand how similar situations in terms of participation can be influenced by different context factors. The differences (in terms of location, size or technological development) will enable us to identify relevant context factors. These factors and their impact on the participation activities are detailed in the next sub-section.

5.5.3.2. Context Factor Analysis

In this section, we reflect on the context factors inferred from the coding of the interviews. At this stage, the context factors are labeled by the researchers as broad categories. These factors are as follows (see summary in Table 7):

Table 7. Context Factors Identified

Context Factor	Definition	Namur	Linköping
Smart City Consideration	The consideration of stakeholders for the smart city concept linked to participation	*Participation-Oriented*: Sustainable city with ICT as support	*Technology-Oriented:* Digitalization to facilitate sustainability and manage societal challenges
Drivers	The goals that led to the implementation of participation	*Top Down*: Political Push (city), Urban Competitiveness, Challenges	*Top-Down*: Political Push (Country) and Attractiveness, Challenges
Degree of centralization	The extent to which participation is coordinated between stakeholders	*Centralized* in the administration and coordination through human interaction	*Decentralized* with an ecosystem view and coordination through official documents
Legal Requirements and Plans	The legal constraints about obligation of participation for the city	*No constraints* and spontaneous participation	*Minimum legal constraints* on citizen participation
Citizens' Characteristics	The maturity for participation, as perceived by stakeholders, of the population	*Population considered as mature*: Educated and employed citizens	*Population considered as mature*: Educatedandemployed citizens

Smart City Consideration: In Namur, the interviewees disconnect technology in their consideration of "what is a smart city", as technology is for them only an enabler to reach "smartness". Instead, they consider a smart city as a city "*capable of reacting to change*" in a "*sustainable*" way to answer the needs of the territory. The smart city manager mentioned that the main definition used internally is "*creating an ecosystem of actors involved in a sustainable transition process by using technologies as means to support the process*". This consideration shows that Namur favored the use of non-technological participation methods (direct interaction and living labs) that will be supported in the future by technological devices such as public displays. In Linköping, the main smart city considerations are linked to digitalization and digital transformation. The idea of becoming a Smart City is quite recent, and the central job position charged with this development currently lacks a specific definition of the smart city. During our interview, the digital transformation manager said he would like to "*have benchmark objectives in order to be able to measure progress*". In the current digital agenda for Linköping (Linköping Municipality, 2016), there are implicit projects linked to the smart city but not explicit ones. The digital transformation manager stated that their view of smart city development is technologically-focused. This focus on digitalization might have encouraged the use of technological participation methods (mainly online platforms) by the administration.

Drivers: The main driver for both cities was the political push. In Namur, the political willingness came from the city council (and was influenced by the ecological party). Other factors such as marketing, urban competitiveness to get recognition and traditional societal challenges (social, environmental, participation) were also mentioned as important drivers. Some bottom-up activities came directly from the citizens in terms of neighborhood coordination but were not directly related to the smart city design. In Linköping, there has been a political push for digitalization, as there has been nation-wide in Sweden. The digital agenda for Linköping refers significantly to the national digitalization goals, but with focus areas derived from the city's requirements (such as higher levels of digitalization in education and health care). Another factor is urban competitiveness; the digital transformation manager described attracting people to university, as well as high-tech businesses in the area, as factors that makes it important to

have a high level of digitalization within the municipality. In the digital agenda, the impact of digitalization in other domains (education, health, etc.) is also presented as a motivation. In both cases, the smart city development was driven by a top-down approach but the cities still invested in participation methods to know the needs of the citizens.

Degree of centralization: In Namur, the majority of citizen participation projects are centralized at city level. At this level, the administration coordinates all actions thanks to informal human interaction. The Smart City Manager coordinates the actions across all departments internally, the Head of Data Office optimizes data and processes it internally and the Living Lab Manager focuses on urban planning. External to the administration, the ecosystem (university and businesses) is also "*active and ready to engage in change*" but the latter are considered as spontaneous partners. For instance, the university conducts research and supports the actions of the administration (e.g. to organize hackathons). Furthermore, Namur has a strong service industry and has several small and micro-businesses that can support participation (e.g. to develop an online platform). However, for the specific citizen participation activities, there are many platforms managed by citizens (community groups, social media, etc.), and the city has to set the cursor between representative and direct democracy. In Linköping, the centralization is currently low. The main coordination activities are performed through official documents such as a shared Agenda for planning and development or a Digital Agenda. This is intended to be mediated through the digitalization function (cross-functional in nature). The newly established digitalization function (consisting of three people that work cross-*functionally within the administration) has been established as a possible solution to this issue. An interviewee stated that "Initiatives have been decentralized, and now they are trying to centralize the efforts. Al other Swedish municipalities have the same issues with coordinating smart city development as well as digitalization initiatives". There have been "hackathons" in the Mjärdevi Science Park with the objective of developing new open data-based services. There is also a collaboration with municipally owned companies* and the university through "problem-oriented workshops" that has been driving the development ICT infrastructure. The stakeholders involved are thus comparable for both cities but their degree of autonomy differ. Furthermore, the coordination between participation activities is not implemented in the same manner (human interaction in the administration for Namur and official documents for Linköping).

Legal Requirements and Plans: Namur does not have legal requirements for its smart city strategy. However, most of the projects are funded by the European Union (such as the Living Lab) and they thus must comply with some requirements. In terms of urban planning, the Directive Plan at local level and the Structural Plan at Regional Level also give requirements for urban development. No legal requirement binds the city to engage in participation activities. Linköping, through the national Planning and Development Act, requires participation in city development projects in 2 steps. First, the planning is being done in different formats: comprehensive plan and detailed planning. Second, the act underlines the necessity for minimum efforts in the announcement, participation and analysis/response of citizens. Additional participation *can* be added at the discretion of each project manager, typically in the earlier stages of a project, as a way to collect necessary information (co-creation). Linköping has formulated a policy for 'citizen dialogues' (Linköping City, 2016) which outlines what a dialogue is and the degree of participation expected. These degrees are based on Arnstein's Ladder of participation (Arnstein, 1969) and the document is based on national guidelines. This document is followed by concrete guidelines for citizen dialogues that list approaches to participation, together with a short description. It also shows what approaches have been used in Linköping previously. Legal requirements for participation are thus stronger in Linköping, whereas Namur engages in participation activities for the sake of collecting input.

Citizens' Characteristics: Namur is a service industry city with educated citizens. This explains why the city welcomes participation. One interviewee declared that "Since the citizens of Namur are more educated, citizens have a sort of self-regulation in the opinions they issue and in the level of the debates they can have (true facts, respect, …)". Similarly, the citizens of Linköping are described by the interviewees as "relatively young with high levels of education (university city) and high employment

rate". The size of both populations is also relatively small which makes it easier to contact them and try to ensure representativeness. In both cases, the population is quite well educated with a high employment rate, which impacts the view of officials about their relevance for participation.

5.5.4 Discussion: Context-Specific Recommendations

In this section, we reflect on the results by providing concrete hypotheses for further research and recommendations for practitioners. We then apply these recommendations to the case of Brussels Furthermore, we detail the limitations of the study.

We have identified five context factors that can impact citizen participation activities in smart cities. In order to demonstrate this impact, we formulate several hypotheses observed in the two cases that would need to be empirically validated in further research. Depending on the smart city consideration, which may be Technology-oriented or Participation-oriented, the use of online (H_1) or offline participation methods (H_2) is observed. However, we must state that these hypotheses are not mutually exclusive, since technology can support the participation process. Linköping constitutes an example of a smart city that starts from the tech-oriented view and that invests in online participation methods. In terms of drivers for smart city development, both cities chose a Top-Down Approach and invested in participation to complete and improve their already existing strategy (H_3). No Bottom-Up approach was observed in the two cases studied. The degree of centralization can lead to participation that is enabled by the administration, mainly (H_4) like in Namur, or in a decentralized ecosystem view (H_5) like in Linköping. The legal requirements can "force" minimal participation activities, depending on whether they are strong (H_6) like in Linköping or weak (H_7) like in Namur. The citizens' characteristics can also have an impact on whether or not the administration welcomes participation, depending on the perceived maturity of the population. In both cities, the maturity was perceived as high (H_8) and no observation for low maturity was made.

The end goal of this research avenue is to issue recommendations for decisions-makers to make better decisions about citizen participation in smart cities. These recommendations are based on scientific sources or general handbooks such as (Kirby et al., 2003). Table 8 summarizes the context factors, the hypotheses about their impact on participation as well as the contextualized recommendations for policy-makers.

Table 8. Contextualized recommendations for citizen participation in smart cities

Context Factors (Identified in this study)	**Instantiation**	**Hypotheses: Impact on participation** (Observation from the two cases)	**Contextualized recommendations for policy-makers** (based on scientific literature)
Smart City Consideration	Tech-Oriented	Use of "Online" participation methods (H_1)	Understand the requirements for the online tools and integrate the citizens into the process through the PD approach (Foth and Brynskov, 2018) Examine the citizen participation actions using analytical tools such as the "scaffold of participation" suggested by Cardullo & Kitchin (2019)
	Participation oriented	Use of "Offline" Participation methods (H_2)	Focus on representativeness of participants and measure the impact of participation on decision-making by using Arnstein's Ladder (Arnstein, 1969)

Drivers	Top-Down	Administration invests and coordinates participation with other stakeholders (H_3)	Convince political representatives to evolve towards a middle-out design to draw on the collective knowledge of all actors based on the suggested process of Fredericks, Cadwell, & Tomitsch (2016) or by having frameworks such as the Triple Bottom Line in mind (Ahmad and Mehmood, 2015)
	Bottom-Up	The citizens autonomously participate in public life	Organize traditional participation activities to let citizens communicate with city representatives and position the city as a coordinator of participation (Linders, 2011)
Degree of Centralization	Centralized	The administration coordinates participation (H_4)	Install a pilot project to open the collaboration with other stakeholders and coordinates actions with citizens and businesses taking inspiration from the Quadruple Helix Model for Innovation (Cossetta and Palumbo, 2014)
	Decentralized	Each actor implements participation autonomously (H_5)	Coordinate all actions through traditional (working group) or innovative (living lab) actions (Cosgrave et al., 2013) and elaborate a plan to develop a coherent ecosystem of participation methods (Simonofski et al., 2019)
Legal Requirements and Plans	Strong	Administration forced to invest in participation (H_6)	Avoid routinized participation through an evaluation of the influence of citizens on city's decisions with framework such as the one suggested by Simonofski et al.,(2018)
	Weak	Administration invests spontaneously in participation (H_7)	Draw up plans for participation accepted by city representatives and make sure that the methods implemented are coherent with each other (Simonofski et al., 2019)
Citizens' Characteristics	High maturity of the population	Administration more welcoming of citizens' input (H_8)	Develop prototypes of innovative participation methods (online platforms, etc.) by analyzing the requirements of "lead users" from the population (von Hippel, 1986)
	Low maturity of the population	Administration more reluctant about citizens' input	Balance the online and the offline participation activities and convince representatives through selected use cases and change management initiatives at strategic level (Cameron and Green, 2015)

In order to test the relevance of the context factors and the context-specific recommendations, we have decided to apply them to the case of Brussels (Belgium), a larger city that has decided to engage in a smart city strategy. We collected data about the actions of Brussels by means of an in-depth interview with the smart city manager of Brussels and the analysis of key policy documents provided by the manager. Brussels has implemented the following citizen participation activities: direct interaction techniques (such as workshops for participatory budgeting), online platforms ("BPart"), a living lab with a focus on urban planning ("StudioP") and an Open Data platform. We asked questions about the five identified context factors, and the interview revealed that:

- The Smart City Consideration is participation-oriented, as numerous participation activities constitute the essence of the project.
- The Drivers come from the top as the administration invests in the participation activities.
- The Degree of Centralization is strong due to the citizens' initiatives, and the actions of the city as well as of the region that also invests in actions.

- Legal Requirements are low, as no there are no binding requirements for Brussels to invest in participation.
- In terms of Citizens' Characteristics, the population is considered as mature by the stakeholders.

Therefore, we issued the recommendations linked with the hypotheses issued in Table 8. The two most relevant recommendations are to analyze the impact of participation and to ensure consistency between the different participation activities. The city manager deemed these recommendations to be useful for the overall strategy.

Despite the relevance of the context factors, this study presents some inherent limitations First, the inferred context factors are based on the analysis of two cities. Even though Brussels constituted a first validation step for these factors, it is necessary to investigate a higher number of cases. Due to the exploratory nature of this research, this limited sample, based on two cities similar enough but with enough key differences in terms of smart city strategy, constituted an ideal base to formalize a first set of context factors. However, with a higher number of comparisons, we would expect to be able to derive several additional factors. For instance, context factors discussed in the literature, such as national culture (Hofstede, 2011) or public values (Jaspers and Steen, 2018), were not discussed in the interviews but could have an impact on citizen participation in smart cities. Furthermore, the five factors presented in this study are broad, independent categories that could be refined into sub-categories. Secondly, another limitation is the focus on top-down activities by city stakeholders when examining participation, rather than on spontaneous activities organized by other stakeholders (NGOs, businesses or citizens directly), such as information town meetings. The impact of context on these bottom-up activities was not captured by this study. Finally, another limitation refers to the relation between the smart city concept and participation. Some actions were not performed under the "smart" label, and the perception by practitioners of this concept relating to participation would be beneficial to better understand.

5.5.5 Contributions

In this study, we identified five context factors impacting citizen participation strategies in two smart cities (Namur and Linköping): the smart city consideration, the drivers for participation, the degree of centralization, the legal requirements and the citizens' characteristics. By comparing the citizen participation activities, we were able to see how two cities, with their respective contexts, invested in participation. Our study revealed that similar stakeholders were involved (Administration, University and Businesses) and similar participation methods were applied (direct interaction, living lab, open data and online platform). However, these methods were implemented differently, for different reasons and encountered different challenges due to the impact of the five identified context factors. Having these context factors in mind, this study opens a research avenue for further identification of context factors as well as better contextualized recommendations on citizen participation strategies. The application to the case of Brussels is promising, as it shows that the identified factors were relevant for a completely different city and that the recommendations were deemed a useful by the city official.

This study is relevant for academics, as it pioneers the formalizing of context factors that impact the key element of citizen participation in smart cities. In the future, researchers will benefit from a theoretical basis to further investigate the relevance and the impact of these factors on citizen participation as well as on other elements of the smart city strategy. Thanks to a higher number of comparisons, the identified context factors could be generalized and understood in greater detail. Furthermore, the importance of each context factor could be weighted using a Likert scale or ranked to better understand their perceived relevance by stakeholders. Another research avenue that was opened up is the understanding of the relations and possible tensions in between the context factors (e.g. does the smart city consideration impact the degree of centralization?). Another key theoretical contribution resides in the fact that the understanding of the context factors is an essential pre-condition to better evaluate citizen participation in smart cities. Having these factors in mind, a fairer comparison between cities is possible.

Furthermore, this study is also relevant for practitioners as it provides them with recommendations that aim to be city-specific by taking into account their context. By analyzing their current context, stakeholders would be able to recognize in which category they belong and then follow the recommendations embedded in the literature. The suggested formalization helped the city of Brussels reflect, on their context and appropriate recommendations were subsequently issued. These recommendations are currently based on previous research but will be enhanced and improved when applied to other concrete cases.

6. UParticipate Decision Support Guide

In this section, we take a more in-depth look at a specific criterion of CitiVoice: the participation of users in e-government service development within the “Citizens as co-creators” category. More specifically, we take the practical viewpoint of a public project manager that has to make decisions about user participation in the development of e-government services as a point of departure for designing a decision support guide. We choose to focus on this criteria as it is the most in line with the practical challenges faced by project managers in Belgium. Furthermore, we have to restrict the study to one criteria as the impact of context factors on all criteria from CitiVoice would’t have allowed the same in-depth study.

E-government service development is taken as a use case for medium-scale projects in order to study participation. Indeed, users can have a more active role in e-government in general and e-service development in particular (Axelsson et al., 2010; Holgersson et al., 2012). A wide range of user participation approaches and methods have been described in detail in the literature. However, project managers within public organizations are sometimes reluctant to involve the users in the development process and need more support when making decisions on this matter (Simonofski et al., 2019). Several reasons have been identified, e.g., lack of knowledge of potential methodological approaches; lack of time and other resources; additional complex requirements to integrate, and so forth. Another key challenge, aligned with the lack of knowledge of potential methodologies, is the wide variety of existing participation methods. Indeed, some methods are more relevant than others, depending on the specific context, users’ characteristics, their motivation, the organizational culture, or the project stage (Simonofski et al., 2019). This is aligned with studies that question the preconception that more participation is always for the better and reflect on the tension between the positive findings from the general ISR and the opinions of project managers (Heeks, 1999; Holgersson et al., 2018), and is relevant both for research and for practice. For instance, Heeks (1999) challenges the consideration of user participation as a “magic bullet” that can solve everything without taking into account the context or the target users. Without an appropriate ex-ante analysis, user participation could prove to be useless or even negative for the project manager in the public organization.

In that regard, and on top of suggesting a tool to manage participation on medium-scale (RQ2), the research question that this section tackles is RQ2b: *“How can the project managers’ decisions related to user participation in e-government service development be supported, taking several influencing factors into account?”* The end goal of this research is to provide practitioners with a decision support guide to help them decide: (1) whether they need to organize for user participation in e-government service development and (2) on the modalities of user participation, with regard to the context specificities. By context, in line with section 5.5., we again mean elements from the environment that influence the decisions of stakeholders about a specific project. These factors are here again, elicited with the project managers directly so that they are in line with their practical challenges. In order to reach that goal of *situated* user participation (participation that takes into account the context), this section presents a conceptual model that constitutes an essential theoretical basis for a decision guide. We also present how we derived from this model the second management tool developed in this thesis: the UParticipate Decision Support Guide. Lastly, we present an empirical validation of the decision support guide, which provides insights and feedback about its use.

This guide will support the decisions of project managers related to user participation in e-government service development. However, before diving into the workings of this guide, we will go through each of its building blocks, as numerous influencing factors can impact the decisions of project managers. Therefore, in section 6.1, we identify the different participation methods used to collect insights from users as well as the degree to which they can have an impact on project managers’ decisions. Furthermore, we will also explore the preferences of citizens and public servants for these methods. In

section 6.2, we focus on the first influencing factor impacting these decisions: the organizational challenges faced by project managers. In section 6.3, we focus on the second influencing factor: the stage of the e-government project. In Section 6.4, we focus on the third influencing factor: the public values that are strived for by practitioners. In Section 6.5, we explain how we built the theoretical model and derived the decision support guide from it. Finally, in Section 6.6, we focus on the empirical validation of the guide by taking the improvement of the open data portal of Namur as a use case.

6.1. Participation Methods

The development of e-government services has long been an internal process, but over the years, user participation has increasingly been advocated in different research areas. Within the e-government literature, several studies have attempted to understand how citizens can be involved in the development of e-government services (Holgersson et al., 2012). In the scientific literature on public administration, user participation can be mapped to the concepts of co-creation and co-production, where the citizens (considered here as end users) provide their knowledge and experience in governmental processes (Galvagno et al., 2014). The Open Government movement also advocates this increased participation of citizens in public processes (Lee and Kwak, 2011). As we have established in the previous section, the field of smart cities is the latest that has shed new light on the topic of user participation. Here, ICT is used as a tool to tackle the ever more complex challenges that modern cities face (Caragliu et al., 2011). The need for "Smart Governance" is one of the key dimensions of a smart city and underlines the importance of an increased collaboration within governmental bodies and an increased co-creation of e-government services (or smart city projects) with users. This "smarter" governance is expected to increase public value as e-government services will be more easily adopted, more innovative and more adapted to answering users' requirements.

This section is aimed at identifying the main methods that support the participation of citizens in e-government service development. Furthermore, we aim at contrasting methods suggested in literature with their use by practitioners and with their perception by citizens. The contributions of this study are thus twofold: an inventory of participation methods identified in literature and a table analyzing the discrepancy between the use of these methods and their perception in practice. The section is structured as follows. First, the Background section exposes the concept of user participation as well as its impact on public value in the context of smart cities. Second, the multi-method approach applied by this study to contrast theory and practice is explained in the Methodology section. Third, the Results section details the participation methods identified as well as their validation with the multi-method approach. Fourth, we reflect on the results in the Recommendations section and more specifically provide practitioners and researchers with an easy-to-use table presenting the methods and recommendations to be taken accordingly. Finally, the Contributions section summarizes the contributions and how this study contributes to UParticipate.

6.1.1 Background

6.1.1.1. Degrees of Participation

Before discussing the participation of citizens in the development of e-government services, we first have to go back to the importance of user participation in traditional software development methods. The information system research field has long proven that an increased user satisfaction and early involvement in the development process (e.g. requirements engineering activities) improves system quality (Hartwick and Barki, 1994). The importance of user participation and customer involvement has been underlined by the evolution of the traditional Waterfall software development methods to agile methods. These methods advocate, among other principles, more customer involvement in software development (Beck et al., 2001). This increased user participation has historically been implemented in the form of three main practices that we will refer as "participation degrees" in this thesis: participatory design, user-centered design and user innovation. Based on (Holgersson et al., 2012), we provide the following simple definition for these three concepts:

- *Participatory Design* (PD) advocates an approach where good ideas are as likely to come from the user groups as from the decision-makers (Schuler and Namioka, 1993). In that regard, users and system developers are considered partners in the development process. In the context of this approach, the users can contribute as advisors (by assessing prototypes), as

representatives of a particular user group or as all-inclusive participants where all users contribute to the development work.

- *User-Centered Design* (UCD) emerged in the field of human-computer interaction and underlines the important impact of user needs on the design of the interface (Abras et al., 2004). Contrary to the previous approach, users and developers are not seen as equal because users only provide knowledge to the developers, who then take into account this business domain knowledge. For instance, the developers could organize focus groups to gather this knowledge but still have the power to take all decisions unilaterally.
- *User Innovation (UI)* is the extreme counterpart of non-participation, where the problem identification and design solutions emerge directly from the user, or more specifically from the "lead users" group. This sub-group refers to users that have strong needs that will become more general in the marketplaces in the future (von Hippel, 1986).

In the case of e-government services, the customers and/or users are, among other actors such as businesses and other administrations, the citizens. Going back to the CitiVoice Framework, there are three main ways of considering citizens (Simonofski et al., 2017b): citizens as democratic participants (where ICT is to enable citizens' impact on decision-making through, for instance, e-voting systems), citizens as customers (where ICT is used to provide better service quality to citizens), and citizens as co-creators (where citizens can add value in the process of government). In the later sections, we will examine how specific participation methods can facilitate the co-creator role of citizens, particularly through participation in the development of e-government services. This co-creation of e-government services has already been researched, particularly by a very active Scandinavian body of research (Axelsson et al., 2010; Holgersson et al., 2012).

6.1.1.2. Relevance of Participation for e-Government Service Development

In their attempt to define public value in the context of a smart city, Dameri and Rosenthal-Sabroux (2014) identify three defining elements in smart cities: effectiveness, environmental consideration, and innovation. In another attempt to conceptualize Smart cities, Caragliu et al. (2011) identify several dimensions such as "Smart Mobility", "Smart Environment" but also "Smart Governance". The concept of smart cities aims at encouraging the quality of life of citizens, but cannot be limited to technology only, and must start from the human side of the equation (Nam and Pardo, 2011b). Hollands (2008) founded this "human capital" school of thought that underlines the importance of human capital in improving and designing smart cities. The co-creation of e-government services thus falls completely within the definitions of public value. Within the consideration of (Dameri and Rosenthal-Sabroux, 2014), it improves effectiveness and facilitates bottom-up innovations. In the dimensions of (Caragliu et al., 2011), it falls within the participatory governance dimension that relates to increased collaboration with citizens. Thus, public processes have evolved from a technology-oriented top-down approach to a bottom-up approach starting from human capital. In this bottom-up process, insights from users are essential for public value to be generated. Too often, smart cities did not reach their objectives because the citizens, their end users, were not involved in their design. With CitiVoice, we have seen that several categories of participation can be identified, including the participation of citizens in e-government service development. The co-creation of e-government services with citizens must thus be considered as an essential pre-condition for a city to become smart, and will have definite outcomes of public value in smart cities. As seen in section 2.2.3, these outcomes are related to traditional information systems outcomes: improved intention to use e-government services (Anthopoulos et al., 2007), better alignment between system and requirements (Olphert and Damodaran, 2007), increased accuracy, usability, usefulness (van Velsen et al., 2009), capacity building (Olphert and Damodaran, 2007), industrial democracy (Axelsson et al., 2010), improved user interface (Holgersson et al., 2012), user satisfaction (Sørum, 2011), increased trust in e-government services (Anthopoulos et al., 2007), enabler of democratic participation and promotion of innovation in society (Linders, 2011).

One of the fundamental differences between the e-government and smart city research areas to date is that e-government research concerns all governance levels, whereas smart city research focuses on the local level. Consequently, user participation in e-government services can deliver value at all governance levels; however, we argue that this participation is particularly relevant at local level in a smart city context. Indeed, cities have more direct interaction with citizens and citizens feel more connected to the problems of their city. For instance, previous research suggested that citizens in Flanders and Wallonia consulted the regional and federal websites less often in comparison to local websites (Verdegem and Verleye, 2009). In this study, we chose to focus on all governance levels in order to have the most complete view on user participation, but the findings will be particularly relevant for cities investing in a smart city strategy.

6.1.2 Methodology

Figure 18 represents the overall methodology that we followed in this study. The four main research activities are in blue, while the four main contributions are in yellow.

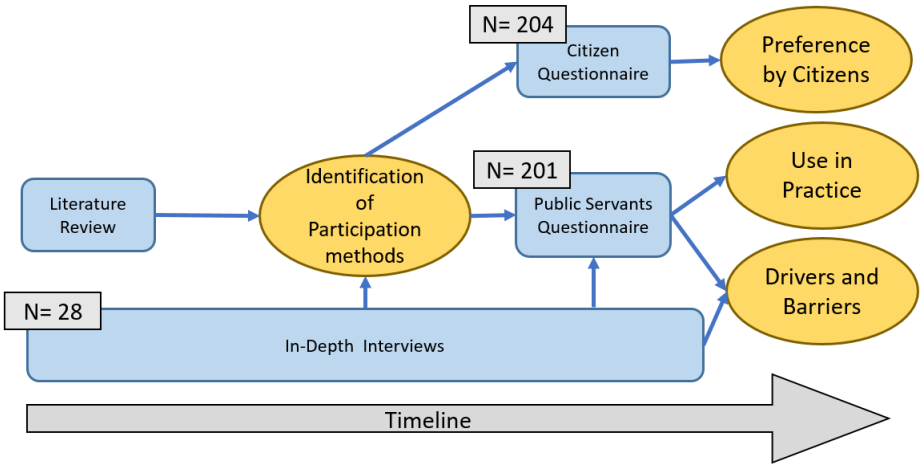


Figure 18. Participation Methods Identification Methodology

In order to reach the goal of this study, we have chosen to follow a multi-method approach combining quantitative (two questionnaires) and qualitative (in-depth interviews) methods This multi-method approach allowed us to confront the theoretically grounded methods identified in the literature with an empirical analysis by practitioners conducted in both a qualitative and a quantitative manner. This combination of methods allowed us to cover the complex topic of user participation in detail. Furthermore, the combination of methods made it possible to improve the research instruments used in subsequent steps. To this end, we performed the interviews throughout the course of the study. The findings from the interviews allowed us to refine the list of methods found in the literature review, to refine the questions in the questionnaire sent to public servants and finally, to refine and validate the drivers and barriers of public servants regarding user participation.

First, we identified eight main participation methods through a systematic literature review to explore to current literature in well-regarded scientific electronic databases (Google Scholar, Scopus, ScienceDirect, Web of Science) (Falagas et al., 2008). The details of this review are detailed above in section 3.1.1. This review allowed us to identify 19 papers discussing these eight participation methods.We then evaluated the relevance and use of these methods in practice by means of in-depth interviews and two questionnaires (one targeting public servants and one targeting citizens). Since the interviews and the public servants' questionnaire were conducted in the federal country of Belgium, it

was necessary for the target group to have a balance between different governmental levels in order to reach a representative sample.

Regarding the in-depth interviews, we performed 28 of them with public servants from all Belgian governmental bodies in order to understand in greater depth how they co-create e-government services. The interviewees were selected on the basis of their role within their organization. We selected people with a clear strategic position on the digital strategy within each of the federal, regional and local organizations, until the e-government landscape in Belgium was sufficiently covered. These interviews were conducted in a semi-structured manner following the guidelines of (Drever, 1995). After a full transcription of the interviews, they were analyzed by means of coding techniques to make the findings emerge (Gorden, 1998). Indeed, two coding steps were undertaken: open coding and axial coding. In the first step, phrases were coded using labels. In the axial coding step, duplicate labels were removed and related labels were grouped into one concept. The interview guide, based on the participation methods found the literature, can be found in Appendix 9.3. Table 9 details the distribution of the interviewees across the three government levels in Belgium as well their respective organizations.

Table 9. Interviewees for participation methods identification

	Organization type	Level	Organization
1	Administration	Federal	All-round Semi-cellular Trunking Radio communication system with Integrated Dispatching (ASTRID)
2	Administration	Federal	Belgian Royal Observatory
3	Administration	Federal	Federal Police
4	Administration	Federal	Federal Public Service Chancellery of the Prime Minister – Service for Administrative Simplification
5	Administration	Federal	Federal Public Service Economy, Small & Medium-sized Enterprises, Self-employed and Energy – Statistics Belgium
6	Administration	Federal	Federal Public Service Finance and Federal Public Service Social Integration
7	Administration	Federal	Federal Public Service Finance – General Administration of the Patrimonial Documentation
8	Administration	Federal	Federal Public Service Information and Communication Technology – Actor 1
9	Administration	Federal	Federal Public Service Information and Communication Technology – Actor 2
10	Administration	Federal	Federal Public Service Internal Affairs – Emergency and Crisis Management

11	Administration	Federal	Federal Public Service Mobility and Transport – Belgian Civil Aviation Authority
12	Administration	Federal	Infrabel
13	Administration	Federal	Ministry of Defence
14	Administration	Federal	Privacy Commission
15	Administration	Federal	Royal Meteorological Institute of Belgium
16	Administration	Federal	State Archives of Belgium – Actor 1
17	Administration	Federal	State Archives of Belgium – Actor 2
18	Administration	European	EUROCITIES
19	Administration	European	European Commission – DG CONNECT - Actor 1
20	Administration	European	European Commission – DG CONNECT - Actor 2
21	Administration	Regional	Agency Information Flanders
22	Administration	Regional	Brussels Regional Informatics Centre
23	Administration	Regional	e-Wallonia-Brussels Simplification
24	Administration	Regional	Public Service of Wallonia – Directory-General Economy, Employment and Research
25	Administration	Local	Flemish Organisation of Local Cities and Municipalities
26	Administration	Local	Intermunicipal Company for Informational and Organisational Mutualisation
27	Administration	Local	Municipalities of Saint-Gilles and Brussels
28	Administration	Local	Union of Villages and Cities of Wallonia

For the questionnaire targeting public servants, 204 public servants (from all governmental levels) answered an online questionnaire about the co-creation of e-government services. The questionnaire (cf. Appendix 9.3.2) consisted of questions about the participation methods applied and the drivers for (non-) participation as well as the development stage where the participation occurs. We also allowed the respondents to choose multiple responses to the questions asked in the questionnaire, in order to better illustrate their current situation regarding e-government service co-creation. To collect the data, we applied a data gathering strategy based on quota sampling. Despite some limitations, such as the potential lack of representativeness, this sampling method has been applied in similar studies to collect data from people with no specific motivation to provide information and has some advantages such as control over the chosen samples and faster data collection (Wijnhoven et al., 2015). The respondents were selected based on quota sampling where the different strata referred to the different governmental levels until we had respondents from all administrations. However, not all respondents answered

positively to the question “Do you develop e-government services within your organization?” Therefore, the sample was reduced to 151 respondents who could answer questions regarding user participation in these services. The 53 other respondents only answered the question about the barriers that prevented them from developing e-government services. Table 10 details the respondents of the questionnaire sent to public servants, also divided by federal levels.

Table 10. Number of respondents per target group (Public Servants)

Target group	Targeted Respondents	Number of actual respondents
Federal administrations	209	69
Regional administrations	298	70
Provincial administrations	112	18
Private sector	94	16
Private-Public partnerships	5	1
Local level administrations	589	30
Total	**1317**	**204** (151 + 53)

Furthermore, in order to complement the findings of the public servants’ questionnaire, we issued a second questionnaire to understand citizens’ drivers for (non-)participation as well as their preferred participation methods and stages of participation. This second questionnaire was also based on quota sampling (where the different strata relate to the demographic distribution of the population) and produced 203 responses. The questionnaire consisted of three questions: the willingness to participate, the preferred participation methods as well as the preferred participation stage. The response options of these questions were identical to the previous questionnaire in order to facilitate the comparison of results (Cf. Appendix 9.3 Section). Table 11 details the demographic distribution of the questionnaire sent to the citizens. Even though quota sampling allowed us to reach representativeness in terms of socio-demographic distribution, other sampling methods should be applied in further research to control other factors (e.g. digital literacy).

Table 11. Demographic distribution of respondents (Citizens)

Demographic Variable	Number of Respondents
Age	
< 29	102
29 < 49	56
> 49	45
Gender	
Man	111
Woman	92
Education (Highest Degree Obtained)	
Lower Secondary School	7
Higher Secondary School	69
High School	39
University	69
PhD	19
Employment	
Student	67
Employed	99
Self-Employed	14
Non-Employed	7
Retired	16

6.1.3 Results

In this section, we present the participation methods identified from the literature and their further analysis based on the results of the in-depth interviews and the two questionnaires. First, we present the identified participation methods and their link with e-government research. Second, we discuss the drivers and the barriers of practitioners regarding user participation in e-government services. This discussion is based on the results of the questionnaires and the insights gained from the interviews. Finally, we present how the different participation methods are used by practitioners and how citizens perceive these methods.

6.1.3.1. Participation Methods Identified

By performing a literature review as described above, we were able to identify a set of eight participation methods that are described below. Each of these methods provides means to realize participation, but the influence of the citizens will be different depending on the context of the specific participation school

(PD, UCD and UI) it is implemented in. For instance, workshops can be used in the three schools, but how the outcomes of the workshops are taken into account depends on the participation school.

- **Interviews**: Interviews are a direct interaction method often used in the context of requirements engineering. In the context of e-government, Billestrup and Stage (2014) have examined this approach by studying how software developers rely on public servants in interviews (and groups discussions) as representatives of citizens because they assume they know what the citizens need.
- **Representation in the project team**: In order to give more influence to users, Chan and Pan (2008) advocate the identification of salient intermediaries representing the users in all development stages (design, development and maintenance).
- **Workshops**: The organization of workshops to interact with a selected group of representative users is a method often used in the requirements identification stage of e-government service development (Følstad et al., 2004; Oostveen et al., 2004). In more recent research, these workshop are organized by means of creativity techniques such as visualization tools or improvisation principles (Mahaux and Maiden, 2008).
- **Surveys**: Surveys are used for a number of purposes (market evaluation, research, etc.), including the large-scale participation of users, mainly in the evaluation phase of e-government services. De Róiste (2013) provides insights about such user evaluation through online surveys, phone or in-person surveys.
- **Dedicated Software:** In order to facilitate the large-scale participation of users, practitioners can develop dedicated software (that can take the form of platforms, applications,…) to gather citizens' ideas and needs (Berntzen and Johannessen, 2016). In the context of e-government service development, Crowd-centric Requirements Engineering (CCRE) platforms apply the crowdsourcing paradigm in all phases of requirements engineering, including elicitation, negotiation and prioritization (Snijders et al., 2015).
- **Social Media**: Social Media is disrupting numerous activities, including software development (Storey et al., 2010). The use of Social Media in an e-government context often refers to the political participation of citizens. Feeney and Welch (2016) have recently explored how social media is used by government, whereas Bonsón et al. (2012) explore how it changes citizen-to-government relations. Even though these papers suggest that social media can be used to improve software development, no concrete application is suggested.
- **Living Lab**: The most recent method resides in the Living Labs, defined as a "*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). This new method is often implemented in a smart city local context to explore the needs and ideas of citizens about innovative ICT projects (Cossetta and Palumbo, 2014).
- **Usability tests on prototypes**: Prototyping is a method often used to present an unfinished product to its potential users. In the context of e-government, van Velsen et al. (2009) suggested a user-centric requirement engineering method for the design of e-government services with a rapid prototyping tested through focus groups, interviews or citizen walkthrough. Prototyping is also suggested by other authors such as (Følstad et al., 2004; Oostveen et al., 2004).

6.1.3.2. Drivers of User Participation

This section presents the results from the questionnaire sent to public servants, the interpretation of which is further fueled by the in-depth interviews as most of the barriers towards user participation are not always straightforward but are more underlying to the specific values and processes within the public sector. The interviews and the public servant questionnaire reveal that user participation in e-government service development is perceived mostly as positive by public servants. There is indeed a consensus about the consideration of user participation as a success factor for software development.

Figure 19 lists the different drivers for including users in the development of e-government services. This question was put to the 151 respondents (out of the 204 total respondents of the questionnaire), who stated that they include users in the development of e-government services.

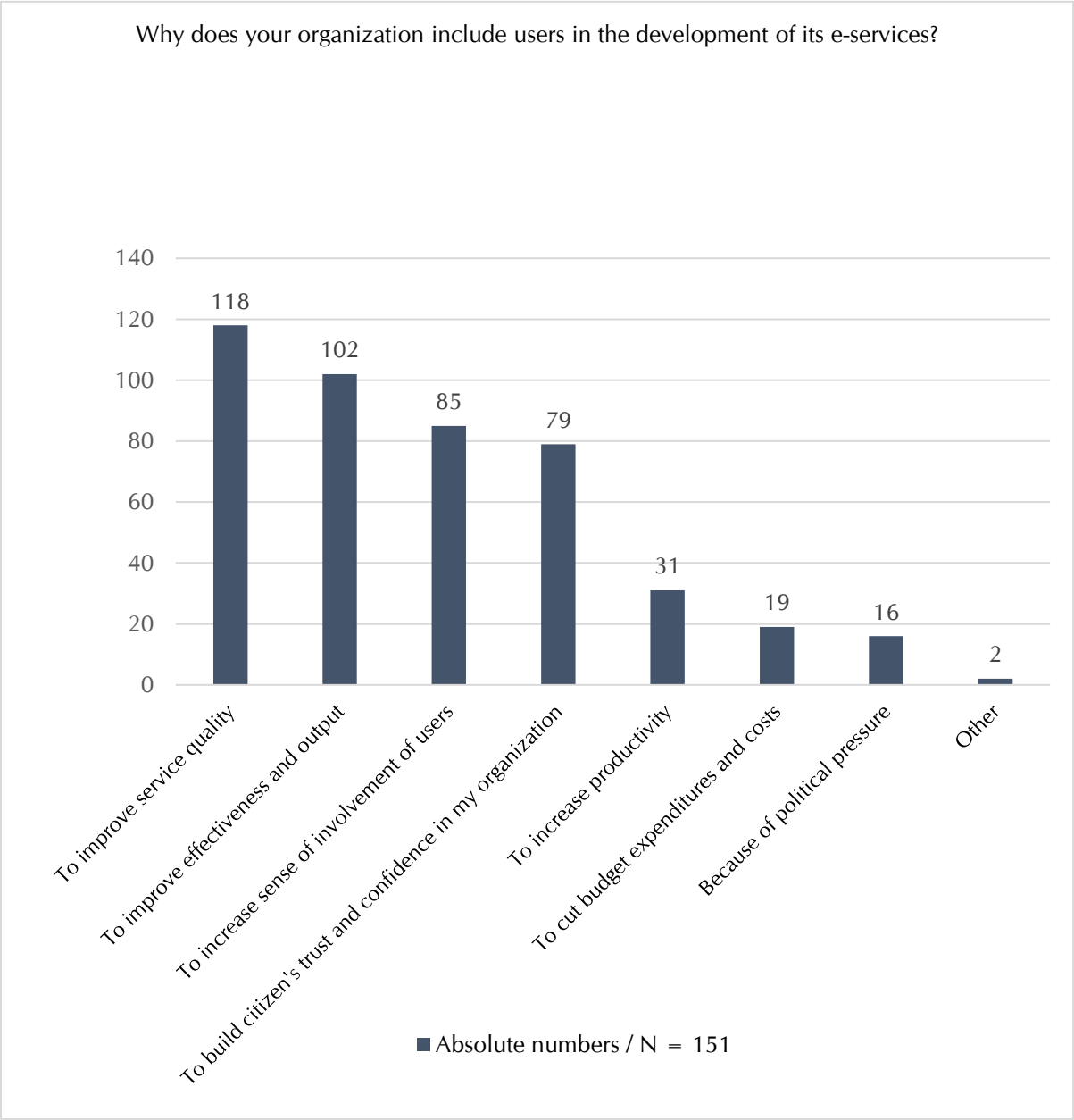


Figure 19. Drivers for including users in the development of e-government services according to the implementers of participation methods (Source: Public Servants Questionnaire)

According to the respondents, the inclusion of users in the development process is first and foremost driven by the desire to reach better service quality for users, to improve the effectiveness and output of e-services, and to increase the sense of involvement and trust of users. The first two drivers are traditional in the area of user participation, but the third and fourth drivers appear to be specific to the public sector as regards citizen participation. This specificity proves that the participation of users in the public sector is not entirely similar to user participation in the traditional Information Systems field. This specificity was also confirmed during the in-depth interviews: interviewees stated that users are not merely seen as consumers of the e-services, but also as citizens having democratic rights that need to be taken into account. Therefore, the distinction between “Involvement” and “Participation” is interesting to detail here. The sense of involvement, that is the feeling of being listened to by the administration, is

perceived as a consequence of the participation methods applied. A last finding to take note of is the low result for “Political Pressure”. It shows that participation is driven by internal reasons instead of external pressures.

Despite user participation being currently considered as a success factor, e-government services are also often developed for internal use without considering their potential use by external users (which include citizens as well as businesses or other public partners). This leads to e-government services being developed internally and never being truly fully exploited afterwards. Figure reveals the main barriers identified in the questionnaire. This question was only asked of the 53 respondents (out of the 204 respondents of the questionnaire) who stated that they do not include users in the development of their e-government services.

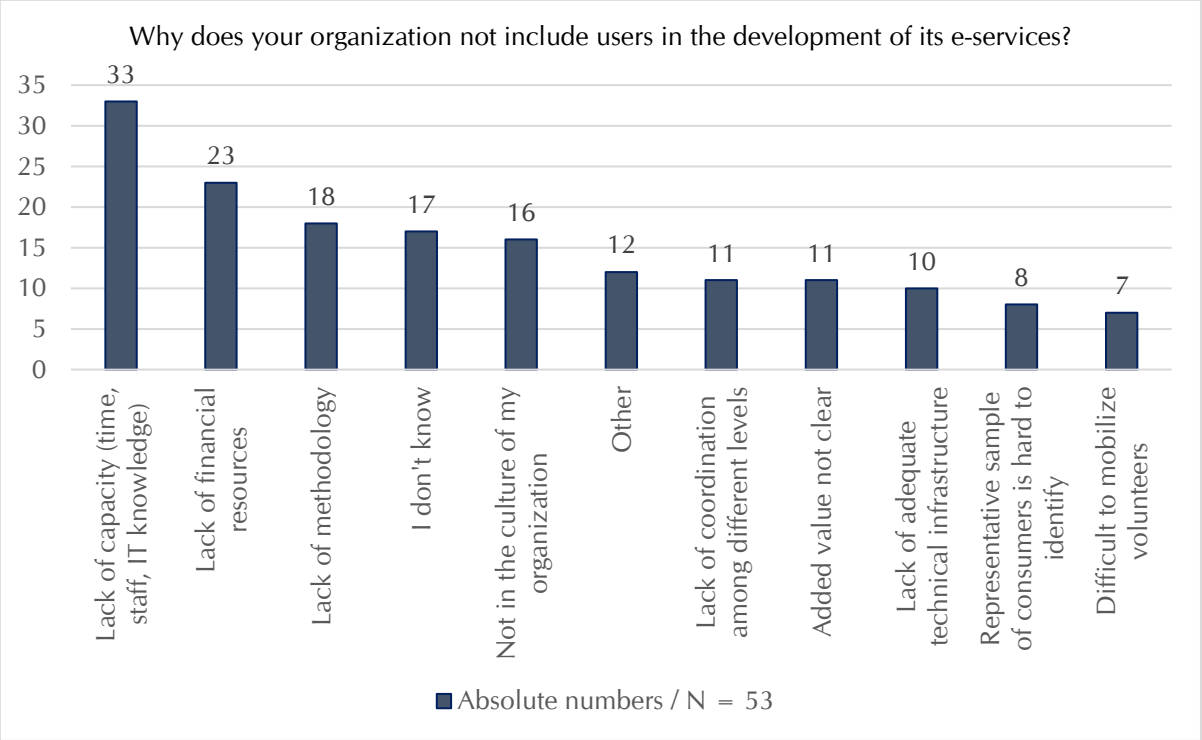


Figure 25. Barriers to the participation of users according to the non-implementers of participation methods (Source: Public Servants Questionnaire)

The three main barriers to citizen participation are the lack of capacity, lack of financial resources and lack of methodology. For all categories of respondents, the number of respondents that selected the category “I Don’t Know” is rather high. This may suggest that administrations have not yet considered how to include users in the process, or have not even considered getting users to participate. The culture of the organization is also perceived as a major barrier. The “Other” option is also rather high, but the additional information asked of the respondents when that option was checked revealed that in most cases, the respondents’ answers could be mapped to “Added value not clear”. These findings were also discussed during the in-depth interviews. The interviews gave more context to some barriers:

- Lack of capacity and lack of methodology: User participation for e-government services is challenging because it is a time- and money-consuming process without clear methodology. The development process is already complex, with different actors having conflicting goals (citizens that want a better service quality, IT managers that manage servers, Record managers that care about security of information, and other public servants that do not want too many changes in their workflow, etc.). The inclusion of all stakeholders adds complexity to the process and makes the planning of the development process more difficult.

- Not in the culture of my organization: the inclusion of the stakeholders is also made more difficult by the administration's own culture, its hierarchical structure and the impact of regulation on its existing processes. The culture of Belgian administration is indeed less favorable to citizen and user participation than in the Scandinavian countries, for instance. The work of incorporating feedback from stakeholders or the necessary signatures by superiors lead to the risk that the software becomes obsolete by the time all stakeholders are involved.
- Representative sample: As the user group of citizens potentially constitutes the whole population, there is a need for a multichannel method to collect requirements so that the application is useful to a larger number and a diverse set of potential users. However, the particular challenge of finding users makes it even harder. Different categories of stakeholders have different requirements and require different types of participation methods, e.g. the younger generation is more inclined to use social media, whereas the older generation is more likely to prefer to be approached face-to-face.

On top of the findings of the questionnaire, the interviews also reveal two additional barriers that were not captured prior to designing the questionnaire. Indeed, only the comparative analysis of a larger number of interviews was able to reveal these underlying problems, closely linked to the intra- and inter-organizational relations of administrations.

- Responsibility: There is no clear responsibility about who should engage in the co-creation with citizens (between private or public sector, or between federal levels in Belgium). A striking finding from the interviews revealed that practitioners are sometimes reluctant to get citizens to participate in co-creation, as they feel they would encroach on the responsibilities of other actors. This challenge would be particularly significant in the development of inter-organizational e-government services.
- Political Support: A last problematic aspect of participation lies in changing political support. On the one hand, politicians push for increased citizen participation but, on the other hand, there seems to be a certain fear of citizens' feedback and how it may impact the existing or expected e-government services and processes. The main challenge here is the reconciliation of the concept of representative democracy, in which politically elected actors steer the actions of administrations – although it should be underlined that the administration has a level of independence of the political level – and the concept of direct democracy, in which citizens and other actors gain direct influence on the political and administrative level.

6.1.3.3. Participation Methods: Use by Public Servants and Citizens' Preferences

After looking in-depth at the drivers of and barriers to the co-creation of e-government services, we will now examine how practitioners implement the participation methods and examine the preferences of citizens regarding these methods.

Figure 26 represents the discrepancy between these two by means of relative numbers in order to facilitate comparison.

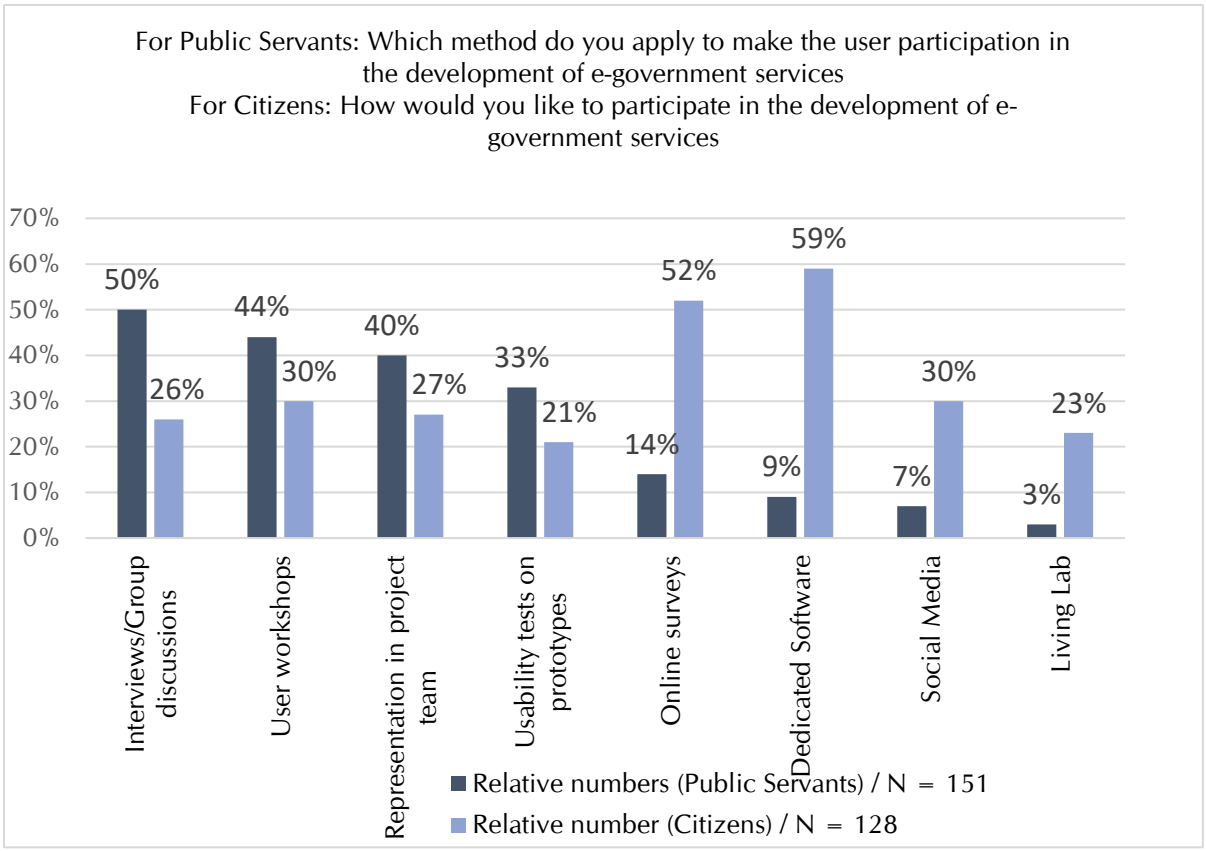


Figure 26. Participation Methods applied by Public Servants (implementers) and Preference of Citizens (interested Citizens Only) (Source: Public Servants Questionnaire and Citizen Questionnaire)

Regarding the specific method of requirement identification, Figure 26 shows that there is a clear distinction between traditional small-scale methods that are often used (interviews, group discussions, user workshops, prototyping) and more innovative large-scale methods that are rarely used (online surveys, platforms or social media). It is noticeable that Living Labs are neither extensively used nor known amongst public servants. Furthermore, it must be noted concerning the methods used that no major differences were found between governance levels.

When asking citizens which phase of the project they would like to be involved in, out of the 203 respondents, 75 were not interested in participating in the co-creation of e-government services. For the 128 interested people, the distribution of preferred participation methods can be found in Figure 26. In contrast with public servant's lack of knowledge and use of Living Labs, there seems to be a lot more awareness about this kind of participation structure among citizens. But Figure 26 also points to several other interesting implications. First, the high number of potentially interested citizens shows that there is interest on the part of citizens in engaging in co-creation if the right opportunity is given to them. Second, there is a clear discrepancy between the methods currently used and the methods preferred by citizens. Citizens tend to prefer large-scale online methods (Dedicated Software, Surveys, Social Media) rather than the traditional direct methods currently applied (Focus Groups, Representation in Project team, Interviews). During the interviews, several public agents made clear that there is an interest in those large-scale methods, such as dedicated software. However, several public administrations indicated that they are active on social media, but mainly to share information and only to a limited extend for other reasons. The prototyping option also scores rather high, indicating that many citizens would like to interact with something tangible when they participate.

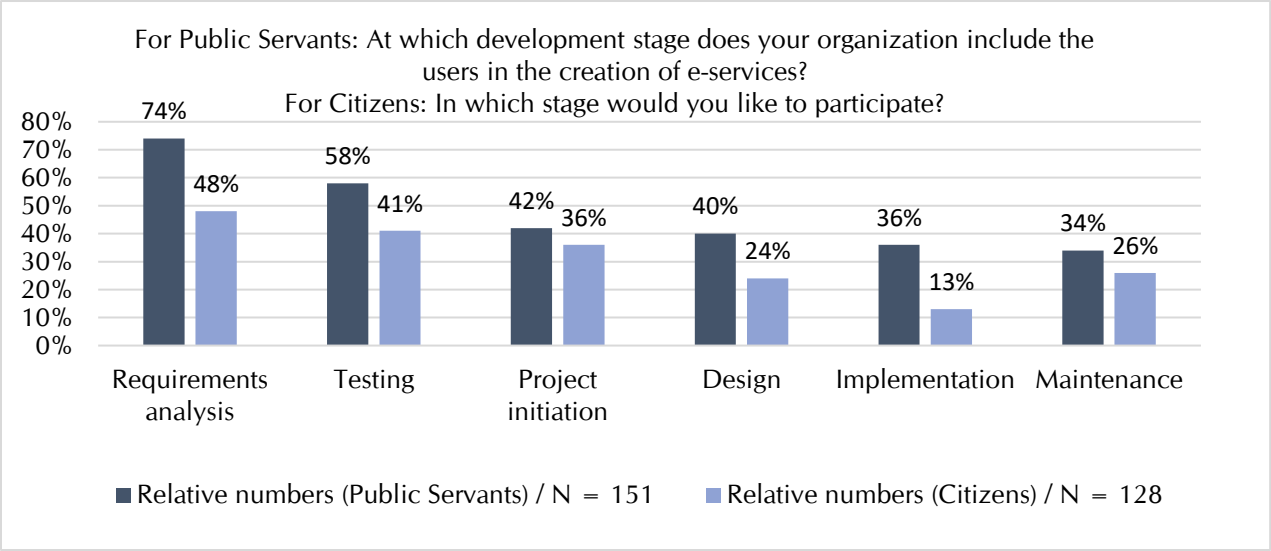


Figure 20. Inclusion of users in development stages by Public Servants (implementers) and Preferences of Citizens (Source: Public Servants Questionnaire and Citizen Questionnaire)

As demonstrated in Figure 20, co-creation with users can happen at different stages of the development process. This question details the most widely accepted stages of software development from the well-accepted Waterfall model. Participation most commonly happens in the requirement analysis and testing of the e-services (resulting in a list of stakeholder requirements). The design and implementation stages score, unsurprisingly, lower as they require advanced ICT skills. However, the maintenance stage (evaluation of the e-service) scores quite low, which reveals a lack of user involvement in the long-term evaluation of services. Improvements could also be made to the project initiation stage (decision to develop an e-service). Figure 20 also shows in which stage citizens would like to participate when given the opportunity. Here, no major discrepancy can be noted between the use in practice and citizens' preferences.

6.1.4 Recommendations

In this section, we will reflect on the results described above. Regarding the identified drivers and barriers of public servants to user participation, the findings are coherent and further validate previous literature on this matter. For instance, the impact of the (national) culture on e-government strategies has been discussed in (Omar E.M., 2011), whereas the necessary political support for these challenges has been discussed in (Furuholt and Wahid, 2008). Furthermore, the influence of the Belgian state structure on e-government has been studied by (Chantillon et al., 2017a). In this study, we provide further empirical analysis of these findings.

However, the results provide evidence of discrepancies between the methods applied by public servants and the ones that are preferred by citizens. The Comparison Matrix (Table 12) summarizes the discrepancy between use in practice and preference by citizens as described in Figure 20, and provides a recommendation for closing the gap. A ranking of 1 means that the use in practice is high or that the preference by citizens is high. For instance, the interview method constitutes the most used method in practice (1) but scores low in terms of preference by citizens (6).

Table 12. Comparison Matrix between use of and preference for participation methods

Participation Methods	Use in Practice	Preference by Citizens	Recommendation
Interviews/Discussions	1	6	Improve the method
Workshop	2	5	Improve the method
Rep. in Project Team	3	8	Use in specific cases
Prototypes	4	3	Use the method more extensively
Surveys	5	2	Use the method more extensively
Dedicated Software	6	1	Research the method
Social Media	7	4	Research the method
Living Lab	8	7	Use in specific cases

Thanks to these structuring insights, we can draw a number of conclusions. First, there is a clear discrepancy between the use in practice and the preference by citizens. However, these results must be interpreted with caution so that the right action is undertaken. There are several possible explanations why some methods could score so low. Possible explanations are:

- The methods are insufficiently known, and hence it is not clear how they could support the participation of users
- The methods are conceived as being costly (time, money) and hence would complicate the planning process (unknown impact on the planning process and resources, unknown advantages of the methods compared to the more straightforward, or better known, higher scoring methods)
- There is a relative lack of experience with the methods, which means an investment of time and money is needed in its development and implementation, which could be too heavy for an individual public servant in charge of development.

Table 12 also details several recommendations to be taken into account by practitioners or researchers for each method:

- Use the method more extensively *(Medium Use / High Preference)*: These methods are used by practitioners and well accepted by citizens. We thus suggest using these methods more extensively. Good practices for these more traditional methods can be found in the traditional user participation area.
- Improve the method *(High Use / Low Preference)*: These methods are extensively used in practice but score a relatively low preference for citizens. We suggest that these methods not be dropped (as good practices are already well-established in practice), but research should be conducted to understand why citizens do not prefer these methods. To that end, research on the motivation and drivers of citizens should be undertaken.
- Research the method *(Low use / High Preference)*: The citizens would like to be involved through these methods. Unfortunately, they are not used in practice. These more innovative methods call for research in pilot projects to be undertaken in order to establish a clear methodology integrating these methods.
- Use in specific cases *(Low use / Low Preference)*: These methods are rarely used and are not preferred by citizens. Instead of dropping these methods, we suggest they be considered for

specific cases (e.g. for lead users or highly motivated citizens). These methods indeed call for an important citizen commitment that could deliver high value but only if the right profile participate. The identification of these lead users in the population for e-government services should be on the research agenda for further studies.

A striking finding of this study is that there is no "*High Use* / *High Preference*" combination. This finding should be confirmed by further research, by studying the context of other countries for instance. In fact, all findings of this research should be validated in other settings, as the research at hand only reflects the situation of the Belgian sample that was analyzed. Finally, in the next step of the research, we also intend to test several participation methods, by incorporating the actions suggested in the participation matrix in a real-life context through Action Research or Case Studies research.

6.1.5 Contributions

The goal of this section was to identify methods that can be used to enable the participation of citizens in e-government services and to analyze their use in practice and citizens' preferences. A literature review allowed for the identification of eight participation methods. Next, in-depth interviews and two questionnaires provided insights into the barriers and drivers related to their implementation and their perception in practice by public servants and citizens. In particular, there is a discrepancy between the methods used and the citizens' preferences. This has led to a set of recommendations for closing the gap.

The findings presented in this section is relevant for research, as they identify a core set of participation methods to co-create e-government services. This section helps to set the foundations for the creation of public value in Smart Cities. Indeed, the change in processes that comes with a "smarter governance" and an increased user participation is an organizational issue that is essential to tackle if one aims at creating public value through its e-government strategy. The research presented in this section also provides an empirical analysis of these methods and shows an interesting discrepancy between the current methods applied and the ones preferred by citizens. Finally, it fuels potential further research into the identification of solutions to tackle the barriers preventing user participation. Furthermore, this study is also relevant for practice, as it will provide practitioners with a list of different usable methods to co-create their e-government services as well as some recommended actions to be taken for each of these methods to make it more successful. Thanks to a better understanding of the citizens' perception of the methods, public servants will be able to make a more informed choice when choosing which method to implement. Therefore, this section constitutes the first part of the theoretical model of UParticipate by formalizing participation methods as well as an understanding of participation degrees (User-Centered Design, Participatory Design and User Innovation).

6.2. Organizational Challenges

After identifying the eight participation methods and bearing in mind the three degrees of participation, it is necessary to identify which factors might influence the decisions of project managers relating to participation.

One of the findings of the previous section was that public organizations sometimes lack an ideal setting to enable citizen participation in e-government. In this section, we will explore how participation can face challenges specific to the e-government domain. The goal of this challenge identification is to analyze the as-is situation of government and its impact on participation decisions, in order to integrate it into the UParticipate Decision Support Guide. In order to reach that objective, we chose to examine how agile software development methods are tailored in an e-government context and how they tackle the domain-specific challenges (number of users, organizational, regulation, etc.) of this field. We used agile methods as a proxy, because user participation constitutes an essential principle for these methods.

Traditional systems development approaches, such as the Waterfall model, seemed to prevail for a long time in the development of e-government services. No complete study has been found on current software development practices in governments, but authors have underlined the predominance of the Waterfall model (Pardo and Scholl, 2002; Følstad et al., 2004). Such methods rely substantially on thorough planning and process standardization, and assume that the requirements remain static throughout the development process. They prevent public organizations from quickly adapting their processes to the changing requirements of e-government users. Moreover, they make connections between citizens, government representatives and other stakeholders difficult.

Nonetheless, over the last decade, some governmental organizations are becoming interested in a number of new techniques and approaches, such as agile development, to enhance responsiveness and collaboration. New work habits such as the new ways of working and recent political movements (such as Open Government) that suggest a more collaborative work environment in governments have both established the need for increased user participation and internal collaboration in e-government (Lee and Kwak, 2012). Agile software development refers to a group of flexible and lightweight methodologies that rely on a set of principles and practices for the development of software (e.g., time-boxed iterations, customer involvement, daily meetings, continuous process improvement, etc.) (Beck et al., 2001). However, the implementation of such principles and practices in an e-government context may be problematic because of the intrinsic characteristics of government: regulatory compliance, lack of operational support, reluctance to change, etc.

By clearly identifying these challenges, we will be able to refine and adapt the agile methodologies to make them more easily usable. Indeed, the long-term goal for which this study lays the foundations resides in the tailoring of agile methods according to the specificities of e-government. As a first step, the objective of this study is to examine the organizational challenges faced by practitioners when trying to implement agile methods in an e-government context. In that regard, the goal of this study is to identify the challenges, in an e-government context, that impact the work of practitioners when implementing agile software development methods. In order to reach that goal, we have conducted three focus groups with practitioners following the abductive reasoning approach in order to find out and validate the context-specific challenges that could impede the agile development of e-government services.

The section is structured as follows. In the Background section, we present some information about e-government service development and agile methods as well as previous work that guided us in this study. In the Methodology section, we detail the research design we applied to determine and validate the e-government specific challenges. In the Results section, we present the challenges that emerged from the organized focus groups. In the Recommendations section, we reflect on the findings by providing leads for solutions, inherent limitations of the study and future directions to tackle the identified

challenges. Finally, in the Contributions section, we present some closing comments and summarize how this study contributes to UParticipate.

6.2.1 Background

This study is at the intersection of two lines of research: the development of e-government services and the tailoring of agile software development methods. There have been many attempts in scientific literature to define the concept of "e-government service" (Lindgren and Jansson, 2013). In this thesis, as mentioned in Section 2.2.3, we consider an e-government service to be any interaction, through the use of ICT networks, between the government and its users in order to deliver a service, with the purpose of meeting needs in the general interest. In today's work environment, traditional software (or, in this case, e-government service) development methods might not be fully adequate. Van Velsen et al. (2009) has underlined some specificities of the e-government domain that can impact software development practices: the heterogeneous and large user group that are the citizens, the complicated processes and contents of e-government services or the crucial need for interoperability between the systems of different governmental bodies. Furthermore, in recent years, the changing and higher requirements of citizens from their governments have been a driving factor behind new developments in e-government services. The importance of user participation in e-government service development has already been underlined before (Axelsson et al., 2010). In fact, according to (Lindgren, 2014), e-government service development should involve all stakeholders that will be affected by the systems at different levels: the end users, the management team and the top management. Thus, citizens, public servants, higher governmental positions and political representatives should be considered as part of development process. Furthermore, other papers have examined the need for an increased collaboration in the back office of government when developing e-government services between these stakeholders (Anthopoulos et al., 2007). A more recent study has examined the need for innovation in the processes of governments and in their digital strategy (Holgersson et al., 2017).

In summary, the willingness to engage citizens in the development of public services demonstrates that there has been a general shift towards new collaborative and innovative ways of working. In particular, (Mergel, 2016) states that e-government organizations have shown a particular interest in implementing agile software development approaches in order to achieve a more iterative and client-centered development process. The study referred to a failure project (healthcare.gov) that demonstrated how Waterfall processes may be dissatisfying. Furthermore, it initiated calls for more agile management approaches which are expected to help e-government organizations adapt faster to environmental changes and citizen requests. Agile methods share a number of principles that drive the development process of practitioners.

These 12 Agile Principles (AP) are described in the Agile manifesto (Beck et al., 2001) and are listed below for the sake of clarity:

- AP1*: Customer satisfaction by early and continuous delivery of valuable software (Valuable Delivery)*
- AP2*: Welcome changing requirements, even in late development (Welcome Changes)*
- AP3*: Working software is delivered frequently, weeks rather than months (Frequent Delivery)*
- AP4*: Close, daily cooperation between business people and developers (Close Cooperation)*
- AP5*: Projects are built around motivated individuals, who should be trusted (Motivation and Trust)*
- AP6*: Face-to-face conversation is the best form of communication (Face to face Communication)*
- AP7*: Working software is the primary measure of progress (Target Working Software)*
- AP8*: Sustainable development, able to maintain a constant pace (Constant Pace)*
- AP9*: Continuous attention to technical excellence and good design (Technical excellence)*
- AP10*: Simplicity—the art of maximizing the amount of work not done—is essential (Work Simplicity)*
- AP11*: Best architectures, requirements, and designs emerge from self-organizing teams (Self-organization)*
- AP12*: Regularly, the team reflects on how to become more effective, and adjusts accordingly (Continuous Improvement)*

A non-exhaustive list of Agile methods includes: Extreme Programming (XP), SCRUM, Feature-Driven Development, Dynamic Systems Development Method (DSDM), Lean Development/Management (Cohen et al., 2003). However, a growing line of research has identified that practitioners also use tailored methods that fit the specificities of their organizations (Campanelli and Parreiras, 2015). This research tends to fall into two streams: situational adaptation of existing methods (contingency factor approach) and the composition of reusable fragments from different methods (method engineering approach). In this regard, several studies also investigated the impact of the context (target users, organizational challenges, national culture, etc) on the implementation of agile methods. For example, (Ayed et al., 2017) studied the impact of the national culture on agile methods implementation and reported some culture-related *Agile Implementation Challenges*. Similarly to the objective of that paper, this study is aimed at investigating the impact of the e-government services development context on the implementation of agile methods. In a previous study, we analyzed the context of e-government services development by organizing 35 in-depth interviews. We were able to identify challenges that governments face when implementing e-government strategies. These *Digital Transition Challenges* cover a wide range of the digital transition strategy: software development processes, organizational structures, services infrastructures and applications, internal competencies, organizational culture, policies and data exchange. The complete findings of this research activity can be found in (Chantillon et al., 2017b). The latter study is considered a prelude to understanding the e-government context.

In this study, we use these *Digital Transition Challenges* and *Agile Implementation Challenges* as a theoretical background to find out the challenges (referred as Thematic Challenges in the Results section) faced by practitioners when implementing agile methods in governments. More specifically, we evaluate how these challenges impact the Agile Principles listed above in order to pave the way for the tailoring of agile methods to the context of governments.

6.2.2 Methodology

To the best of our knowledge, no previous work has tried to identify the underlying challenges to the implementation of agile methods in the e-government domain. As an overarching methodology to find out and validate the specific challenges that emerge when implementing agile methods in governments, we decided to follow the adbuctive reasoning approach. As a reminder, this approach enables an iteration between identifying concepts in the empirical data, and deciding on the most promising explanatory reasons to go forth with exploring (Schurz, 2008). This approach can be considered as close to the reasoning of the grounded theory where the data is iteratively coded into theory at each step of the process (Strauss and Corbin, 1998). In order to gather this data, we chose to organize focus groups to help us understand which challenges practitioners face when implementing (agile) development methods in their organization. The data was then iteratively coded (after each focus groups) into the concepts of interest (the e-government specific challenges).

We chose to organize focus groups in order to understand challenges as perceived by public sector representatives and to generate ideas about solutions to these challenges. Furthermore, we conducted the focus groups according to the literature's best practices (Morgan, 1996; Krueger and Casey, 2000). To follow these practices, we chose to conduct discussions between 5 and 10 participants. We chose to follow a single category design to focus on a set of practitioners familiar with agile methods so that the validation of the constructs is empirically grounded. The list of people involved in the focus groups is detailed in the "Results" section. We decided to stop the research activity after three focus groups, as each challenge had reached saturation and no more original findings were determined. We also made sure that the focus groups were homogeneous in terms of governmental levels (all participants were agile practitioners at a specific governmental level) but with enough variation between participants (in terms of organization, agile knowledge, position and responsibility) to stimulate discussion and contrasting opinions.

In order to develop the questioning route of the focus groups, we followed the development process suggested by (Krueger and Casey, 2000). This approach will be complemented thanks to the use of graphical facilitation techniques to stimulate the discussion. We also adopted a funnel approach in order to stimulate free discussion at the beginning in order to further focus on specific challenges (Morgan, 1996). As a summary, the three focus groups generally followed this four-step process: (1) The participants were asked to introduce themselves, their organization as well as their knowledge and experience with agile; (2) They were asked to draw on post-it notes the challenges that they face when trying to implement agile methods in their organization; (3) Each practitioner discussed the challenges he/she identified and placed them on a board. At that stage, we helped the participants to group their challenges into general Thematic Challenges (TC) to design Affinity Diagrams. This visualization method has already been tested in agile tailoring research such as (Ayed et al., 2014). In this step, we relied on the theoretical background (*Digital Transition Challenges* as well as the *Agile Implementation Challenges*) summarized in the "Background" section, so as to help the participants assign the post-its to the general TC. However, this background was not provided to the participants in order to avoid the introduction of any bias in the study. Our assistance was reduced to a minimum to avoid bias on the part of the researchers, as we only intervene to facilitate consensus among participants about the assignment of the post-it; (4) Fourth, starting from the most populated Thematic Challenges, a discussion emerged with the researchers playing a mediating role. As suggested by (Morgan, 1996), we used the theoretical background to generate discussion for this step.

After a complete transcription of the three focus groups, we performed a classic analysis technique and analyzed the findings of the focus groups (Rabiee, 2004). The visualization allowed us to have both a quantitative and a qualitative analysis of the practitioners' statements. For the quantitative analysis, we looked at the frequency of Challenges. For the qualitative analysis, we focused on the discussion that emerged from identifying these challenges in order to check if other challenges than the ones reported on the post-its emerged. Furthermore, we formulated hypotheses about how the challenges impacted the Agile Principles described in the Background Section

6.2.3 Results

In this section, we present the challenges that impact Agile Principles in an e-government context, identified thanks to the findings of the three focus groups. These challenges were iteratively theorized by means of the organization of three focus groups following the adbuctive reasoning approach. The participants were selected based on convenience sampling. However, we ensured diversity in terms of organizations, as participants came from different governmental levels (local and regional) and from different governmental sectors (IT, employment, simplification, etc.). Furthermore, the focus groups were also diverse in terms of roles, since the first focus group consisted mainly of developers, the second one of middle level management team leaders, and the third one of strategic leaders. Table 13 details the profiles of the different focus group participants. This table details the current roles, expertise and organization of the participants. It is worth noting that some participants relied on their previous agile experience in other public organizations to identify the challenges.

Table 13. Focus Group Participants

N°	Organization	Role	Level	Agile Experience
1	Intercommunal Cooperative	Project Leader	Local	Customized Agile Method
1	Intercommunal Cooperative	Developer	Local	Customized Agile Method
1	Intercommunal Cooperative	Developer	Local	Customized Agile Method
1	Intercommunal Cooperative	Developer	Local	Customized Agile Method

1	Intercommunal Cooperative	Developer	Local	Customized Agile Method
1	Intercommunal Cooperative	Developer	Local	Customized Agile Method
1	Intercommunal Cooperative	Developer	Local	Customized Agile Method
1	Intercommunal Cooperative	Developer	Local	Customized Agile Method
2	Simplification Body	Project Leader	Regional	Agile Project Management
2	Employment body	IT Advisor	Regional	Customized Agile Method
2	Employment body	IT Director	Regional	Customized Agile Method
2	Public Consulting organization	IT Advisor	Regional	Agile Project Management
2	Public Consulting organization	IT Manager	Regional	SCRUM/CANBAN Practices
3	Regional Government	Product Owner	Regional	Agile Project Management
3	Regional Government	General Director	Regional	Agile Project Management
3	Regional Government	General Inspector	Regional	Agile Project Management
3	Regional Government	IT Project Leader	Regional	Agile Project Management
3	Regional Government	General Inspector	Regional	Agile Project Management
3	Regional Government	General Director	Regional	Agile Project Management
3	Regional Government	General Director	Regional	Agile Project Management

In the next sub-sections, we detail the thematic challenges identified as well as the insights gained from the focus groups. Table 14 provides a summary of the different Thematic Challenges (TC) identified, their occurrence in the three focus groups, the number of challenges (as reported on post-its). We will also detail how the identified challenges impact the Agile Principles (AP) detailed in the Background section.

Table 14. Challenges identified in Focus Groups

ID	Thematic Challenges	Occurrence in focus groups	Number of Challenges reported by Practitioners
TC1	Internal Competences	3	16
TC2	Mobilization of users	3	12
TC3	Internal Stakeholders Alignment	3	11
TC4	Drivers to Adopt Agile	3	11
TC5	Impact of Regulations	3	10
TC6	Hierarchical Structure	3	10
TC7	Resources Management	2	6
TC8	Domain Complexity	1	9

6.2.3.1. Internal Competences (TC1)

The most often reported challenge is the lack of internal competences, also reported as the unavailability of specific IT profiles in e-government teams. For example, several participants pointed out that team members are over-specialized, that they lack time and resources to continuously improve their own competences and that their soft skills and knowledge of agile methods may be limited. This lack of "Competences" is most likely not specific to the e-government domain but can be a result of the low attractiveness of the public sector as reported by some practitioners. Indeed, participants reported that governments have difficulties attracting specific profiles to facilitate the digital transition. However, it can also be the result of the low investment by leaders in the implementation of methods such as agile with no immediate pay-off. This challenge has a number of consequences. First, it is hard to find common lexica and understanding with other public agents to discuss the advancement of projects, making communication difficult (AP6, *Face to face Communication*). Secondly, there is a lack of cross-disciplinarity within development teams, although that is one of the main practices in agile methods. Indeed, self-organization is difficult if the team cannot support all necessary development tasks (AP11, *Self-organization*). Most developers in e-government projects are specialized in clear-cut tasks, which can lead to a decrease in technical excellence (AP9, *Technical excellence*).

Hypothesis: TC1 impacts AP6, AP9, AP11

6.2.3.2. Mobilization of users (TC2)

The second most frequently reported thematic challenge is the difficulty to mobilize and motivate users to participate. Close collaboration between users and developers is an essential Agile Principle. In the case of governments, users can be the citizens, businesses or even public servants. When these users are the citizens, participants reported that their number and the diversity of their profiles make it difficult to identify a fitting participation methodology. The use of representatives was discussed in the focus groups, but several questions remain unanswered: Can the representatives fully understand the needs of the whole user population? How to ensure their availability? The matter of availability has been discussed for the specific case of public servants as users. Indeed, if development teams work in an agile way, there is a need for other internal public servant users (sometimes from other departments) to adopt agile principles to be more available and reactive in communicate their requirements and feedback. Thus, the diversity of e-government users makes their participation in the development process difficult (AP4, *Close Cooperation*). Furthermore, the lack of user participation may make the integration of late requirements difficult (AP2, *Welcome Changes*) and thus decrease the delivery of valuable systems aligned with the requirements of users (AP1, *Valuable Delivery*).

Hypothesis: TC2 impacts AP1, AP2, AP4

6.2.3.3. Internal Stakeholders Alignment (TC3)

Governments constitute a diverse ecosystem with multiple internal stakeholders, each of which has his/her own objectives. Among these stakeholders, there are different business teams that do not always communicate with each other, leading to some extent to a silo structure. This structure may hamper the alignment of development projects in the organization. Furthermore, different IT teams may have different maturity levels regarding agile methods. This bimodality leads to a more difficult alignment internally. The silo structure is particularly widespread in large governmental organizations. Thus, the alignment between the different stakeholders and teams makes it difficult to implement agile methods in the governments at scale. The participants reported that the silo structure leads to a lack of communication between units (AP4 *Close Cooperation*, and AP6 *Face to face Communication*) and makes the improvement of the overall development process difficult (AP12, *Continuous Improvement*).

Hypothesis: TC3 impact AP4, AP6, AP12

6.2.3.4. Drivers to Adopt Agile (TC4)

Another crucial challenge resides in the need for influential drivers (or sponsors) able to give impetus to the implementation of agility. There are two main methods to transition to agile: bottom-up and top-down. In the bottom-up approach, the willingness to change development practices emerges from the operational development teams themselves. In this case, the main challenge is to convince the leaders of the organization to invest in a sustainable change towards an agile way of working. Indeed, if projects are not built around motivated individuals, they contradict an essential Agile Principle (AP5, *Motivation and Trust*). In the top-down approach, the strategic leaders of governments impose the adoption of agile practices by the development teams. However, this sponsoring does not always lead to concrete actions (hiring of agile specialists, support of pilot projects, etc.) as participants stated that short-term objectives often drive the IT strategy in governments. More generally, these difficulties in finding drivers for Agile methods raise the question of innovation in the public sector: who has the capacity and the responsibility to drive innovation in the products and services of the governments? This challenge does not impact a specific agile principle, but is an essential pre-condition to the implementation of agile methods.

Hypothesis: TC4 impacts AP5

6.2.3.5. Impact of Regulations (TC5)

Governments have to take into account the new regulations in their processes and in their development projects. Several participants in the focus groups pointed out that regulations significantlyimpact their development practices and may be in tension with their willingness to implement agile methods. They stated that they were awaiting regulations (e.g., regarding data security) that often lead to delays impacting the team's ability to deliver valuable software (AP1, *Valuable Delivery*). Since these regulations contain critical information that may have significant impacts on the system to be developed, the project team is not able to work on the system at a constant pace (AP8, *Constant Pace*). Furthermore, the impact of regulations on e-government services are sometimes not budgeted but nevertheless have to be incorporated into the development. The specific regulation regarding government procurement was cited as the main regulatory barrier. Since, in government procurement, the planning and outputs of development projects have to be fixed upfront, it makes it difficult to change the scope of the project afterwards. The lack of scope flexibility is in tension with the agile principle (AP2, *Welcome Changes*) which involves welcoming changes, even late in the project. However, agile methods could also constitute a lead for a solution, as it provides support for changes in priority during the development process in response to new regulations.

Hypothesis: TC5 impacts AP1, AP2, AP8

6.2.3.6. Hierarchical Structure (TC6)

Governments tends to function hierarchically. This top-down way of working is present within governments as all major decision validations regarding the project or resource requests have to pass through several official decision-making bodies ("Steering Committee", "Working Group", etc.) which slows the development process as a whole (AP8, *Constant Pace*). The pyramidal structure is in tension with the transversality advocated by agile methods (AP4, *Close Cooperation*), since each department has to follow its own hierarchy. Furthermore, participants reported that leaders in governments are reluctant about the concept of scope flexibility (AP2, *Welcome Changes*), as it is perceived as a loss of control over projects. Furthermore, the top-down culture is also a consequence of the influence of political representatives on the functioning of governments. Development teams see their work heavily influenced as politicians require the projects to be modified to fit their own needs and agenda, often linked to the agenda of the elections. This reduces the self-organizational margin of teams (AP11, *Self-organization*) and increases the complexity of the development process (AP10, *Work Simplicity*).

Hypothesis: TC6 impacts AP2, AP4, AP8, AP10, AP11

6.2.3.7. Resources Management (TC7)

Despite their limited budgets, Belgian governments are required to innovate and develop their online strategy. Among other consequences, strategic leaders from the third focus group reported that this lack of resources in governments led to a lack of internal competences as described in the first challenge. When asked to "do more with less", governments are reluctant to engage in agile methods as these are perceived as experiments with no clear pay-offs or cost-reduction. There is indeed no awareness that agile methods can deliver value, also over the short-term. Furthermore, the up-front resource management, based on legally binding software requirements specification, makes it difficult to review the scope of the project (AP2, *Welcome Changes*). This reluctance to invest in agile methods is also a consequence of the "Hierarchical Structure" and the agenda of political representatives, who prefer to invest in short-term projects so as to deliver value before the end of their mandate.

Hypothesis: TC1 impacts AP2

6.2.3.8. Domain Complexity (TC8)

The last e-government specific challenge relates to the complexity of the governmental domain with its regulations, diverse user base, security requirements, size of the projects, etc. Some participants reported that this complexity is in tension with the notion of short "Time-boxed iteration" advocated by agile principles, as most important requirements take time to be integrated in the software. Indeed, the participants in question consider that some requirements cannot be delivered as a "working piece of software", as agile methods usually recommend (AP3, *Frequent Delivery* and AP7, *Target Working Software*). Therefore, the initial planning of the iteration delivery is made difficult.

Hypothesis: TC1 impacts AP3 and AP7

6.2.4 Recommendations

In this section, we launch a discussion on a possible tailoring of agile methods to the e-government challenges identified in the previous section. Table 15 summarizes the impact of each challenge to the Agile Principles described in the Agile Manifesto (summarized in the Background Section).

Table 15. Summary of Impact of Challenges on Agile Principles

	AP1	AP2	AP3	AP4	AP5	AP6	AP7	AP8	AP9	AP10	AP11	AP12
TC1						X			X		X	
TC2	X	X		X								
TC3				X		X						X
TC4					X							
TC5	X	X						X				
TC6		X		X				X		X	X	
TC7		X										
TC8			X				X					

Table 15 makes it possible to identify which agile principle is impacted the most by the identified challenges, i.e. "*Welcome changing requirements, even in late development*" (AP2). Particular attention thus needs to be paid to tailoring practices to implementing this principle. Furthermore, Table 15 also

shows that TC6 (Hierarchical Structure) is the challenge that impacts the most the Agile Principles. This challenge, although not reported as the most important by practitioners, seems to be the barrier with the highest impact on agile methods implementation.

However, this study is only the start of an interesting sub-domain of the e-government research area and has limitations that suggest paths for further research. First, we chose to study the impact of the Thematic Challenges on the Agile Principles as stated in the Agile Manifesto. Further studies should use other constructs as a basis for the impact analysis. For instance, the impact of the Thematic Challenges on the operational agile practices could constitute an interesting lead for further research. Secondly, our findings reflect the situation in Belgium and should be validated in other countries with different state structures, cultures and maturities in e-government. Furthermore, the findings could also be further validated through focus groups with a different composition in terms of participants. In this study, we controlled for the aspects of the federal level and hierarchical positions, but other factors could affect the discussions: agile knowledge, digital literacy, size of the organization etc. To illustrate this limitation, some *Digital Transition Challenges* identified in previous work (Chantillon et al., 2017b) were not discussed in the focus groups. For instance, the digital divide of the population was not addressed. This divide impacts the development of e-government service, since it increases the need for user-friendliness and for multi-channel service delivery. We may argue that this digital divide of citizens may impact the user involvement principle of agile methods (AP4) as a diverse range of users should participate in the development to ensure representativeness. Furthermore, the participation of users with a lower digital literacy might make the collection of requirements difficult.

Finally, these challenges should also be validated in a concrete setting through case studies in governments. In that regard, all the identified challenges could lead to action research in concrete settings in order to design innovative solutions to tailor agile methods. At this stage, we have already reflected on leads for potential solutions to the adaptation of agile methods to the e-government domain. Concerning the mobilization of users (TC2), leads for solutions could be found in research on user participation in information systems. In the previous section, we have established an inventory of participatory methods to stimulate this participation (Simonofski et al., 2017b; Simonofski et al., 2017a). Among these methods, one particular method is particularly suited to fostering user participation: dedicated software that applies the crowdsourcing paradigm to the requirements engineering process (Snijders et al., 2015). With such methods, the large user group of e-government services could be targeted more easily. The regulatory challenges (TC5) may be handled by keeping a Waterfall process at the beginning of the project or around the release time, while implementing an agile process throughout the system development phases. For example, government organizations are usually required to prepare plans for security emergencies on critical infrastructures. The preparation of such documents may require the intervention of several specialists and is often a precondition for the approval of the software. In such cases, a waterfall process could precede the iterative development phase. Similarly, when several operations, including the verification of regulations (e.g., citizens privacy rights), are required to take software to production, a Waterfall process can subsequently be implemented. Challenges such as the lack of alignment between e-government stakeholders (TC3) and the lack of drivers (TC4) can be addressed through the implementation of a change management initiative at strategic levels of organization. Various change management models could be considered, e.g., the Satir process model and the Kotter's eight-step model (Cameron and Green, 2015). In summary, by examining all the identified challenges in-depth, we should be able to provide a concrete agile methodology that fits the specificities of e-government.

6.2.5 Contributions

In this section, we have identified, refined and validated the challenges that practitioners face when implementing agile methods in an e-government setting in Belgium. Therefore, this study contributes in several ways to the existing body of knowledge on agile methods for the development of e-government

services. First, it contributes to research by providing empirical validation of the constructs identified in (Ayed et al., 2017) for *Agile Implementation Challenges* and (Chantillon et al., 2017b) for *Digital Transition Challenges*. Second, it suggests and validates the challenges that could hamper the implementation of agile methods in an e-government context. This contribution is helpful for research, as it allows researchers to build on these challenges to further examine agile methods in e-government. However, this contribution is also helpful for practitioners, as it can be used as a check-list for points to consider before investing in an agile strategy and before tailoring a method. Third, this study also opens up a discussion on the tailoring of agile methods to the specificities of governments. This tailoring will take the form of specific guidelines that reuse practices from several agile methods (e.g. SCRUM). The design science research paradigm will help to consider these guidelines as artefacts to be refined by means of several research activities. The first research activity that we intend to perform next is to conduct in-depth interviews with agile practitioners that have successfully implemented agile methods in their governmental organization. Next, we will extract best practices and test them in concrete settings thanks to the action research paradigm. After several iterations, we expect to formulate valid guidelines that will adapt the software development processes of government to the challenges we identified. Finally, this section presents the first influencing factor that will be part of the theoretical model of UParticipate by formalizing organizational challenges that can have an impact on user participation, using agile methods as proxies.

6.3. Project Stages

In this section, we examine a second influencing factor that impacts the decisions of project managers related to user participation: the stage of an e-government development project. The main goal of this study is to examine how user participation is enabled at all stages of a local e-government project. Furthermore, we also seek to examine the nature of the relationship with the participation stimulated by smart city research. However, we do not limit the perspectives of participation to these two research fields but we also map it to the user participation perspective as found in information systems engineering. In order to reach that goal, we examined one particular city's engagement in participation methods through the lenses of e-government, smart city and user participation: the Belgian city of La Louvière. We had the opportunity to help them from the start to develop their strategy and to monitor the implementation of participation methods. Through a one year plus study, we were able to conduct in-depth interviews with major practitioners in that city. They were linked either to the e-government or to the smart city strategy of La Louvière. We, therefore, examined how the different stages of the e-government strategy were impacted by the participation methods and which challenges and benefits emerged from this strategy. Furthermore, we also had the opportunity to make recommendations about the participation methods applied following action research's methodological best practices.

This part is structured as follows: in the Background section, we present the concepts of e-government, smart city, participation, and their interrelations. In the Methodology section, we formulate the research gap this study addresses and describe how the study of La Louvière was conducted following best practices in action research. In the Results section, we present the e-government strategy of La Louvière and the participation methods implemented based on our recommendations. In the Recommendations section, we reflect on the research implications of how to bridge the gap between smart city and e-government research. Then, we give recommendations for practitioners involved in an e-government implementation process to help them develop their projects with the aid of participation methods. The Contributions section summarizes the contributions and limitations of the study and details how this study is relevant for UParticipate.

6.3.1 Background

In order to examine the different stages of an e-government project, we draw inspiration from the Human–Computer Interaction (HCI) research area. HCI is closely linked to participation, as its core idea is to involve the end user in the development of a system. Hence, HCI can help to gain insights into citizen participation in cases where the e-government project consists in developing a system in which citizens are end users. In particular, user experience (UX) becomes critical in the development of e-government services, as these often reflect complex procedures. Hartson and Pyla (2012) believe that developing systems that guarantee a high-quality user experience is an iterative process composed of four steps. These steps are "Analysis", where data on end users' needs and wishes are gathered and analyzed, "Design", where design alternatives for the participatory system in progress are built and reflected upon, "Prototype", where prototypes of the system are built with various fidelity levels, and "Evaluate", where the prototypes are evaluated by UX experts and/or end users. These steps are iterative and can overlap (for instance, a quick prototype can be sketched to foster discussion in the "Design" step). Considering citizens as end users, the participation methods listed in Section 6.1 can be invoked in all four stages of the process in order to guarantee a high usability and in turn an efficient use of the system by citizens. For instance, interviews for the analysis, workshops for the design, living labs for the prototyping, and questionnaires with usability tests for the evaluation. In the next sections, we will refine and apply this methodology to a specific e-government project.

6.3.2 Methodology

We have chosen to apply Action Research methodology, defined as “an approach in which the action researcher and a client collaborate in the diagnosis of the problem and in the development of a solution based on the diagnosis” (Bryman and Bell, 2007). We believe this approach is appropriate, as it entails close collaboration between the researchers and the members of the organization in which the research takes place. In this case, we applied this methodology to the case of La Louvière, which wanted to engage in an e-government strategy and develop an e-government portal to offer its services online.

For each of the four steps of the e-government strategy described in the next section, we applied the four stages of the action research spiral as described by Altrichter, Kemmis, McTaggart and Zuber-Skerritt (2002):

- Plan: in this step, with the aid of best practices from the scientific literature, we were able to assist La Louvière officials in the design of a participatory e-government strategy.
- Act: by means of on-field interaction, La Louvière officials implemented the actions and strategy discussed in the “Plan” step.
- Observe: in this step, we were able to understand the impact of the actions taken upon the daily lives of the stakeholders as well as the impact on the portal that was to be developed.
- Reflect: By means of in-depth interviews and focus groups, we were able to reflect on the process and to make improvements for the next iteration.

Table 16. Interviewees in La Louvière

ID	Function	Responsibility	Gender	Number of interviews
1	Head of Unit	Designing the e-government strategy	Man	8
2	e-Government Manager	Implementing the e-government strategy	Woman	3
3	Document Management System Manager	Rationalizing the internal processes	Woman	4
4	Head of IT	IT Support of La Louvière	Man	2

In order to plan and reflect on the e-government strategy, in addition to the close collaboration with the stakeholders during the one year plus study, semi-structured interviews were scheduled with relevant stakeholders throughout the process, as listed in Table 16. This qualitative method is effective when covering a complex topic in detail and to collect experiences from the practitioners in-depth (Baarda et al., 1996; Boyce and Neale, 2006). Unfortunately, this method is prone to interviewee bias, as individuals may give a distorted view of the subject. Triangulation is thus crucial for the validity of the research. Therefore, people from four different positions and perspective were interviewed to obtain the following perspectives: a strategic project management perspective, two operational perspectives (portal design and procedure rationalization) as well as a technical perspective. The interviews occurred in February, April, June, August, September, and November 2017, as well as February and March 2018. These semi-structured interviews were supplemented by more informal discussions throughout the whole project, as the different interviewees were continuously open for collaboration and feedback.

For each phase of the e-government process of La Louvière, we implemented the four main steps of action research (Plan, Act, Observe, Reflect) as summarized in Table 17. First, the global e-government strategy was formulated by the stakeholders. Second, the as-is processes of the administration were

rationalized before engaging in any IT investments. Third, an online portal was developed to simplify the internal processes as well as the services offered to citizens. Finally, a feedback mechanism (in the form of an online survey on the portal) was added in order to gather input from the users. Improvements to the portal were made based on this feedback. This survey constitutes the only quantitative method to collect data from users in the overarching action research methodology, due to the high number of citizens using the portal. A large-scale method was a more effective way to collect representative feedback.

Table 17. Action Research: Study Summary

	Plan	Act	Observe	Reflect
Strategy	Presentation of a theoretical framework and review strategy drafts by the researchers	Diffusion of the strategy internally	Interviews	Advice for the "Digital Strategic Plan" and continuous improvement of strategy
Processes	Recommendation of participation methods	Set up of a working group	Interviews	Benefits and inconveniences of the first participation activity
Portal	Agile practices and testing	Design of the portal	Interactive testing + interviews	Collaborative work analysis
Improvement	Introduction of feedback mechanism	Introduction of a satisfaction survey	Live testing + interviews	Analysis of insights from citizens and improvement

6.3.3 Results

The research performed in the Belgian city of La Louvière (80,719 inhabitants) was particularly interesting, as no e-government actions had been taken prior to our intervention. Thus, from the outset, we were able to analyze the different challenges and choices that the stakeholders had to make. Furthermore, La Louvière was also an interesting choice as there is an important digital divide amongst its citizens in terms of skills and access to IT tools. The term "digital divide" is used to refer to the differences in digital literacy and access to digital tools among citizens, but digital inequality is not limited to its cognitive perspective. Indeed, La Louvière is a city of the Wallonia region where access to IT resources and internet is low compared to the EU average (Statbel, 2016). Furthermore, interviewees also stated that, according to their personal experience, the citizens of La Louvière suffer from a high digital divide as a consequence of the large proportion of unemployed people (21.85%), who rarely interact with e-government services.

This section is structured around the four main phases of the e-government project of La Louvière. For each of these phases, we detail how specific user participation methods were used to gather the input of citizens or public servants.

6.3.3.1. Formulating the strategy

In this initial step of the e-government strategy of La Louvière, it was first necessary for the stakeholders to fully understand the ins and outs of e-government prior to starting any concrete action. Thus, we provided a course on e-government for the head of the unit in which the managerial and technological opportunities and challenges were discussed. A specific e-government maturity model was presented. The head of unit reacted very positively to this structuring maturity model as it "allowed him to present

his ideas and implement the e-government vision concretely". With the help of this structuring theory, it was also easier for the head of unit to present the draft strategy to the political representatives in order to secure the project's funding.

We were able to make recommendations about the strategy on three main axes. First, the necessity to work in an agile manner through the iterative execution of the different phases of the project. Second, the need for increased consideration for citizens during the testing of the portal and its refinement. Finally, the need to make good use of a variety of communication channels (mail, social media, etc.) in order to inform the public of the new strategy.

It must also be stated that the strategy evolved throughout the project. At the latest stage of the study, the e-government strategy evolved towards a "Digital Strategic Plan". In this new plan, the head of unit organized the current and future actions of the city around several smart city dimensions. The e-government project could only be found in the "smart governance" dimension. however, the "smart people" dimension also introduced some elements applicable to e-government, such as the nomination of "digital referents" within each department or the organization of workshops to train the staff.

6.3.3.2. Rationalizing the Processes

After the validation of the strategy by the political representatives, two new staff were hired to implement the strategy. First, an e-government manager was recruited to plan the development of the e-government portal on which citizens would be able to access the majority of the services provided by the municipal administration of La Louvière. Second, a Document Management System (DMS) manager was hired, as the rationalization of the as-is processes constitutes an essential preliminary step to the e-government portal development. The DMS activity has limited impact on the citizens but allows for self-evaluation of the internal processes and workflows by public servants. Thanks to this activity, the public servants benefited from common encoding metadata and facilitated the back-office adoption of the portal. The participation of public servants in the strategy was not limited to the DMS but shaped the whole e-government strategy. In order to increase the acceptance of the project and to gain input from public servants, the e-government manager organized interviews and group discussions (method: interviews) to explain the methodology applied in the strategy to one representative from each department impacted (Human Resources, IT, Records Management, Communication, Finance, Legal, etc.). The idea behind this working group was also to identify people who could prove to be valuable resources within each department. The e-government manager stated that "the overall reaction from public servants was positive since they had the opportunity to give ideas and feedback beforehand". However, the manager also noted that "the digital divide is present within the population but also internally between departments. Therefore, the explanations had to be adapted in accordance with the digital literacy of the department". The work performed by the DMS Manager also benefited from these participation methods. After she analyzed and modelled the existing process as is, she worked in pairs with the representatives from each department to validate the workflows.

6.3.3.3. Designing the Portal

While integrating the input internally and rationalizing the processes, the e-government manager also acquired an e-government software from an IT company specialized in that domain. Through a contact developer at that IT company, they were able to work in close collaboration with the manager, giving direct feedback to customizing the portal of the IT firm. It must also be noted that the IT company works with Open Source software that encourages continuous improvement and feedback from their users. However, the manager noted that the collaboration was sometimes hindered by the difficulty for the developer to fully understand the complex requirements of the manager.

After a first iteration, the manager subjected the portal to interactive testing internally in order to gain further input from the public servants. The organization of workshops with citizens was discussed but not conducted, due to time and budget constraints.

The e-government manager also took into account feedback from various stakeholders as well as from the public servants. For instance, she collaborated closely with another city working on a similar portal project to exchange best practices and to understand the risks of failure. Furthermore, we intervened as researchers to conduct live testing on the portal (method: prototyping). We also conducted a heuristic evaluation following the method prescribed by Nielsen and Molich (1990). This evaluation was relevant at this stage of the project, as it could be used to eliminate usability problems prior to live testing of the portal. Another advantage of heuristic evaluation is that it produces rich results with little effort and does not require extensive UX training. Later, a live testing session was organized at the municipal administration of La Louvière. We approached citizens who were coming to perform administrative tasks and suggested that they try the portal instead of going through the traditional time-consuming process. As it is often the case with live testing activities, most citizens preferred not to use the portal. However, we gained valuable insights into the barriers citizens experience when facing such a portal. The most common barrier was that the portal did not support the specific administrative processes needed by the citizen. The other frequent hindrances were the lack of time (many citizens felt that they would not save time by using the portal) and perceived complexity, reflecting the digital divide among citizens. In addition, we think that a large majority of citizens consider administrative tasks to be a chore. As a result, they come to the city administration keen to get it over with and are not inclined to try anything new. This would explain the unconvincing reasons for not using the portal that we received from some citizens, with one of them refusing to use the portal because she, in her own words, has “the brain of a goldfish”. On a brighter note, the citizens who did use the portal were satisfied overall, despite the minor usability issues they encountered. One said that “it is quite nice of the city to make this available to the people of La Louvière”.

Figure 21 presents a screenshot of the current version of the portal. This portal is an essential first step in the city’s e-government strategy, as it fits into the “Cataloguing” and “Transaction” stages described in Section 2.1. Some transactions available even offer “Vertical Integration” with the federal Belgian administration.

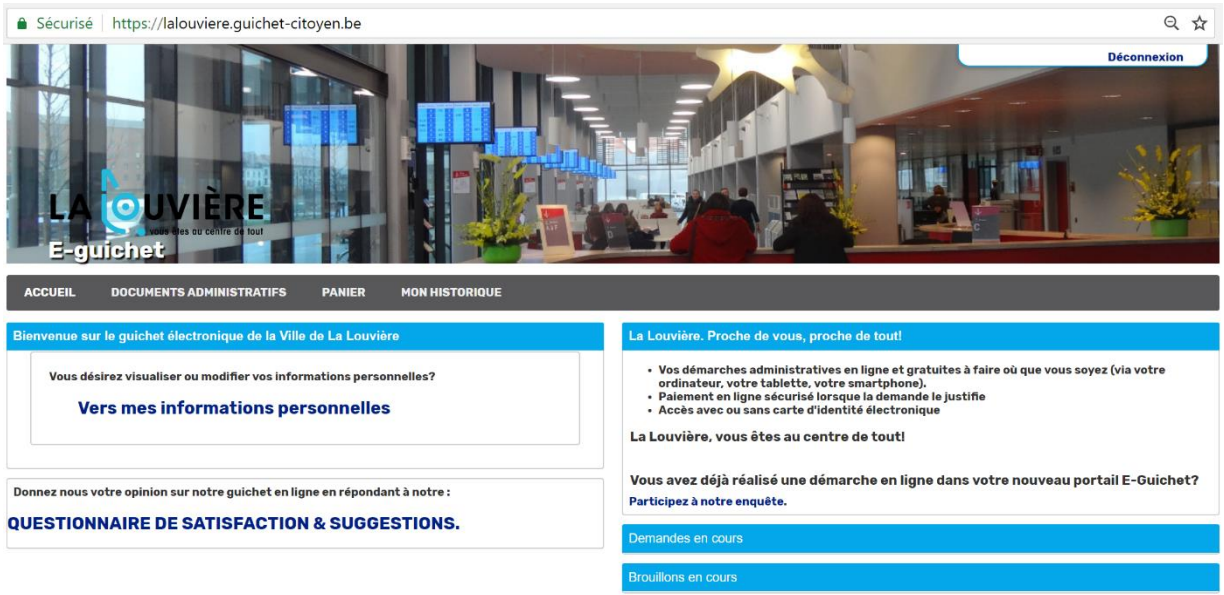


Figure 21. Screenshot of the e-government portal of La Louvière.

6.3.3.4. Improving the Portal

Six months after its online launch, more than 6,400 requests were filed on the portal by users. In order to evaluate the satisfaction and to collect the ideas of the citizens regarding the portal, we refined the evaluation survey suggested by Alawneh, Al-Refai and Batiha (2013). Their survey was intended to evaluate the satisfaction of the users of e-government portals along several dimensions (method: survey). This questionnaire enables citizens to give their opinion on:

- Accessibility: degree to which the interface of the portal is accessible for citizens with all levels of digital literacy;
- Communication on online procedures: degree to which citizens are aware of the existence of the portal and its benefits;
- Quality of online administrative procedures: citizens' perceptions of the quality of services and products available on the portal;
- Future use: citizens' intention to re-use or recommend to the portal to others.

The full satisfaction survey can be found in Appendix 9.4. The questionnaire currently has collected more than 300 responses. The responses were collected thanks to convenience sampling based on people voluntarily agreeing to answer the satisfaction survey on the portal. The link to the survey was set on the welcome screen (lower-left side of Figure 21) as well as after the citizens completed a procedure. On top of the evaluation dimensions, the survey also allows citizens to provide suggestions about future documents and procedures to put online, as well as about ways to improve the e-government strategy. Therefore, it is a direct way for citizens to participate in the improvement of the e-government strategy of La Louvière. The e-government manager of La Louvière monitors the suggestions and feedback from citizens, answering them as promptly as possible.

The e-government manager has also decided to install a terminal on the ground floor of the administration. With the terminal, citizens are able to access the e-government portal with the assistance of employees to explain its functioning. This allows people to access the multi-channel strategy of La Louvière, thus tackling the significant digital divide within the city. However, discussions are currently underway regarding the future of the terminal, as it will require additional investment to maintain a welcoming public agent to work alongside it.

6.3.4 Recommendations

In this study, we focused on the benefits of user participation in all stages of an e-government project through the introduction of three participation methods. However, this study also has inherent limitations. First, we were able to analyze the impact of only three participation methods on the project, but other methods should be examined in the future. The stakeholders we interviewed were limited to four (though we interviewed them multiple times). More information about the challenges and the perceptions of the project could have been elicited with a larger number of interviewees. Furthermore, the findings only reflect the situation of one city in Belgium and should be cross-validated with studies in other cities (of different scales, e-government maturity, population distributions, etc.) in Belgium or internationally to determine the extent to which our findings can be generalized. Another neglected aspect of this study is the physical accessibility of the portal. The digital divide is a recurrent term in discussions about smart cities. There are cases where citizens cannot interact with technology because it is physically impossible for them (for instance, they suffer from a heavy disability, or they do not have access to the required hardware). A solution labeled as smart such as the portal developed in La Louvière should tackle the digital divide from both perspectives.

In order to demonstrate the value of participation methods in an e-government project, we propose an implementation process describing the different stages of an e-government project and where the three

participation methods applied in La Louvière added value in the process. Figure 22 details this implementation process by abstracting the four main phases described in the Results Section.

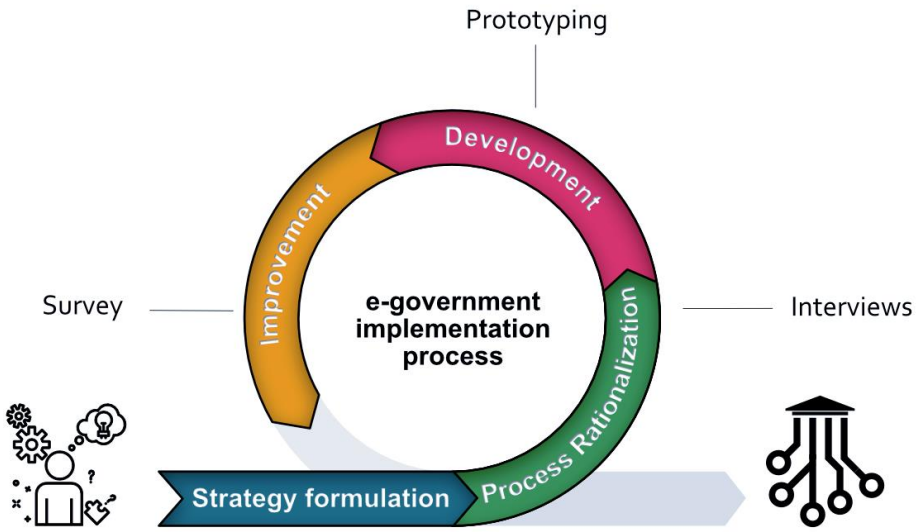


Figure 22. e-Government implementation process

Through the case studied, three different participation methods were used to introduce governance shifts in the e-government strategy of La Louvière: Interviews, Prototyping, and Online Surveys. However, many more methods are available (including ones researched in the smart city literature) which could be applied in this context. Table 18 suggests a participation method matrix where we formulate a hypothesis about the potential relevance of participation methods in each of the four steps of the implementation process. The green cells refer to the methods tested in La Louvière. In blue, we make a positive recommendation since our experience with the case studied and related research suggest that the method could have benefits for the suggested step. In orange, we make a negative recommendation, since the methods may not be appropriate to the respective phase.

Table 18. Participation Methods/Project Stages Matrix

	Strategy Formulation	**Process Rationalization**	**Development**	**Improvement**
Interviews	Positive	Tested In La Louvière	Positive	Lack of representativeness
Workshops	Positive (H1)	Positive	Positive	Lack of representativeness
Representation in Project Team	Positive	Positive (H2)	Positive	Lack of representativeness
Dedicated Software	Important investment at this stage	Not applicable	Positive	Positive
Living Lab	Important investment at this stage	Not applicable	Positive (H3)	Positive
Prototyping	Not applicable	Not applicable	Tested in La Louvière	Not applicable
Social Media	Too many stakeholders involved	Not applicable	Positive	Positive (H4)
Survey	Too many stakeholders involved	Too many stakeholders involved	Positive	Tested in La Louvière

All of the cells in Table 18 are leads for further research. The positive and negative recommendations should be tested in concrete settings. In order to illustrate these recommendations, we detail here four hypotheses that are particularly promising:

- H1: Workshops to “Formulate the Strategy”

In the context of the case studied, no participation methods were applied to formulate the strategy, as this was performed by the head of unit of the city in collaboration with the researchers. However, insights to gain ideas from citizens and public servants could have been collected by organizing workshops. Indeed, the organization of workshops to interact with a selected group of representative stakeholders has already been applied in e-government service development (Oostveen et al., 2004). The insights gained from workshops can also be helpful in more strategy-related phases before developing the e-government service. Furthermore, as citizens or public servants may be reluctant to speak openly about their ideas and feedback, facilitation techniques should be used. For instance, creativity techniques such as visualization tools or improvisation principles have already been applied (Mahaux and Maiden, 2008).

- H2: Representation in Project team to “Rationalize the Processes”

In La Louvière, the e-government manager and the DMS manager conducted interviews to understand the current processes and how they could improve them. However, the participation method was only applied to gain insights from public servants and not into the citizen’s perspective. Furthermore, their impact was limited, as they only gave information without contributing any ideas as to how best to improve the current situation. In order to give greater influence to users (including citizens), the managers could have included interested public servants or citizens in the project team (or in a steering committee) to gather direct feedback on the rationalization. This has already been underlined in the literature, as Chan and Pan (2008) advocate the identification of salient intermediaries in all phases of an e-government project.

- H3: Living Lab to “Design the Portal”

During the development of the portal, the IT manager and the e-government manager used the prototyping technique to get insights from potential users to assess the usability of the portal during its development. We argue that input can and should be gathered in other phases of the software development process (requirements elicitation or implementation). One possible method that allows this end-to-end participation resides in the Living Labs. This method, often implemented in smart cities, can be applied to explore the needs and ideas of citizens regarding e-government projects (Cossetta and Palumbo, 2014). Furthermore, additional activities could be organized within this living lab, such as hackathons to provide citizens with the opportunity to actively participate in the implementation of the solution.

- H4: Social Media to “Improve the Portal and Strategy”:

In order to get continuous feedback and ideas about their portal, La Louvière set up an online survey on the portal. However, this will only gain feedback from the people using the platform. Even though this survey gathers relevant feedback, more extensive inputs could be obtained by using social media channels. Indeed, the use of Social Media in an e-government context often refers to the political participation of citizens, but it can also be used in software development (Storey, Treude, & Van Deursen, 2010). Some authors, including Bonsón, Torres, Royo and Flores (2012), have already studied the use of social media in an e-government setting.

6.3.5 Contributions

User participation is an opportunity for governments to benefit from relevant information to design and improve their projects. The number of participation methods keeps increasing and is increasingly under discussion in various research areas (e-government, smart city, open government, information systems, human–computer interaction, etc.). However, there is little information about the impact of these methods on concrete projects.

This study contributes at several levels. First, we examined the case of La Louvière and were able to analyze empirically the impact of three participation methods in the processes of the city. Second, we were able to abstract, in an implementation process, four different steps that could be applied in other cities. Furthermore, we also suggested a participation method matrix for a participatory e-government project building on the aforementioned four phases and participation methods.

This study provides leads for further research. The participation methods presented in the matrix that were not tested in this study should be implemented in concrete cases as recommended in the Discussion Section. In addition, further research should be conducted to investigate whether the participation methods do indeed lead to an increased used of the portal in La Louvière. The impact of participation should also receive additional attention. Indeed, all activities performed in this study were limited to consultation purposes with no guarantee of an impact on decision-making. An analysis of the extent to which citizens have had an impact on the decisions of the e-government projects would be particularly valuable.

Therefore, this section presents the second influencing factor that will be part of the theoretical model of UParticipate, by formalizing the project stages that can have an impact of user participation.

6.4. Public Values

The last influencing factor we will focus on in this section involves the public values that governmental entities strive for when developing e-government services. Indeed, what tends to be forgotten in both public administration and information systems literature is the relationship between the public values pursued by the public servants working on e-government projects and the inclusion of users in those projects. Public values are an important context factor that can be described as “normative concepts that are used to give direction to public action and/or legitimize such action”, and that guide the direction and choices made by public servants (Karkin and Janssen, 2014; Jaspers and Steen, 2018); as such they are also expected to impact the choice on the type of user participation method.

The objective of this section is to examine the impact of public values on the choice of user participation methods, with a view to understanding how public values impact policy-makers in their selection of user participation methods for the development of e-government services. Since the link between public values and user participation methods has not been documented yet in literature, we performed an exploratory study with the aid of qualitative and quantitative techniques. We selected four illustrative projects where user participation was applied in an e-government context. To help us understand this link qualitatively, we designed a semi-structured interview guide and conducted one interview per project to get a better understanding of the public values striven for by the respondents as well as the participation methods used in the respective projects. To help us understand this link quantitatively, we performed a ranking of the public values for each project. This combination of methods helped us to gain a deeper understanding of the complex phenomenon that is the influence of public values on user participation in an e-government context. This study contributes at several levels. The examination of several cases where user participation methods were applied and brought benefits to stakeholders, depending on their drivers, allows us to understand the link between public values and participation. From this contribution, we derive a set of management recommendations to help the decision-makers choose which method to implement in their organization, depending on the values they aim for.

The Background section details the literature of user participation and its link with public values in the context of e-government. The Methodology section explains the exploratory research method we applied. The Results section presents the influence of the values on user participation, which is then discussed in the Recommendations section. Finally, the Contributions section summarizes the contributions, the limitations and further research leads. Furthermore, this section details how this study is relevant for the development of UParticipate.

6.4.1 Background

6.4.1.1. Public Values

We have seen in the previous sections that different influencing factors impact the choice to make use of a participation method and the specific choice of a certain type of participation method. Indeed, factors will impact the behavior and choices made by the public servants deciding on user participation methods. These context factors result, among others, from the users’ characteristics and motivation (Wijnhoven et al., 2015)n the functioning of the public administration (Simonofski et al., 2018b) or the stage of the e-government project (Simonofski et al., 2018c). All those external factors will have an impact on the choices made in the development of information systems, so those factors can be considered to be context factors impacting the internal choices.

The previous section focused on organizational challenges or project stages. However, as indicated by (Bannister and Connolly, 2015) and demonstrated by (Chantillon et al., 2018a), the relation between public values and e-government policies has been neglected by scholars, both from an organizational and individual, i.e. public servant, perspective. Also, the relation between public values and participation

methods in an e-government context has, to our knowledge, not been researched to date. What has been researched is the relation between public values and the inclusion of citizens or other users in the co-creation of services. This research has, for example, been undertaken by (Alford, 2016; Farr, 2016; Osborne et al., 2016; Jaspers and Steen, 2018). So, there is clearly an interest in the topic of public values and participation, but there is also a neglect of the relation between public values and participation methods in an e-government context. Therefore, we decided to focus in this study on the relation between the public values striven for by public servants and the influence of those public values on participation methods.

In 1952, (Kluckhohn, 1952) provided one of the first descriptions of a ”value”. The author argued that it is “a conception, explicit or implicit, distinctive of an individual or characteristic of a group, of the desire which influences the selection from available modes, means and ends of actions” (Kluckhohn, 1952). Whereas this definition correctly points to the higher level rather than individual ideas and thought, the authors’ focus lies only on values in general and not on *public* values. Bozeman (2009) states that public values provide direction to three relationships. They include “[1] the rights, benefits and prerogatives to which citizens should (and should not) be entitled, [2] the obligations of citizens to society, the state and one another; and [3] the principles on which governments and policies should be based” (Bozeman, 2009). This is a highly relevant description, since it points to the relation between the public administration and its public servants in relation to external users, here described as “citizens”. This description as such makes the connection to new approaches to user participation methods. Indeed, public values have not only an internal public administration meaning, but are highly important in steering and regulating relations with society.

We define public values, in line with (Bøgh Andersen et al., 2013) as “the ideals, coined as principles, to be followed when producing a public service or regulating citizens’ behavior, thus providing direction to the behavior of public servants.” Our specific interest lies in the public values of the public servants involved in the development of information systems. Those public values steer the behavior of public servants, and as such are also expected to influence their decisions on participation methods. Until now, however, and to the authors’ knowledge, no research has been conducted on what public values, and balances between those public values, influence decisions on participation methods. This study aims to make a contribution to this fundamental missing link on the relation between the heart of public service and its users, as “the notion of public values is at the heart of good governance” (Bøgh Andersen et al., 2013).

On the basis of recent public values research (Jaspers and Steen, 2018), a number of public values have been selected, emphasizing three clusters of public values which are expected to influence the decision on user participation methods. The first cluster focuses on *service delivery*. The public servant might decide to include users in order to increase the quality of the service that is provided to the users. Secondly, there is a cluster on a *better relationship* between public servants and the users. The focus here lies on the mutual respect of the parties in the development of services. The third cluster focuses on the democratic quality and; especially, the perceived willingness of public servants to ensure *better democratic quality*. An overview of the different public values that are related to each of those three clusters can be found in Table 19. It was decided to make use of this typology for three reasons. First of all, it is a concise typology which makes it suitable for an exploratory study. Secondly, the typology has been built from theory but has already been used in practice. Finally, and most importantly, the typology was used for research on participation by citizens in the development of services. This topic is closely related to our research, which makes it highly suitable for application in this research (Jaspers and Steen, 2018).

Table 19. Public Values (Jaspers and Steen, 2018)

Better services	Better relationship	Better democratic quality
Efficiency	Mutual Learning	Participation
Effectiveness	Trust	Empowerment
Quality	Being considerate of clients' needs: accountable, responsive, and transparent	Inclusion
Satisfaction	Being considerate of clients' capacities	Social capital
Sustainability	Reciprocity	
	Individual freedom	

6.4.1.2. Theoretical Model

As indicated above, the aim of this exploratory research is to gain a deeper understanding of the relationship between the public values that are striven for in an e-government project and the types of user participation methods which are chosen. This logic is represented in Figure 23. Our research focuses on the hypothesis that the choice of a 'User participation Method' is influenced by the 'Public Values' that are striven for in an e-government project. As explained above, we relied on the review of (Simonofski et al., 2019) for the methods and on (Jaspers and Steen, 2018) for the values. It is important to underline that within one project, several user participation methods can be used. In our view, those different user participation methods can be influenced by the different public value clusters. In order to first explore this theoretical link, we chose to study the influence of values on participation methods by a quantitative and qualitative analysis of four projects.

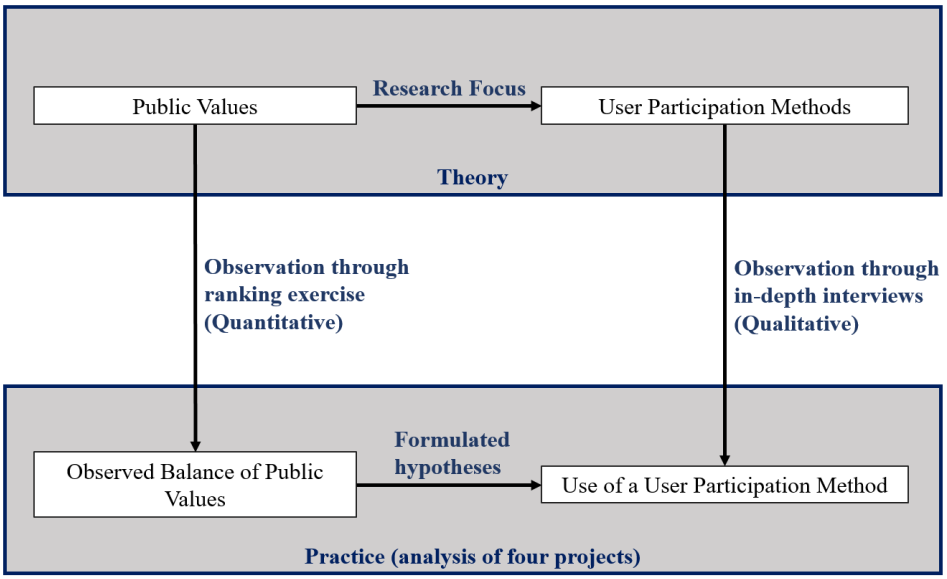


Figure 23. Theoretical Model

6.4.2 Methodology

In order to collect insights about the influence of public values on user participation methods, we performed an exploratory study of four projects to validate the theoretical model previously described

(Stebbins, 2001). We chose these four projects based on three criteria: It is part of an ongoing e-government strategy, we had knowledge about the implementation of participation methods in the project and finally, we knew different members of all four projects.

A multi-case study approach was taken whereby each project was analyzed qualitatively by means of (1) an in-depth interview with a key stakeholder and (2) a quantitative ranking exercise. A multi-case study approach allowed us to look at various cases, as we assume that there is a relation between public values and participation methods, the same phenomenon being present but in different ways in the various cases (Flyvbjerg, 2006; Yin, 2013). The exploratory nature of this study is a consequence of the lack of empirical research on the influence of public values on e-government service development. Therefore this research used an explanatory multi-case study approach.

To understand the importance of public values within each project, we performed a quantitative ranking exercise where we presented the interviewees with the different values from Table 19 and asked them to rank them according to their importance in the project. To further complete this information, we applied a qualitative approach, with a focus on in-depth interviews. This qualitative information helped us to understand the importance of public values, the user participation methods used and the relation between the two. In order to perform the interviews, we designed an interview guide (that can be found in Appendix 9.5) following research best practices (Boyce and Neale, 2006). We made intensive use of probing questions in order to gain knowledge about the public values and avoid the personal values of the interviewees overlapping with the ones driving the project. The interviews were analyzed following simple coding by the authors of this study (Minichiello et al., 2008). We then discovered the concepts and the relationships between them, based on the coding of the interview transcripts. For each of the user participation decisions, the identified keywords were categorized into more general concepts (in this case: public values clusters defined by (Jaspers and Steen, 2018)). Finally, relationships between these concepts and the participation decisions were induced from the examination of the four cases.

This multi-case study approach combines a qualitative and quantitative analysis to have a more valuable research result. The ranking exercise allowed us to have quantitative data about the public values, whereas the interviews allowed us to have information about their impact on development practices and user participation methods (Baarda et al., 1996; Boyce and Neale, 2006). This triangulation of sources improves the validity of the results (Bowen, 2009).

The four projects are presented in Table 20.

Table 20. Analyzed Projects for Public Values

Governmental Body	Governmental Level	Date of the interview	Function of the interviewee
Emergency Service ecosystem - National Geographic Institute (Belgium)	Belgian federal level	14/12/2018	Project Manager
City of Namur (Belgium)	Belgian local level	09/01/2018	Head of Data Office
City of La Louvière (Belgium)	Belgian local level	19/12/2018	E-Government Project Manager
City of Linköping (Sweden)	Swedish Local level	07/12/2018	Head of Digitalization

The first project focuses on the analysis of the development process of an emergency service tool for high-ranking officials during officials' summits in the Brussels Capital Region (Belgium). As a result of

the large number of official summits of the North Atlantic Treaty Organization (NATO) and the European Union (EU), the Belgian Ministry of Interior Affairs (MIA) asked for the development of a precise tracking tool to be used by all Belgian partners involved in the organization of those summits. This tracking tool would allow all organizing partners involved to follow the live movements of high-ranking officials, such as Heads of State and Prime Ministers. The Belgian Crisis Centre, part of the MIA, organized the development of the tool together with the Belgian National Geographic Institute, an external consultant specialized in agile methodologies and ASTRID, a semi-private organization responsible for emergency service communication coordination which is governed by the MIA. A short time period of less than six months was available for the development of the service.

The second project focuses on the digitalization of the city of Linköping in Sweden. The main goal of this project (running since early 2018) is to accelerate the digitalization of the municipality and the companies it owns. Three persons are responsible for this: one head of digitalization at strategic level and two business developers at operational level. At the time of this study, the focus was on building a framework to ensure the development of a coherent strategy in order to answer to the requirements and needs of its users.

The third project focuses on the digitalization of the city of La Louvière in Belgium, that has been running since February 2017. This project aims at improving the internal functioning of the administration as well as the services offered to the users. Three persons are involved in this project: The head of digitalization, the e-government project manager and the process analyst. The focus lies on the development of an online portal for citizens to use.

The fourth project focuses on the digitalization of the city of Namur in Belgium, that has been running for more than three years. Here, too, the project aims to improve the internal functioning through the development of interoperable applications. The main focus currently lies on the improvement of an Open Data portal and an end-to-end rethinking of the data flow in the administration. This is handled by the Head of the Namur Data Office in collaboration with the IT department.

6.4.3 Results

In this section we present the balance between the different public values, both at a clustered and non-clustered level among the four projects. Afterwards, we analyze the decisions about user participation method(s) made in the four projects and present the drivers between these decisions as explained by the different respondents.

6.4.3.1. The Balance of Public Values

In order to understand the causal relation between public values and user participation methods, it is first important to understand how the different respondents balance the different public values: what are, according to the respondents, the key public values that were striven for in the projects they worked on? The respondents were asked in to rank the 15 public values, from most important to least important in the e-government project they were working on. By ranking the public values, the respondents also assigned a number of points to each public value: The first public values received 15 points, the second 14 points and so on for the next 13 values. The last value received 1 point.

Before going into the public value cluster balance for each individual project, we present the aggregated percentages in Figure 24. We obtained this result by calculating the total sum of points for each of the value clusters for the four projects and by dividing this by the total sum of all value points for the four projects (e.g. “Better services” (BS) received 181 points in total, this was divided by 420 as this is the total number of points to be divided when ranking the 15 public values. This gives 37% in total). What is immediately clear from this balance is that the highest percentage (42%) is dedicated to the public values that fall within the cluster of “Better relationship” (BR). This is immediately followed by the BS

cluster with 37%. The cluster “Better democratic quality” (BD) only received 20% of the total points. There is as such, for the four projects together, a clear preference for the BR and BS clusters.

When looking in more detail at the balance of the public value clusters for the four individual projects, as presented in Figure 24, then it is immediately apparent that there is not a single public value cluster that receives more than 50% of the points. All clusters, in all four projects, remain under 50%, with the maximum being reached for the Emergency Services project by BR, with 48%. Secondly, the Digitalization Linköping project is the only one in which the BS cluster is the one with the highest percentage. The three other projects all three have BR as their main public value cluster. For the Digitalization Namur and the Digitalization La Louvière projects, however, this cluster is immediately followed by the BS cluster. Those two projects have a more balanced public value approach than the other projects.

A third interesting finding is the fact that for Digitalization Linköping, Digitalization La Louvière and Digitalization Namur the BD cluster is in third place, with respectively 22%, 18% and 11% of the points being assigned to the public values of this cluster. Another interesting finding is the fact that the BR cluster scores the highest in the Digitalization Emergency Services project, followed by the BD cluster. The difference between those two clusters is also the highest (17%) difference between the first and the second cluster for the four projects.

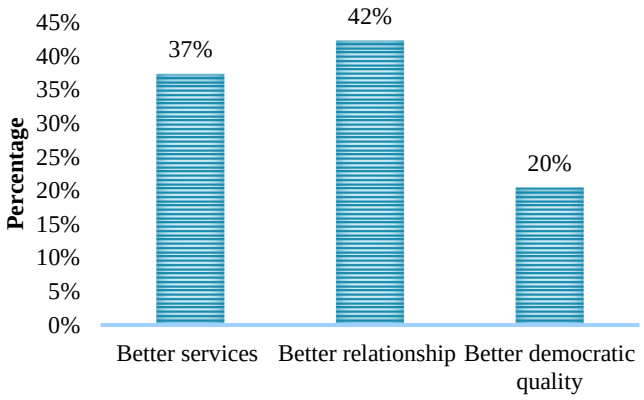


Figure 24. Aggregated Value Clusters for all projects

6.4.3.2. Influence of Public Values on User Participation Methods

This section analyses the influence of the public values previously identified on the choice of user participation methods. Figure 25 details the different participation methods that were used in the four projects, the public value cluster driving the choices (represented by the labels on the arrows) and whether or not the interviewees considered that the chosen method successfully implemented the values they aimed for. These drivers were extracted from the in-depth interviews thanks to the GT approach that was used (see 3. Methodology for more information). Regarding the implementation of the chosen values, a better democratic quality seems to be the hardest to reach as three methods failed to do so according to the interviewees. We won’t expand further on the success or not of the methods, preferring instead to focus on why they were used.

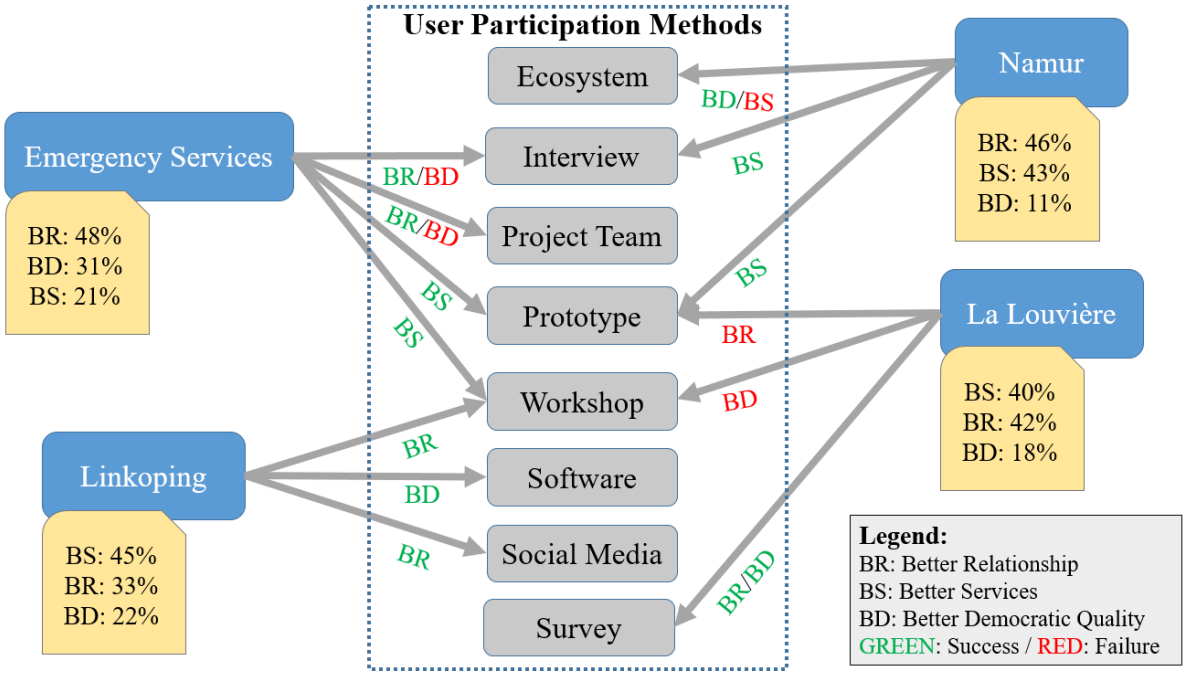


Figure 25. Influence of Public Values on User Participation Methods

The **Innovation Ecosystem** method was used only by Namur as the city leveraged its open data portals so that students could use it to develop applications. It was a way to increase the participation of users in the public domain (BD) but also a way to collect feedback to improve it (BS). The **Interview** method was used by two projects. For Namur, it was a means of better understanding the requirements of the public servants (BS). For the emergency services project, by contrast, it was performed to increase the participation and empowerment of the different stakeholders (BD), to improve their relationship with them (BR), to create more trust (BR) and to ensure that the team would sufficiently take into account client needs and capacities (BR). The **Representation in project team** was only used in the Emergency Services Project. It was deemed highly important to be accountable, responsive and transparent towards the users of the tool, elements which are part of the public value of "being considerate of clients' needs" (BR). Besides being focused on the clients' needs, the team also wantedto be considerate of clients' capacities (BR). Finally, the project team representation allowed us to ensure participation (BD) and inclusion (BD). Three projects applied **Usability Tests on Prototypes**, but for different reasons. Namur and the Emergency Services used it as a way to improve the service (BS), whereas La Louvière used it as a way to show citizens that the e-government portal is a viable alternative to more traditional procedures (BR). Three projects applied **User workshops** but for different drivers. The Emergency Services project applied it to let requirements emerge (BS), Linköping aimed at mutual learning between operational and strategic public servants for the digitalization strategy (BR), and La Louvière wanted to include people from each department so that they would feel part of the e-government strategy (BD) Only Linköping used **Social Media** as a way to improve information delivery to citizens (BR). Only Linköping also used **Dedicated Software** to collect the ideas of citizens to improve the digital strategy (BD). La Louvière used **Answer to surveys** to let citizens give feedback on the portal and give ideas to improve their digitalization strategy (BD)

We must also note discrepancies between the quantitative insights on public values and the drivers for the use of participation methods expressed in the interviews. For instance, the main public value category driving the project of Linköping is to reach BS. However, in the interviews, they mostly used participation methods to improve the relationships with their users and the democratic participation of citizens.

6.4.4 Recommendations

A first element for reflection and discussion is the discrepancy in results between (1) the qualitative interviews in which the respondents made a connection between public values and user participation methods and (2) the quantitative public values ranking. When looking at the results of the quantitative ranking exercise, we see that the Linköping project respondents puts the BS cluster first. The Emergency Services, La Louvière and Namur project respondents put the BR cluster first. We underline, however, that in the case of Namur and La Louvière, this cluster is immediately followed by the BS cluster. With this knowledge, it is interesting to make the connection to the qualitative interview results presented in Figure 25. Indeed, the results show that the user participation methods used and the public values that were striven for are not always connected to the results of the quantitative ranking exercise. This is rather surprising, and underlines the need for more research on this topic. At the same time, we try to provide a first potential explanation for this: The quantitative ranking exercise probes the importance of public values throughout the whole project, whereas the qualitative interviews look to the connection between certain user participation methods and public values, which is a more specific aspect of the project. For the project in La Louvière, for example, the first public value to achieve within the overall project was 'effectiveness' (part of BS). In the user participation methods that were applied, emphasis was placed, however, on prototype testing, workshops and surveys which fall, according to our research results, in different value clusters, i.e. respectively BR, BD and BR/BD. This could partially explain the difference. Another potential explanatory factor is the fact that working on the realization of certain public values can lead towards the realization of other public values. For example, more trust can lead towards greater effectiveness and / or service quality (Van Dyke, 1962).

The results also revealed that for some interviewees such as the city of Linköping, the user participation methods are not considered an effective way to achieve the main public values driving their projects. However, we argue that they can be an effective way, and we suggest a decision aid for doing so. Therefore, based on the alignment between the balance of values (quantitative) and the methods used (qualitative), we formulate recommendations about the use of specific methods depending on the values driving the organization. We based these recommendations on two sources of insights: (1) the reported success of the interviews in the use of the specific participation methods to reach the targeted cluster of public values and (2) the underpinning of these methods in the scientific literature to reach the targeted cluster of public values. In line with the exploratory nature of this study, these recommendations and "one-to-one" mappings should be further validated and by no means exclude other possible mappings between values and suggested methods.

If the organization aims at reaching **Better Services**, we recommend the use of *interviews* or *prototyping*, as they constitute easy-to-use methods that do not consume a lot of time. Namur, Linköping and the Emergency Services used these methods to collect insights from the users at low cost quite fast. -Interviews allow a better understanding of the business domain and of the requirements, and can easily be used in the requirements engineering phase (Billestrup and Stage, 2014). On the other hand, prototyping allows a fast presentation of the e-government service to collect feedback. For instance, (van Velsen et al., 2009) suggested a rapid prototyping process in the context of e-government services

If the organization aims at reaching **Better Relationships**, we recommend the use of *representatives in the project team*, *social media* or *workshops*. These methods are more time-consuming but allow for more creative and individual insights to be gathered. Workshops, as successfully used by Linköping, allow to discuss with each other and truly express their voices with the aid of innovative techniques such as visualization tools or improvisation principles (Mahaux and Maiden, 2008). The representation in the team allows control over the process to be given to lead users. and therefore enables the process to be transparent to them (Chan and Pan, 2008). In the emergency services case, it was an effective way to include representatives from key user groups in the project. Finally, Social Media allows delivery of the information to the users in a transparent way as well. The media can be internal to the organization or

directed to the external users (citizens, businesses, etc.) like in the Linköping case (Feeney and Welch, 2016) and (Bonsón et al., 2012) discuss the use of social media in software development.

If the organization aims at reaching **Better Democratic Quality**, we recommend the use of *surveys*, *dedicated software* or *innovation ecosystems*. Due to the larger scale of these methods, we formulate the hypothesis that they would be more appropriate to ensure a representativeness in the democratic participation of users. We must note, however, that some threats to inclusion would still be present (such as possible bias for the digital literacy). De Róiste (2013) provides an example of survey evaluation by users online, by telephone or in persons. The online survey method was used by La Louvière. In terms of dedicated software, Crowd-centric Requirements Engineering (CCRE) platforms can be used to elicit, negotiate and prioritize requirements of the users and could be applied to e-government service development (Snijders et al., 2015).Regarding innovation ecosystems, a lot of successful use cases can be found in the literature (Cossetta and Palumbo, 2014) (Briscoe and Mulligan, 2014). Namur used it successfully to improve its open data strategy.

As a next step of the research, a diagnosis questionnaire to know whether or not to go towards participation and which method to use would be a useful decision support aid for practitioners.

6.4.5 Contributions

By exploring the influence of public values on the choice of user participation methods in an e-government context, this study makes a contribution at several levels. We provide an understanding of the impact of three public value clusters (better services, better relationship and better democratic quality) on the use of participation methods. The results show that user participation methods can be implemented differently depending on the underlying drivers. Then, we derive recommendations to practitioners about the appropriate method to use depending on the context and the public values driving the organization. These contributions will open new leads for further research on the relation between public values and user participation, at the crossroads between public administration research and information systems research.

As indicated at the beginning of this section, this work is an experimental study combining both qualitative and quantitative methods to understand the effect that public values have on the use of participation methods. One limitation to this study comes from the limited number of respondents. Indeed, four cases were selected and for each case one interview was conducted. Although we agree that a higher number of interviews would have been welcome, we wish to underline that each of those projects was conducted by a small number of stakeholders. As we especially wanted to interview project participants who had been involved since the start of the project and had been in the project “cockpit”, some concessions had to be made on the number of interviews and potential respondents. Another threat to validity comes from the potential overlap between the personal values of the respondent and the public values driving the project. In order to limit this treat, we carefully explained the concept of public values to the respondent and used probing questions intensively.

We suggest that further research on this topic focuses on three aspects. First of all, it would be highly relevant to conduct a number of follow-up interviews. Not only with key figures from the projects, but also with people who were involved in the project as partner or only as an end-user. Secondly, what we also suggest is to further validate the logic of this study as well as the findings via extra projects in which user participation methods have been used. Thirdly, we suggest examining the possible relationship and mutual influence of the public values context factors with other context factors that might impact user participation decisions. Finally, whereas this research focused on the impact of public values on the choice for certain types of user participation methods, it would be most interesting to gain a deeper understanding on the effect of public values on the fact that user participation methods are used at all. In order to understand this relationship, it would be necessary to also analyse cases in which no user participation methods were used.

In this thesis, this section presents the third influencing factor that will be part of the theoretical model of UParticipate by formalizing the public values can have an impact of user participation.

6.5. Development of UParticipate

After identifying all the building blocks of user participation in e-government service development in the previous sections, we will now focus on the integration of the building blocks with each other within the UParticipate Decision Support Guide.

The section is structured as follows. In the Methodology Section, we detail how we used design science research to build the conceptual model and the decision support guide. In the Conceptual Model Section, we explain the different parts of the model and formulate hypotheses about the relationships between influencing factors and user participation. In the Decision Support Guide Section, we focus on the functioning of the guide giving recommendations to practitioners after an ex-ante analysis. In the Contributions Section, we summarize the implications of UParticipate as well as its implications for research and practice.

6.5.1 Methodology

This section details how we build the two artifacts of this research: the conceptual model about participation in e-government service development and the decision support guide derived from it. In order to develop the conceptual model and derived guide, we rely on the design science research methodology as described by (Hevner et al., 2004). Figure 26 details the overall methodology.

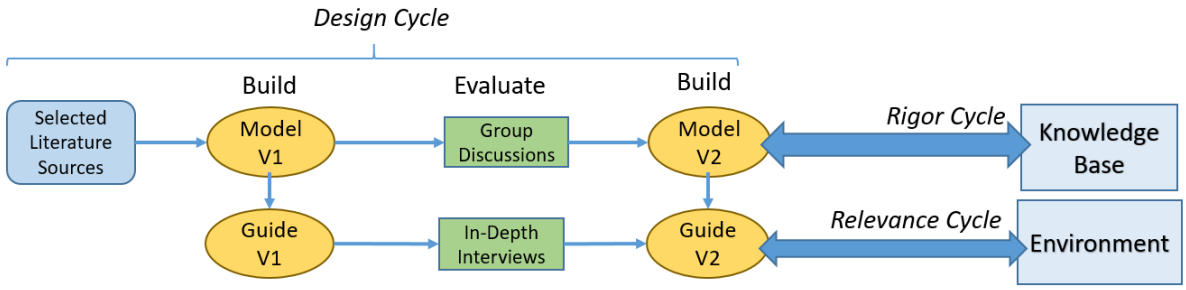


Figure 26. Design Science Research Methodology for UParticipate

In the *design cycle*, we first build the theoretical model artifact and suggest relationships between potential influencing factors and user participation, based on previous literature sources detailed in Table 21. The publications in Table 21 represent different and complementary aspects of user participation practices. These papers present hypotheses and/or insights about user participation, as well as recommendations for practice. The purpose of using these particular sources in UParticipate is to combine the output of these papers into a model for understanding various facets of user participation, aiming to capture the entire process on a higher level of abstraction. Second, we derived the decision support guide artifact from the model and derived hypotheses for the relationships. The concepts of the model and the guide were then considered as artifacts to be refined iteratively. Thus, in order to collect practical insights and validation about the model and the guide, we performed three in-depth interviews and three group discussions. In the group discussions, the focus was on the completeness of the model, by letting practitioners assess the relevance of each element of the model and give their opinion about the influencing factors. In the interviews, the focus was on the relations between the elements and the participation decisions, and the usability of the guide. Thanks to this validation, the artifacts were improved to be more aligned with the experience of project managers. An overview of the empirical validation activities conducted can be found in Table 22. Based on these validation cycles, we developed a second version of the guide and the model. In the *relevance cycle*, we ensured that the decision guide contributes to its environment and answers business needs by providing a relevant decision aid to

practitioners. In the *rigor cycle*, we ensured that the model contributes to the existing knowledge base by positioning its contributions and limitations in the contributions section.

Table 21. Literature Sources to design UParticipate

Conceptual Model Element	Main reference	Description
Participation Methods	(Simonofski et al., 2019)	Studies participation methods based on Systematic Literature Review and interviews with practitioners (more details in Section 6.1)
Degree of Participation	(Holgersson et al., 2012)	Studies three user participation approaches and validation through document analysis
Organization	(Simonofski et al., 2018b)	Explores which organizational factors impede agile methods implementation through focus groups (more details in Section 6.2)
Project Stage	(Simonofski et al., 2018c)	Explores the impact of project stages on participation methods through action research (more details in Section 6.3)
Users' Characteristics	(Wijnhoven et al., 2015)	Studies the motivations of citizens to participate based, among other things, on demographic characteristics
Public Values	(Jaspers and Steen, 2018)	Studies the link between public values and co-production (more details in Section 6.4)

Table 22. Empirical Validation activities of UParticipate

Type	Profile	Description/Role(s)
Interviews	Linköping City (Sweden)	Head of Digitalization
	La Louvière City (Belgium)	e-Government Manager
	FPS BOSA (Belgium)	User Experience Manager
Group Discussions	Information Systems Division (Linköping University)	5 e-government and IS researchers
	Federal Level (Belgium)	6 public servants working on digitalization
	Federal Level (Belgium)	6 public servants working on digitalization

6.5.2 Conceptual Model – Situated User Participation

From the literature and the empirical activities, we have chosen to study the influence of four factors (Organizational context, Project Stage, Users' Characteristics and Public Values) on user participation decisions (method and degree) from the viewpoint of a project manager in charge of e-government service development. By factor, we mean "any element, that the project manager may or may not influence, that impacts user participation decisions". The Conceptual Model and its factors are summarized in Figure 27.

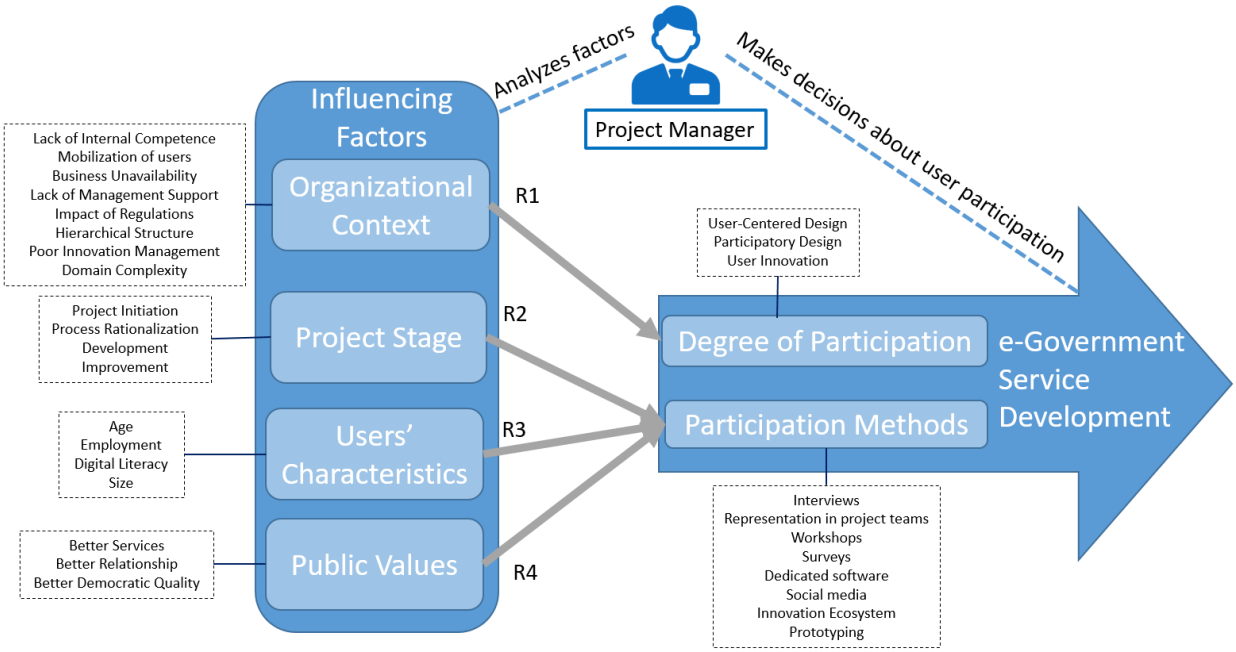


Figure 27. Conceptual Model Representation of UParticipate

In the remainder of this section, we will further expand on the two main participation decisions: the different participation methods and the desired degree of participation. We then explain the different influencing factors, and we explain how these factors may determine the best choice of participation method and degrees (relationships R1-4 in Figure 27). So that the reader have all elements of the model in mind, we briefly remind what was explained extensively in the previous sections.

The four chosen factors are consistent with the ones perceived as important by the stakeholders during the group discussions as described in Table 23. Indeed, the reported challenges could, for the large majority, be mapped to the selected influencing factors. However, due to lack of literature about the type of project, we used "public values" as a proxy, as the end goals of the organization drive the type of project developed. Other factors were mentioned during the discussions, such as the presence of previous experience with participation, the constraints of the projects, the frequency of participation over time, the possibility of anticipating needs, and the reachability of the users.

Table 23. Number of influencing factors from the group discussions

Influencing Factors	Group 1 (Researchers)	Group 2 (Public Servants)	Group 3 (Public Servants)	Total
Users' Characteristic	3	5	7	15
Organizational context	8	4	0	12
Project Stage	1	4	1	6
Type of Project (Public Values)	2	1	0	3
Other	3	1	1	5

6.5.2.1. Participation Methods

There are different methods to collect the input of users in the development of information systems; For the specific case of e-government, eight different methods have been identified in Section 6.1 and are summarized here:

- **Interviews**: Software developers often rely on this direct and simple method to gather input from users during the requirements engineering phase of the development.
- **Workshops**: This method allows interaction with a group of representative users with the aid of innovative techniques such as improvisation principles.
- **Representation in the project team**: Salient users can be considered as partners and intermediaries at different stages.
- **Dedicated Software:** Dedicated software can also be used to support development, such as Crowd-centric Requirements Engineering platforms for requirements elicitation, prioritization and negotiation.
- **Innovation Ecosystem**: Insights from potential users can also be collected thanks to new user-driven open innovation ecosystems such as living labs or hackathons.
- **Usability tests on prototypes**: This method allows for the presentation of unfinished software to its potential users to collect feedback and thereby improve it.
- **Social Media**: Social media is often considered as an enabler of political participation but can also be a lead to improve software development practices
- **Surveys**: Surveys can be used to collect insights from a large number of users through online surveys, phone or in person surveys.

We use these methods as a point of departure for the model, as they constitute an abstraction that can be further refined and instantiated according the specificities of the project.

6.5.2.2. Degree of Participation

The degree to which users are actively involved in the development process and the actual e-government service design (as a result of the various methods above) is also an important element for the project manager to consider. In order to explain this degree, we rely on the taxonomy from (Holgersson et al., 2012) that describes user participation along a spectrum of three approaches:

- **User-Centered Design** is an approach that underlines the important impact of users' needs on the design of an interface (Abras et al., 2004). Users remain passive as they only provide information to developers that hold the decision power.
- **Participatory Design** is an approach where developers and users are more equal partners in the process (Schuler and Namioka, 1993) and where users can act as advisors or representatives.
- **User Innovation** is an approach where the solutions reside within "lead" user groups that are willing and capable to develop solutions themselves (von Hippel, 1986).

The main argument for using taxonomy is that it relies on well-established approaches that constitute a spectrum in the participation from low degrees of user involvement to high degrees of involvement. More details about these approaches can be found in Section 6.1

6.5.2.3. Influencing Factor 1: Organizational context

A growing body of research focuses on the impact of the organizational context and associated challenges on software development practices. Among other studies, Ayed et al. (2012) studies how agile methods should be customized according to the specificities of the organization in order to tackle the context-specific challenges. In Section 6.2, we reported eight barriers that can impede the implementation of agile methods in a governmental context (Simonofski et al., 2018b):

- **Lack of Internal Competences**: Unavailability of specific profiles in e-government service development teams (IT, Business Analysts, Agile specialist, etc.).

- **Mobilization of users**: Difficulty in mobilizing and motivating the specific users targeted by the organization
- **Business Unavailability**: Siloed structure that impedes the internal alignment between business experts and IT stakeholders.
- **Lack of Management Support**: Lack of support from high-level, mid-level and operational employees as well as from political representatives to support the change in development practices.
- **Impact of Regulations**: Impact of regulatory compliance and political agendas on development practices.
- **Hierarchical Structure**: Presence of a hierarchical decision-making process.
- **Poor Innovation Management**: Lack of innovation due to budget constraints.
- **Domain Complexity**: Complexity of the project in terms of interoperability, security, quality, size, partners, etc.

As user participation is an essential principle of agile methods, we rely on these challenges to understand the organizational context, as the more present these challenges, the most difficult it is to increase collaboration and participation in existing processes. The organizational context impacts the decision to make use of user participation methods or not (**R1**). Indeed, if the organizational context is very hostile to user participation (with, for instance, a highly hierarchical structure and low management support), then user participation can be useless (if it is not considered afterwards), inapplicable (the project manager is not allowed to take time to implement participation) or even detrimental (waste of resources). On the other hand, if these challenges are not saliently present in the organization of interest, the organization is likely to be more inclined towards welcoming users' input. Acknowledging the specificities of the organizational context is important based on the study above, and in line with the situated perspective in this study, we include this in the framework so that the project manager is aware of the challenges of his/her organizational context.

6.5.2.4. Influencing Factor 2: Project Stage

Another influencing factor on which user participation method to implement is the project stage. In section 6.3., we reflected upon the e-government stages followed by a local community and synthetized them as follows:

- **Project Initiation**: The e-government strategy was formulated by the stakeholders in terms of scope, objectives and resources.
- **Process Rationalization**: The as-is processes of government were rationalized before engaging in any IT investments to evaluate if they needed to be adapted, transformed or even deleted.
- **Development**: The different software development stages of the new service take place in this step to simplify the internal processes as well as the services offered to users.
- **Improvement**: Feedback mechanisms allow the different stakeholders to give their opinion and ideas on the whole strategy in order to facilitate continuous improvement.

The Project Stage has an impact on the choice of participation methods by the manager. Some methods are more appropriate than others, depending on the project stage (**R2**). The full range of hypotheses has been formulated in a previous work and (Simonofski et al., 2018c) constitutes the basis for the recommendations in this study. For instance, prototyping is helpful in the development of the solution but is not necessarily applicable in the strategy formulation stage. Including the project stage is important for the project managers to understand the relevance of each method. These four stages are also broad enough to be further refined if necessary (e.g. the different software development stages under the "Development" stage).

6.5.2.5. Influencing Factor 3: Users' Characteristics

Wijnhoven et al. (2015) studied the motivations of citizens to engage in Open Government projects. Among the different themes for analysis, he focused on socio-economic characteristics such as Age and Employment. We rely on these two characteristics to understand which user base the practitioners will target with their e-government service and their participation activities. On top of these characteristics, we can also add two other potentially interesting factors: the digital literacy (Hargittai and Hsieh, 2012; Distel and Becker, 2017) and the size of the user group (Oostveen et al., 2004). The characteristics included are thus:

- **Age:** The user base can either be Young (under 20), Adults (between 21 and 59) or Seniors (above 60)
- **Employment:** The target users can be students, employed or unemployed. If they are employed, they can work in governmental bodies or not.
- **Digital Literacy:** The targeted users can have a high-level, medium-level or low-level understanding of digital artifacts.
- **Size:** The potential user population may differ in size depending on whether the service is intended for use by a small town, a city, a region or at the national level.

Users' Characteristics also have an impact on the choice of methods (**R3**). Indeed, depending on the targeted users, different methods should be used. At this stage, different hypotheses were formulated in a citizens' survey reported in (Chantillon et al., 2018c). Acknowledging user characteristics in the e-government service development is important for understanding the specificities of the target users and how it impacts their participation. Additional characteristics can be added to the model to refine the understanding of the user base.

6.5.2.6. Influencing Factor 4: Public Values

Public values are extensively discussed within the public administration literature, as they have an impact on the processes and strategies of governments. Rose et al., (2018) formulate several "ideals" to understand the underlying public values that can influence ICT development in an e-government context. In line with the service, engagement and efficiency ideals previously formulated, (Jaspers and Steen, 2018) provide three main categories of public values:

- **Better services:** This category refers to a better service delivery through values such as efficiency**,** effectiveness**,** quality, satisfaction or sustainability.
- **Better relationship:** This category refers to a better relationship between public servants and users through value such as trust, mutual learning, consideration for users' needs and capacities, reciprocity, transparency or individual freedom.
- **Better democratic quality:** This category refers to the democratic quality of the service delivery through values such as participation, empowerment, inclusion, diversity or social capital.

The inclusion of Public Value as an influencing factor on user participation practices rests on the idea of 'public value' being a proxy for the 'type' (or underlying purpose) of the project. Project managers often experience tensions between the values presented above and need to balance them in terms of their development project (de Graaf et al., 2016; Melin and Wihlborg, 2018). Therefore, they have an impact on the user participation decisions when it comes to developing e-government services. In section 6.4, we examined this impact of public values on the choice of the participation methods (**R4**).

A recent study (detailed in 6.4) examines the impact of public values on the choice of participation methods.

6.5.3 Decision Support Guide Development

The conceptual model helped us build a decision support guide for project managers. This guide was created and improved in close collaboration with project managers through in-depth interviews in order to increase its usability. These interviews helped us understand the requirements of practitioners regarding the guide. These requirements related to the process of the guide, the way to formulate questions and the presentation of the output of the guide. The process for using the decision support guide contains two parts as presented in Figure 28; (1) the influencing factors analysis, and (2) the participation methods matrix. The logic of the guide is as follows; first, each of the influencing factors will be presented to the project managers from the relevant governmental bodies in order to perform an **influencing factors analysis**. This analysis can take the form of a questionnaire on which the project manager has to enter the necessary information for each of the influencing factors. The output of these questions are labels matching the situation of the project managers, as well as scores assigned to each method, ranking them from most recommended to least recommended. Then, the decision support guide issues recommendations in the shape of a **participation methods matrix,** showing which user participation method(s) to use and to which extent the users should be actively involved in this process. These recommendations are for now based on hypotheses resulting from prior research, but can be adjusted as the guide gets used and more insight in the relationships are obtained.

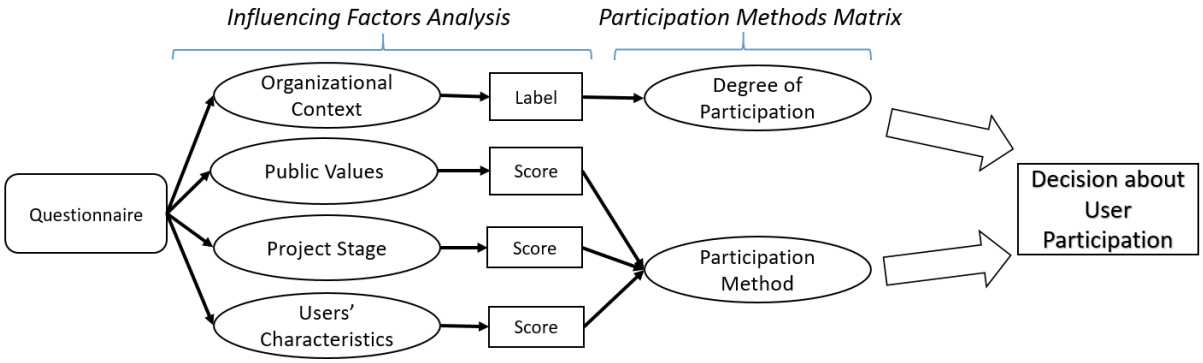


Figure 28. UParticipate Decision Support Guide Process

6.5.3.1. Influencing Factors Analysis

The **Organizational context** is formulated on a three-point scale question ranging from "Not important" to "Important" with the following template: *"To what extent is the challenge "X" important in your organization?"*. Detailed thresholds are formulated to determine if an organization scores low, middle or high to these questions.

- If, on average, the different challenges score Low, this results in assigning the label "F" (Favorable) and recommends user innovation or high levels of participatory design due to an appropriate environment.
- If, on average, the different challenges score Middle, the label "M" (Medium Favorable) is assigned and the recommendation is to focus on participatory design on small scale.
- If, on average, the different challenges score High, this results in assigning the "U" (Unfavorable) label and suggests focusing on user-centered design or not using participation methods at all.

Then, the project manager will be asked to report the **Project Stage(s)** at which he/she wishes to invoke a user participation method. Based on the hypotheses from Simonofski et al., (2018b), Table 24 reports the translation of the hypotheses into scores for each entry following this taxonomy: 0= Not Applicable / 1= Not suggested / 2= Applicable / 3=Recommended.

Table 24. Project Stage Matrix (Sample values based on hypotheses from (Simonofski et al., 2019))

	ITW	WS	REP	SOFT	INNOV	PROT	SOCIAL	SURV
Project initiation	3	3	3	1	1	0	2	2
Process Rationalization	3	3	3	0	0	0	0	2
Development	3	3	3	3	3	3	3	3
Improvement	1	1	1	3	3	0	3	3

The same taxonomy is then applied to the public values in Table 25. The questions about the Public Values are also formulated on a three-point scale question ranging from “Not important” to “Important” with the following template: *“To which extent is the value of “X” important to your organization?”*. These questions will deliver an aggregate score about the three main values categories previously described. An alternative to this formulation would be to ask the respondent to rank the values from most important to least important to avoid a high score for all categories. The hypotheses of this table are based on the research performed in Section 6.4. Depending on the values target by the managers, the recommendations from Table 25 will be applied.

Table 25. Public Values Matrix (Based on research performed in Section 6.4)

	ITW	WS	REP	SOFT	INNOV	PROT	SOCIAL	SURV
Better Services	3	0	0	0	0	3	0	0
Better Relationship	0	3	3	0	0	0	3	0
Better Democratic Quality	0	0	0	3	3	0	0	3

Finally, the taxonomy is applied to the Users’ Characteristics in Table 26. The hypotheses of this table are sample values at this stage. They are based on tendencies identified from the citizens’ surveys performed by (Chantillon et al., 2018c) and (Wijnhoven et al., 2015), as well as from the three group discussions with researchers and practitioners.

Table 26. Users’ Characteristics Matrix (Sample values)

		ITW	WS	REP	SOFT	INNOV	PROT	SOCIAL	SURV
Age	Senior	3	3	1	1	1	3	1	1
	Middle	1	1	3	2	2	2	2	2
	Young	2	2	2	3	3	1	3	3
Employment	Employed Public	3	3	3	2	1	3	1	1
	Employed	1	1	1	1	2	2	2	2
	Students	2	2	2	3	3	1	3	3
Digital Literacy	High	1	1	1	3	1	1	3	1
	Middle	2	2	2	2	2	2	2	2
	Low	3	3	3	1	3	3	1	3
Size	Large	1	1	1	3	2	1	3	3
	Middle	2	2	2	2	3	3	2	2
	Small	3	3	3	1	1	2	1	1

6.5.3.2. Participation Methods Matrix

After the influencing factors analysis, the outcome is a participation method matrix, summarized in Table 27, that recommends which method (row) to use and to what degree (column). Within each box of the matrix, two pieces of information will be found: a label and a score. The label refers to the organizational context factors, whereas the score is derived from the public values, project stage and users' characteristics factors of the model. The degree of participation (column) will be recommended depending on the assigned label. Within the recommended boxes, the higher the participation method scores, the higher the recommendation. For instance, if the influencing factors analysis revealsan unfavorable organizational context (equivalent to the U Label), we recommend the use of User Centered Design. Then, if within the User Centered Design column, the "Interview" method scores the highest, this method will be recommended. The U label could also lead to the use of no participation method for the moment or to experimently take advantages of proxies (public servants assuming up the role of regular citizens). Indeed, this is consistent with the previous argument from the literature that user participation is no silver bullet and may not be appropriate in some cases. We thus recommend the user of the guide to first tackle the challenges present in his/her organization before recomputing the guide.

Table 27. Participation Methods Matrix

	User-Centered Design (or Tackle challenges)	**Participatory Design**	**User Innovation**
Interview	U + Score	M + Score	F + Score
Workshops	U + Score	M + Score	F + Score
Representation in Project Team	U + Score	M + Score	F + Score
Dedicated Software	U + Score	M + Score	F + Score
Innovation Ecosystem	U + Score	M + Score	F + Score
Prototyping	U + Score	M + Score	F + Score
Social Media	U + Score	M + Score	F + Score
Survey	U + Score	M + Score	F + Score

Legend for Labels: **U**=Unfavorable organization, **M**=Medium favorable organization, **F**=Favorable organization

To test the usability and utility of the guide, we first applied it to the case of La Louvière, Belgium. We were able to complete the factor analysis in collaboration with the e-government manager of the city. We asked her questions from the guide from the perspective of possible user participation in the development of an online portal. The answers revealed a medium (M) favorable organizational that suggests a participatory design approach with low degree of citizen involvement. The public values analysis revealed that the city was aiming for better services. In terms of users' characteristics, they were targeting a large middle-aged population with low digital literacy that are employed outside the public sector.

Table 28. Use of UParticipate for the e-government improvement phase of La Louvière

		ITW	WS	REP	SOFT	INNOV	PROT	SOCIAL	SURV
Improvement **Phase**		1	1	1	3	3	0	3	3
Users' Characteristics	Age: Middle-Aged	1	1	3	2	2	2	2	2
	Employed	1	1	1	1	2	2	2	2
	Low Digital Literacy	3	3	3	1	3	3	1	3
	Large Size	1	1	1	3	2	1	3	3
Average **Users' Characteristics**		2	1.5	2	1.75	2.25	2	2	2.5
Public Values: Better Services		3	0	0	0	0	3	0	0
Total:		6	2.5	3	4.75	5.25	5	5	5.5

The computation of the scores, shown in Table 28, ranks the three participation methods as follows: Interviews (6), Survey (5.5) and Innovation Ecosystem (5.25). Since the stakeholders from La Louvière had efficiency objectives driving their strategy, they assumed that the interviews would be too time-consuming and used an online survey to get feedback on the portal and on the e-government strategy at the same time. They did not follow the Participatory Design methodology per se but still considered the feedback (and phoned the persons directly if necessary) into their strategy and to improve the portal. However, the users did not have an impact in the decision-making process. This strategy showed promise as, to this day, 313 forms were completed by the citizens. This enabled the city to have more ideas about their e-government portal and to know about all the problems that users faced when using it. As a reminder, the full satisfaction survey can be found in Appendix 9.4.

6.5.4 Limitations and Further Research

Even though we applied it to two use cases, UParticipate needs further empirical validation, as it is mainly based on previous research and literature sources. We intend to rely on engaged scholarship principles as described by (Van De Ven, 2007) to follow an e-government project (e.g. the UX Projects from BOSA) from the start and to document the use of the guide at different steps. As an example of future developments of the decision support guide, weights could be added to elements of the guide to balance their importance. Furthermore, additional insights on the choice of participation methods could be derived from the organization and public values elements of the model. Another limitation lies in the completeness of the model. Even though we intended to provide a model that contains enough elements to match the messy reality of ICT development and user participation practices, not all influencing factors can be included. This is in part due to the lack of hypotheses formulated in previous papers, and because we wanted to keep the model simple. For instance, the users' characteristics factor, a proper large-scale survey needs to be performed in order to have causal information between the characteristics and the participation methods. Furthermore, we used public values as proxy of "type of project" conducted. A better assessment of the type of project in which user participation is to be organized would be an interesting addition, as different e-government services (ranging from the simple online form to the complex integrated information system) require different participation methods. However, this would require further work in the taxonomy of e-government services. Furthermore, the impact of

organizational challenges on agile methods implementation has also been used as proxy of citizen participation adoption. Another key element to include in the model would be the expected outcomes of user participation, as well as their impact on the quality of the developed e-government service.

6.5.5 Contributions

The aim of this study was to support project managers in their decisions relating to user participation in the development of e-government services by taking the context into account. To reach that goal, we have provided a conceptual model and decision support guide to practitioners and researchers. This constitutes a first step toward performing an ex-ante analysis before engaging in user participation activities and toward making recommendations for a better situated participation. In that regard, this study contributes at several levels. Through the conceptual model, we provide an integrated view of user participation and its influencing factors, grounded in several literature sources. The originality of this model lies in its modular nature and has a value for future research and practice. Therefore, it can constitute a basis for the interested researcher to add further influencing factors. The formulated relationships also constitute solid ground for the interested researchers to build on in further work. Regarding the contribution for practice, the decision support guide delivers useful guidelines to practitioners in the public sector to help them design a suitable strategy. This answers the need in practice for a concrete methodology on participation. This guide will be refined by means of iterative analysis and use by practitioners, aimed at creating a decision support guide that is aligned with ICT developments in the public sector context. We intend the future tool to constitute a solid decision aid for the project managers in the future.

6.6. Empirical Validation of the Guide: Open Data Portal Development

The application of UParticipate to the case of La Louvière described in the previous section is only a rudimentary result that needs to be further refined with additional uses of the guide. Furthermore, this validation is not sufficient, as we used the case of La Louvière to design the guide in the first place. Therefore, we decided to apply it to the development of another e-government service: the Open Data Portal of Namur.

This section details the context of this validation step and, more specifically, how we helped the city implement the actions recommended by the guide. It is structured as follows. In the Background section, we give details about the challenges faced related to Open Government Data (OGD) use. Next, in the Use of UParticipate section, we explain how the decision guide was used by the data manager of the city and which recommendations were issued. In the Methodology section, we explain how we followed the recommendations from the guide, taking a class of Data Science students as a use case. In the Results section, we expand on the challenges faced by the students. In the Managerial Recommendations section, we suggest actions to improve the portal. In the Contributions section, we summarize the findings of this study as well as its limitations and further research leads.

6.6.1 Background

OGD is interoperable data published on the internet by public organizations to be freely used and redistributed by anyone (Attard et al., 2015). The public organizations, who collect and share data, are referred to as publishers, while those who reuse the data are called users (Zuiderwijk and Janssen, 2014). Users can be city managers, businesses, citizens, students, developers, researchers, Non-Governmental Organizations (NGOs), civil society organizations, or journalists (Safarov et al., 2017). OGD is a collaborative effort to realize several benefits, such as the creation of a new sector, innovative products and services, collective problem-solving, and equal access to data (Janssen et al., 2012). However, both publishers and users can experience impediments in the process, such as low data quality, restrictive legislation, paywalls or loss of income, and no interoperability between systems (Crusoe and Melin, 2018). The lack of use has been noted as a problem for OGD (Whitmore, 2014; Safarov et al., 2017). This lack means that the opportunities of OGD are not realized, and also entails a risk for publishers to invest in something that never reaches fruition.

Central to use is the user process, which can be depicted in several ways. Normally, the user process is depicted together with the publisher process as interdependent (Attard et al., 2016). In such instances, the processes form a circle where the publisher shares data with the user, who later responds with feedback. The process is supported by infrastructure (e.g., application programming interface (API) and OGD portals), which needs to be designed to support users' and publishers' activities. The publishers and the users can experience impediments, such as low-quality data and machine-unreadable formats. Impediments are difficult to solve as they can be connected to each other, be caused by activities earlier in the process, and vary in severity (Zuiderwijk and Janssen, 2014). Table 29 summarizes the process depicted by (Crusoe and Ahlin, 2019).This process takes the point of view of the user and will be used as theoretical background in order to implement the actions recommended by UParticipate.

Table 29. OGD User process activities and impediments

Phase	Activities	Sources of impediments
Motivation: The user needs to be aware and motivated to use OGD. In this phase, the user is trying to identify some way to use OGD	Discover OGD and identify where OGD can be used	Public advertisement, understand how OGD can be used, and examples of use
Search and evaluate: The user is searching on the Internet, OGD portals, and publishers' websites for promising data to use. Once promising data has been identified it can be evaluated to determine if it fits with the objectives of the motivation phase	Engine searching, portal searching, browsing the publisher's website, pre-evaluate data on an OGD portal, and evaluate data on the publisher's website	Search features, presentation of search results, metadata, must download the data to evaluate, tools to explore and analyze data, language, and licenses
Access and prepare: The user has the goal to acquire promising data and transform it into usable data.	Manuel access (e.g., download PDF), automated access (e.g. API), and prepare data.	Access method, documentation, filtering, data format, data quality, accessibility, registration, and support
Aggregate and Transform: The user has the objective to combine data and transform the new dataset into information, a product, or service.	Aggregate data, analyze data for information, and develop a product or service	Combine data, quality variations, availability, variations, supporting tools, longitudinal data, and domain knowledge.

6.6.2 Use of UParticipate

After having presented the theoretical background about OGD use, we focus on a concrete case: the lack of use of the Open Data portal of Namur[4]. Indeed, an interview with the Open Data manager revealed that numerous datasets were published on the Open Data portal of Namur but did not reach its expectations in terms of use. Therefore, we decided to use the UParticipate Decision Support Guide with him in order to know which participation methods to implement in order to understand what impedes users from going on the portal and using the datasets.

After completing the guide with him, it revealed that:

- The organization context of the city of Namur was **Unfavorable** (U) in terms of user participation
- The main public values cluster that was targeted was a **better democratic quality** for users
- The goal was to understand why the portal was not used, and thus we were in the **Improvement** Phase
- We decided to restrict the user group to analyze to the university students enrolled in data science, as they can be representative of the typical population using the portal. Therefore, the **Users' Characteristics** were the following:
    - Young Age
    - Students
    - High Digital Literacy
    - Small Size

[4] https://data.namur.be/explore/?sort=explore.popularity_score

Table 30. Use of UParticipate for the Open Data Portal of Namur

		ITW	WS	REP	SOFT	INNOV	PROT	SOCIAL	SURV
Improvement **Phase**		1	1	1	3	3	0	3	3
Users' Characteristics	Age: Young	2	2	2	3	3	1	3	3
	Employment: Students	2	2	2	3	3	1	3	3
	High Digital Literacy	1	1	1	3	1	1	3	1
	Small Size	3	3	3	1	1	2	1	1
Average **Users' Characteristics**		2	2	2	2.25	2	1.25	2.5	2
Public Values: Better Democratic Quality		0	0	0	3	3	0	0	3
Total		3	3	3	8.25	8	1.25	5.5	8

According to Table 30, UParticipate recommends the following actions in terms of importance:

- Dedicated Software (8.25)
- Survey (8) and Innovation Ecosystem (8)
- Social Media (5.5)
- Interviews (3), Workshop (3) and Representation in Project Team (3)
- Prototyping (1.25)

Having computed the U label regarding the organizational context, the recommendation is to use these participation methods in a User-Centered Design manner by giving less control in the processes to the users. Since the Social Media and Dedicated Software were controlled by other departments of the city, we decided to implement methods we had full control over: the issue of a *survey* and the organization of an *innovation ecosystem*. Due to the restricted size of the user group, we also decided to conduct *interviews* to collect more individual feedback from the students.

We can here note that the data manager of Namur found the guide easy to use and was satisfied with the suggested results. He also noted that "even if I choose not to follow all recommendations from the guide, it drives me to be critical and think about the best way to include users in my processes".

6.6.3 Methodology

In this section, we first discuss the context of the use of UParticipate. Then, we detail the data collection techniques we applied to measure our constructs and collect insights from users. Finally, we explain how we analyzed the data acquired from the participation methods.

In order to implement this improvement phase, we followed the four stages of the action research spiral as described by (Brydon-Miller et al., 2003):

- Plan: In this step, we relied on the user process framework by (Crusoe and Ahlin, 2019). From this framework, we selected impediments to be studied based on their perceived possible impact on use. This step was explained in the Background section.

- Act: Thanks to an innovation ecosystem setting (an hackathon-like course), we organized an exploitation of open data portals by students. This step is detailed in Section 6.6.3.1.
- Observe: By means of three participation methods (in-depth interviews and a survey within an innovation ecosystem), we were able to identify the impediments the users faced when exploiting the data on the portal. This step is detailed in sections 6.6.3.2 and 6.6.3.3.
- Reflect. This step refers to the analysis of the data collected through the participation methods as well as the recommendations for practice and research that emerged from it. The analysis of the data is further explained is section 6.6.3.4.

6.6.3.1. Context: an innovation ecosystem

In order to collect information about the impediments that users can experience when using OGD, we examined a specific data science project conducted by 30 master's students between October and December 2018. We argue that these students have high digital literacy and are thus representative of the typical OGD user population. They were asked to use open data portals from the cities of Namur[5], London[6], Paris[7] or New York[8] to develop an application valuable for the citizens or the public servants working in the administration. The guidelines for the project were reduced to a minimum to foster creativity and the real-life use of the OGD portals. The following constraint was nonetheless imposed on the students. The output of their project should be transferable to the city of Namur, provided that the city acquires and makes available the necessary data. In this way, the projects' outputs consisted not only of solutions directly applicable to Namur but also of prospects valuable to the city officials. This hackathon-like setting enables us to provide an *innovation ecosystem* to the students as recommended by UParticipate.

The two other participation methods followed were a *survey* (as recommended by UParticipate) that takes the form of a questionnaire and *interviews.* This can be mapped, in terms of research methodology, to a multi-method approach that combines quantitative (one questionnaire) and qualitative (semi-structured interviews) methods. Johnson et al. (2007) argue that a combination of methods allows for informative, complete, balanced, and useful information. This combination of methods will thus help us reach a complete view of the impediments experienced by users. The quantitative insights helped us to understand the importance of some impediments whereas the qualitative insights gave specific details about the impediments. Furthermore, the quantitative insights helped us to frame the interview guide in order to ask questions about the most important reported impediments.

6.6.3.2. Questionnaire

We structured the questionnaire based on the user process previously detailed by (Crusoe and Ahlin, 2019). This process is divided into four phases that are described in Table 29. In the questionnaire, the motivation phase is referred to as the start phase.

[5] https://data.namur.be

[6] https://data.london.gov.uk/

[7] https://opendata.paris.fr

[8] https://opendata.cityofnewyork.us/

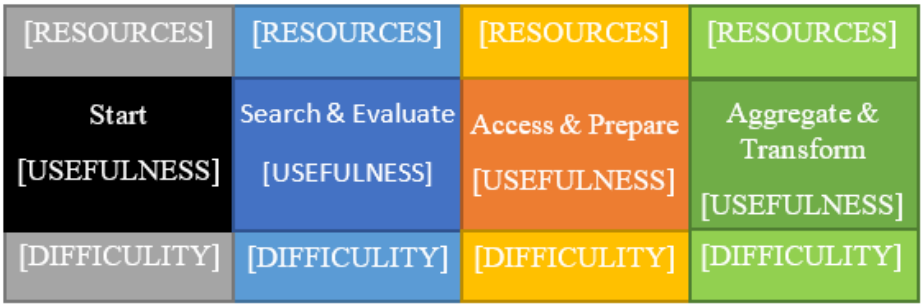


Figure 29. Questionnaire Constructs

Figure 29 summarizes the four phases, gives the overall structure of the questionnaire, and details the three constructs we evaluated:

- Resource allocation: this construct evaluates the amount of time allocated and people involved for each phase. Respondents were asked to rank the four phases according to the time it took to complete them, and also according to how much they contributed.
- Perceived usefulness: this construct evaluates to what extend the phases of the process are perceived as useful for the project's output by the users. A 5-point Likert measurement instrument ranging from “not useful at all” to “very useful” was used.
- Perceived difficulty: relying on a 5-point Likert measurement instrument, the questionnaire measures the severity of the impediments reported in (Crusoe and Ahlin, 2019). We used the term “barrier" in the questions so that the students could answer more easily.

In order to evaluate the perceived difficulty construct, we added statements for each of the challenges (Crusoe and Ahlin, 2019) reported in their paper. For the Likert scale, we relied on the instrument previously described by (Beno et al., 2017). Indeed, the authors also measured some challenges faced by users thanks to the following scale:

In order to measure the perceived difficulty , the severity of the impediments was evaluated by relying on the instrument previously described by (Beno et al., 2017). Indeed, the authors also measured some challenges faced by users with the following measurement instrument:

- Not a barrier: it was easy to use the data.
- Somewhat of a barrier: it was still possible to use the data.
- Moderate barrier: it was difficult to use the data.
- Serious barrier: it was extremely difficult to use the data.
- Extreme barrier: it was impossible to use the data.

Besides the constructs, the questionnaire includes contextual questions on the respondents' background, the skills they acquired for their project, and their confidence with programming, data analysis, and OGD portals. The questionnaire ends with a broad open question, allowing respondents to share insights on the class project and OGD in general. The complete questionnaire is available in the Appendix 9.6 to this paper.

Thanks to this scale, we can understand the degree of difficulty of the different tasks performed within the project.

6.6.3.3. Interviews

In order to complete the insights gathered by the questionnaire, we used the interviews participation method with nine students. We applied quota sampling to select the interviewees. The quota was based on students' study orientation (computer science, management, or mathematics). We hypothesized that

the impediments faced by students throughout the project might vary according to their background. Working with OGD is an interdisciplinary process that can involve idea development, data analysis, and coding. Due to the differences in their interests and curriculum, students from a given background (e.g., mathematics) could be more experienced in some activities (e.g., data analysis). The questionnaire responses were in line with this hypothesis. We limited our study to nine interviews in order to respect the sampling method (only three mathematics students were involved in the whole project) and because of their limited availability due to exam constraints.

The structure of the interview guide is similar to that of the questionnaire. The interview guide starts with introductory questions on the overall user process, as we were interested in comparing the user process framework with the activities conducted by students in their project. Moreover, the severest impediments from each phase that were reported in the questionnaire results were discussed with the interviewees in order to collect deeper insights. The interview guide ends with retrospective questions on the project. This latter part includes, among other things, questions regarding the students' motivation to use OGD again and what support they want from OGD publishers. The detailed interview guide is available in the Appendix 9.6.

6.6.3.4. Data Analysis

The questionnaire results consist of the items evaluated on a 5-point Likert measurement instrument for the perceived difficulty and the perceived usefulness. In order to have a central tendency measure for each of these items, the median was computed since the results consist of Likert-type data (Boone and Boone, 2012). As for the resource allocation construct, it was measured by a ranking exercise on the four phases. In order to obtain a representative ranking, the mode was computed for each phase.

The interviews were analyzed with process and initial coding (Saldaña, 2014). The analysis started with summarizing the interviews and then recording them in a data memo. Afterward, the researchers divided the data among each other based on the user process. Each researcher coded a specific phase for each interview. The coding started with skimming the interview to get a sense of the whole, then important sentences were highlighted based on the goal of this study, and then the highlights were coded using short sentences to retain context and conceptual relations. The codes were then inserted into a table divided by the interviewees and process phases. As the analysis progressed, researchers could write analytical notes to record insights and thoughts. All coding was conducted in the same cloud-based document, so that the researchers could follow each other's coding process and verify codes if needed.

6.6.4 Results

In total, 30 users completed the questionnaire. 22 of them have a management background, four study computer science, and four mathematics. In the following section, the quantitative results from the questionnaire regarding the three measured constructs are successively presented. Then, the discussion on the perceived difficulty is refined with the qualitative insights from the interviews. The findings from the questionnaire regarding the constructs are summarized in Table 31.

Table 31. Questionnaire Constructs for the phases of the User Process Framework

Phase	Perceived Difficulty	Resource allocation	Perceived usefulness
Start	Finding an idea	4 (Least)	Useful
Search and evaluate	Quality of Metada	3	Useful
Access and prepare	Data quality, data cannot be combined	2	Useful
Aggregate and transform	Data availability, no longitudinal data	1 (Most)	Very Useful

6.6.4.1. Perceived Difficulty

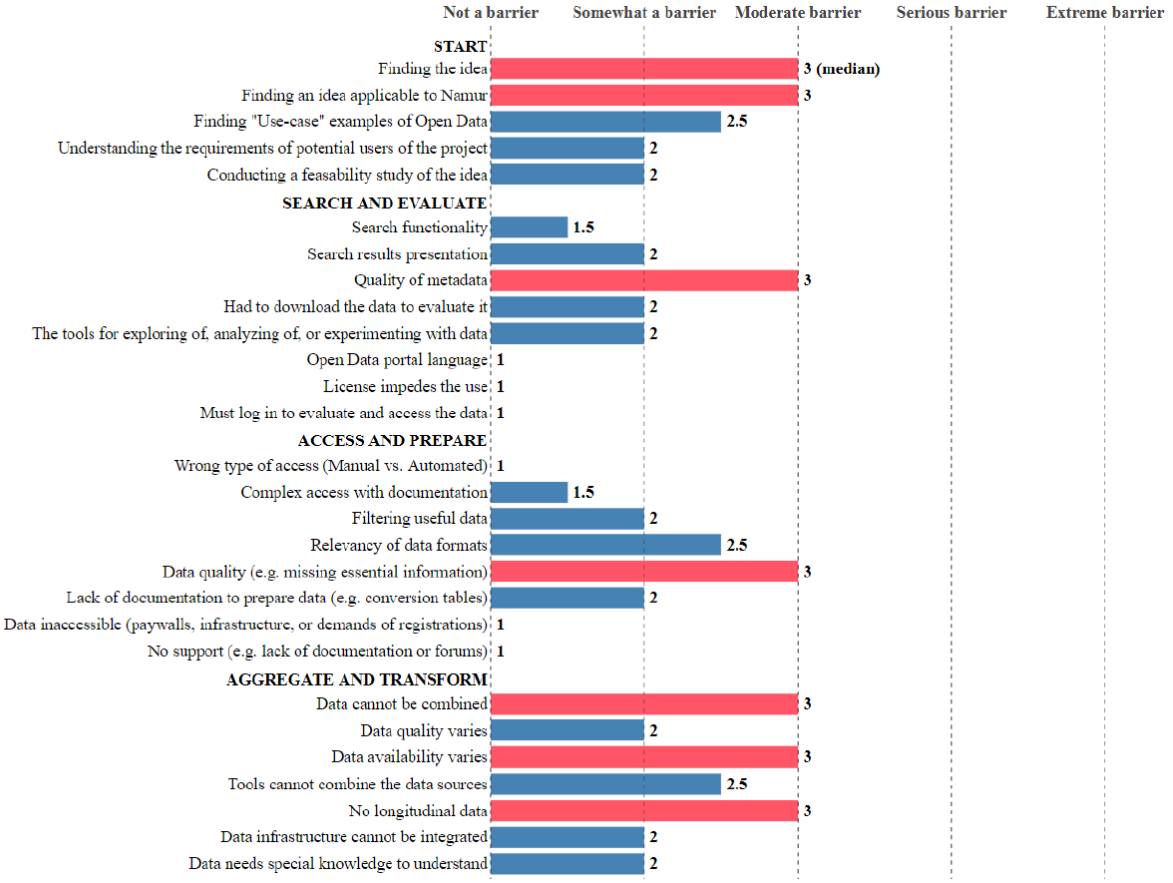


Figure 30. Summary Perceived Difficulties for OGD use

Figure 30 presents the results of the questionnaire regarding the severity of the impediments. The severity was computed as the median answer of the 30 respondents. One can observe that none of the process phases is exempt from moderate barriers (median = 3). Hence, the users experienced difficulties in some activity of every phase, since a moderate barrier indicates that the use of data was difficult. In the start phase, users struggled to find an idea for OGD use. In the subsequent phase, they faced issues with metadata. Metadata is information about a dataset, such as collection methods and freshness. In the access and prepare phase, the problems lied in the quality of the data. Lastly, in the aggregate and transform phase, users had trouble with combining data, the variation in data availability, and complained about the lack of longitudinal data.

The questionnaire results also show that some expected impediments were no problem for the users (median = 1). This observation is rather encouraging, as it points out that potential impediments can have been solved by the OGD publishers considered in this study. It is, however, worth noting that these are concentrated in the search and evaluate and access and prepare phases. Hence, every impediment in the questionnaire for the start and the aggregate and transform phases impeded the use of OGD to some extent.

6.6.4.2. Resource Allocation

In the questionnaire, users were asked to rank the four phases by how much time they had invested in each one.

The least time-consuming phase was the start, followed by the search and evaluate, the access and prepare, and, lastly, by the aggregate and transform phase, which is, therefore, the most time-consuming. The perceived individual contribution reported by the respondents follows this trend as well. The resource allocation and yield per phase thus appear to increase throughout the process.

Furthermore, 26 of the 30 users reported having to learn new skills required for the success of their project. This self-development was expected since most of the users have a management background. The learned skills were mainly about web-oriented languages (Javascript, CSS, HTML, web libraries), Python, and how to connect a Python script and a web page (the Flask framework was recurrent for this matter). This acquisition is one factor contributing to the high time allocation of the late phases.

6.6.4.3. Perceived Usefulness

All phases were perceived as useful (median = 2). The aggregate and transform phase was considered as very useful (median = 1). This outcome was expected, since the final output of the project is delivered at this phase.

6.6.4.4. Qualitative Insights on Perceived Difficulty

In the following section, qualitative insights on impediments are presented, following the phases of the user process framework.

Start: The in-depth interviews revealed that the process of ideation was mainly based on the personal needs, uses, or intuitions of the users. Then, users visited the OGD portals, looking for datasets, and, as a result, changed or gave up their first ideas as data was missing. Sometimes this was repeated several times. This process of divergence and convergence, using creative techniques like mind-maps and brainstorming, was constrained by the availability of datasets in the chosen portals. As one user expressed: “We’ve got a lot of ideas by looking at the datasets’ name in 20 to 30 minutes of brainstorming. But the difficulty was to realize them. When we opened the datasets, important information was missing. Thus, we had to give up some ideas.”

Median for each impediment computed from the questionnaire results. The impediments colored in red are the most severe for their respective phase. All the interviewees faced this issue, and it shaped their output. Two teams of users started directly from the OGD portal and with the combination of datasets to save time. Seven of them mentioned the limited number of datasets as a major constraint for their project development. They said they had more innovative ideas than data to develop them. As one user expressed: “I have the impression that the OGD portals were pretty empty in valuable datasets, or the datasets could be usefully combined with other sets that we didn’t have.” Users were frustrated they could not exploit more than the city’s OGD portal for their project, since the data was too limited and they had little insight into Namur’s challenges or priorities, citizens’ needs or market opportunities. The interviewees reported being discouraged by the abundance of existing apps, the lack of domain

knowledge and given examples, the absence of precise demand, and the lack of useful datasets. As one user explained: “It would have been helpful to have ideas from the citizens”.

Search and evaluate: The interviews confirmed that the main impediments to the search and evaluate phase are in the evaluation activity. No interviewee reported issues with the interface of the OGD portals they used. They found that the portals were well-designed in this regard and provided adequate features for searching data, such as filtering and suggestion of related datasets. The evaluation activity, however, was more challenging. The interviews confirmed that the main impediment in that phase is the lack or inadequacy of metadata, as observed when analyzing the questionnaire answers. Six users stated that they encountered issues with metadata. The interviews allowed us to refine this point, and uncovered that the evaluation of data can be examined at different granularity levels.

First, three users faced issues with the data features’ (e.g., columns in a dataset) names, which they found uninformative and badly described. Unexplained columns meant that the user could not use the dataset. For example, one user encountered a population census dataset holding a number of girls and a number of women and he had to make calculations with census data to determine whether the girls are also counted as women. Another user complained: “In our datasets, half to three-quarters of the features we didn’t know what they meant, and it wasn’t explained anywhere [...] We completely ignored these columns”. Secondly, metadata at the dataset level were mentioned by three interviewees as an issue. One user was disappointed that “some dataset titles are awesome, but there is nothing exploitable in them”. In order to compensate for appropriate metadata, users had to resort to other evaluation methods. One user downloaded the data for further examination. Even worse, one user reported feeling frustrated, as the lack of informative metadata prevented exploitation of the full potential of the available data. On the other hand, one user used the API request functionality to explore a dataset. Nonetheless, some features offered by portals were helpful in the evaluation of data. One user noted that the reuse examples comforted him with the potential of the data and increased his motivation to use data. Another user mentioned the usefulness of visualizations showing an overview of data as helpful.

Access and prepare: The in-depth interviews allowed us to explore the data quality impediment reported in the questionnaire. On a general note, the data quality fluctuated widely across datasets. There was a lot of data in the datasets that three interviewees respectively qualified as “missing”, “irrelevant” or “corrupted”. Two interviewees mentioned the lack of longitudinal data as the main impediment for regression analysis. Finally, a lack of consistency in the datasets was also reported by four interviewees. These impediments impacted the output of the work. One user noted the impact, as “because of the few relevant datasets our application was not as valuable as we wanted. Our application issues abnormal recommendations, such as: fewer trees will lead to better air quality!”. No major issue was reported in terms of data formats as most of the datasets were available in JSON and CSV. Some case-by-case issues were still reported, such as some irrelevant geographic data formats and the presence of the “string” data type instead of “integers” data type. Also, the interviewees experienced no major problem with the APIs (one API was missing, and some errors were present in the requests). However, three respondents declared they did not use the API but rather downloaded the data directly. This approach may reveal that they did not see the added value of using this channel to access the data. It often seemed faster for the users to just download data. The approach may also indicate that the users did not seek to develop a sustainable solution.

Aggregate and transform: In the in-depth interviews, the interviewees explained some activities in the aggregate and transform phase. For the aggregation activity, users can select specific datasets based on criteria, select columns in the dataset, merge datasets to fill out gaps, and use scripts to clean the data. Merging can be time-consuming and involve a “one at a time” error solving approach. As one user told us: ”I spent a very large part of my time just on data aggregation since it was a monster mess”. For transformation, users can calculate averages, integrate data into web applications, think about the end-user experience, and seek support. This can be done, for example, for a specific technique, such as

machine learning. However, there were also a few impediments. To make data combinable, sometimes keys needed renaming, data needed standardization, as datasets were inconsistent (e.g., different metrics), and, on other occasions, several datasets had to be merged to form a complete dataset. As one user explained ”[Datasets] didn’t use the same way of localizing things. They all used neighborhood names, but the issue was that they didn’t use the same neighborhood names. [...] It was nearly impossible to do the matching; they didn’t use the same partitioning at all”. In the worst case, data lacked unique identifiers, datasets could use different unique identifiers, or feedback could be hard to leave, making an increase in data quality improbable. On the other hand, transformation could be impeded by slow data delivery, a need to add exceptions, and technical complexity. As a result, data needed more preparation to be combinable, which likely contributed to the high time consumption of this phase. One explanation is that when the users once started to transform data or combine data, they noted the work needed to prepare the data. Moreover, the in-depth interviews indicated that it was easier to use one dataset than several, or a single category of data (e.g., photos) than combining several.

6.6.5 Managerial Recommendations

The use of three participation methods shows that the impediments can restrain and discourage even skilled users. A publisher aware of the user impediments can develop strategies to support users or change the infrastructure or data to facilitate usage - strategies that increase the likelihood of better return of investment. The areas of improvement are not limited to technical aspects. We suggest publishers perform several actions to enhance the user experience and encourage projects development.

First, we suggest publishers introduce feedback mechanisms for the users to report incomplete data and lack of longitudinal data or metadata. A more advanced feedback mechanism could empower the users to improve the metadata and the data themselves.

Secondly, publishers can follow common standards in how the data is structured (e.g., formats and content) to allow for easier harmonization between datasets. This approach can lessen the time needed to prepare the data for aggregation and use.

Thirdly, publishers could enrich the portals with datasets from other public actors, institutions, and local organizations. The portals could also be enriched with data collected through sensors by several stakeholders. Enriched portals could enable the creation of more innovative ideas.

Fourthly, publishers can involve the users in the development of the portals. This participation can be implemented through several methods (e.g., workshops, interviews, living labs). User participation can help publishers better understand the needs of the users and understand what support and features they need (e.g., tutorials, projects examples, reporting systems). This continuous exchange between users and publishers can support the improvement of both the portal and the re-use projects.

Finally, publishers could give users the opportunity to innovate and compete around real problems and needs. This opportunity can increase the match between output and real-world application. OGD can provide an opportunity to build a community around problem-solving in the city. One way to achieve this is the organization of hackathons by the city in collaboration with other stakeholders (universities and businesses).

6.6.6 Contributions

6.6.6.1. Limitations

Our study presents some limitations due mainly to the specific sample of 30 students. However, we also argue that this limitation does not introduce fundamental bias to the study, as students constitute a re-

user group of OGD (Safarov et al., 2017). Still, the limitations posed by the selected sample are discussed below.

First , our sample consisted of skilled students with computer science, management, or mathematics backgrounds. Therefore, their digital literacy is quite high. We argue that this sample is representative of the OGD users but not of the full population. Thus, alternative studies with users with low or normal digital literacy could be interesting to perform in order to compare the findings. Alternative studies can also extend the sample to study OGD users at the city level to generalize the findings.

Secondly, the motivation of our sample was biased as it is an imposed class project that the students had to perform. Therefore, we were unable to capture information about what could motivate and drive users to visit the OGD platforms in the first place.

Thirdly, the conditions and rules of the class project itself introduced limitations. The students had limited time, and the project was based only on OGD city portals, which restricted the number of datasets. It does not represent the real practices of users, who can be used to web-scraping or combining datasets from various publishers. This constraint could misrepresent the perceived difficulties through the process, especially, at the start phase. As a consequence of time constraint and educational context, priorities were placed on the search, access and aggregation phases. The objective of the students was to deliver on time a visualization or an application to pass the class project, whatever its market viability or power of advocacy. The time devoted to each phase should consider variables in skills, the profile of the users, objectives of the project and avoid generalization.

6.6.6.2. Further Research

In this section, we describe solutions that can be performed to solve the issues raised in this study. Also, the text opens avenues for future research.

Questionnaire Validation: In the proposed questionnaire, several impediments were measured for each project phase. Although the objective was to identify individual impediments, we wondered if the scores for each impediment of a given phase could be used as a reliable measurement of the difficulty experienced for this phase. For this purpose, we computed the Cronbach's alphas (Cronbach, 1951) for each of the four phases. The results displayed in Table 32 shows that the alpha is acceptable for the search and evaluate, access and prepare, and aggregate and transform phases. These numbers encourage us to envision the design and validation of a questionnaire aiming to measure the difficulty for each phase of an OGD project as a future contribution. In particular, a reliable measurement scale measuring the difficulty encountered in the start phase needs to be developed in order for the current questionnaire to reliably assign a difficulty indicator for each phase.

Table 32. Cronbach's Alphas for each phase

Phase	Cronbach’s Alpha	Internal Consistency
Start	0.466	Unacceptable
Search and Evaluate	0.706	Acceptable
Access and Prepare	0/760	Acceptable
Aggregate and Transform	0/805	Good

Ecosystem View on Open Government Data: Valuable and sustainable reuse of the OGD not only depends on the users' capabilities or the publishers' infrastructure but on their interactions. The supply-driven approach of the OGD platforms has shown its limits. The impediments and feedback reported by

the interviewees outline the importance of considering them as stakeholders instead of data consumers. In an ecosystem with OGD as a shared resource, each stakeholder has his own perspectives and expectations: political, economic, technological, or bureaucratic (Gonzalez-Zapata and Heeks, 2015). Research should be conducted on the different support methods needed to stimulate collaboration between actors. What model of partnership or cooperation can enhance the value creation in multiple perspectives? What model of platform can promote interaction in the system? This last question supposes not only new features on a platform but a change in the knowledge and value creation paradigm.

Support for Idea Generation: The OGD reuse is a project with prospective benefits for citizens, communities, or markets. More research is needed to support the users' needs in the start phase, since finding a valuable idea was reported as a key challenge by respondents. The application of several citizen participation methods, as described in Section 6.1, to stimulate the idea generation might be useful. Indeed, using creativity techniques to stimulate discussions among citizens or taking advantage of ideas submitted in participation software are two relevant examples. With these ideas, needs, and requirements properly elicited, it can allow the development of products and services aligned with actual issues faced by citizens.

6.6.6.3. Summary of findings

The publishing of Open Government Data by public organizations has promising possibilities, such as the creation of a new data-driven sector and collaborative efforts toward innovative products and services, with data accessible to all. However, the actual use of OGD remains low (Safarov et al., 2017) and its potential is largely under-exploited.

In this validation of UParticipate, we selected a user process framework as a theoretical baseline to study the impediments experienced by 30 students who conducted a class project using OGD. Through the use of interviews and a questionnaire within an innovation ecosystem, we were able to identify the impediments to OGD use that the students experienced, for each phase of their project. Our results show that finding an innovative use for OGD, the lack of metadata describing OGD properly, and the lack of support to combine OGD datasets are the most detrimental difficulties faced.

In our research, we studied how impediments could impact the user as they progress through the OGD process. Subsequently, we discussed the theoretical implications of our findings, and we provided managerial recommendations to publishers in order to encourage them to consider these impediments before publishing OGD, with the goal of fostering use by users (e.g., citizens, organizations, and entrepreneurs).

The application of UParticipate to a concrete use case shows promising results, as it suggested relevant participation methods. As this section has shown, UParticipate simply points out in which direction to invest efforts for participation, but there is still a lot of freedom left to the stakeholders to implement the recommendations. For instance, we adapted the interview guide based on previous research and we used a combination of participation methods. The reporting of these choices and the iterative improvement of the guide consequently constitutes a promising next step to follow for researchers and practitioners.

7. SmartCity4All Workshop

After putting the different participation methods in context in UParticipate, we chose to focus on one specific method to be investigated in-depth and tested in practice. In this section, we focus on the "workshop" participation method applied to facilitating the participation of children in smart cities. We chose the workshop method from all the methods listed in UParticipate as it is ideal to study participation on a small scale. It only enables the participation of small groups of citizens, but it can do so with innovative techniques that can deliver important value in terms of creativity (Mahaux and Maiden, 2008).

Indeed, as mentioned numerous times throughout this thesis, the concept of the smart city is becoming more and more prominent in the everyday life of citizens. As a term recurring in political speeches and driving decisions that affect citizens' lives, it is essential that they understand this concept. However, the many different definitions of a smart city (Chourabi et al., 2012) and the frequent use of alternative adjectives (e.g. "intelligent" or "digital") make smart city a fuzzy concept to grasp for citizens. Citizens are a key component of the smart city, and that also includes children (Hennig, 2014). This sub-group is considered as essential to consider in the participation process but is often trivialized by decision-makers (Hart, 1992).

Two drivers led us to the instantiation of the workshop method from UParticipate to stimulate children participation in smart cities. First, as we have established with CitiVoice, citizen participation is a key success factor in smart cities. Therefore, numerous participation methods have been put forward to enable the participation of citizens in smart city design (Simonofski et al., 2017a; Simonofski et al., 2018a). A wide variety of methods exists, ranging from traditional direct interaction techniques (e.g. town hall meetings, interviews or group discussion) to more innovative methods such as living labs (Pallot et al., 2010), participation platforms (Aham-Anyanwu and Li, 2015) or civic hackathons (Briscoe and Mulligan, 2014). Within the abstract word "citizens", children are an important sub-group to take into account. Chawla (2001) exposes several benefits of children's participation, such as skills development, preparation for adult participation, formation of children's communities, and increased commitment to children's rights from the organizations that enable this participation. Checkoway (1995; 2011) describes five important forms of youth participation. First, there is social action, which is a collective organization around social issues such as environmental protection or neighbourhood revitalization. Second, there is community planning, where youth are involved in local issues such as building support for implementation. Third, public advocacy, which is when young people actively defend youth's interest in interaction with legislation and agencies. Fourth, there is community education which aims at strengthening the consciousness, competence, and confidence of the youth to "transform the world." Finally, we have local services development, where youth are involved in making the services match needs such as education, health care, housing or economic development. In conclusion, numerous participation opportunities exist for adult citizens in smart cities but only a few more traditional methods exist for children despite their recognized importance. Indeed, these children's participation methods are not really in line with the innovative capabilities of the smart city, as they have remained quite traditional in nature. Therefore, we formulate the first research motivation: "Lack of innovative participation opportunities for children in the smart city".

Second, the education of citizens is considered by the literature and practice as an important aspect of smart cities (Giffinger et al., 2007; Washburn et al., 2009; Nam and Pardo, 2011a; Winters, 2011). It usually takes two distinct yet intertwined perspectives. First, education in smart cities is aimed at increasing the digital literacy of citizens (e.g. (Mahizhnan, 1999; Lombardi et al., 2012)). Second, education in the smart city consists in using new technologies to support in-class teaching activities (e.g. (Washburn et al., 2009; Neirotti et al., 2014)), which would in turn contribute to improving students' digital literacy. This twofold perspective is emerging in Belgium, the country where the workshop was tested. Indeed, while digital education is currently largely absent (Henry and Joris, 2016), an educational reform

is underway and plans to introduce digital education as part of a technical course for 5-15-year-old children. SmartCity4All is in line with this context, as it proposes a hands-on programming activity demonstrating to children how technology can be used to improve a city. However, one educational perspective that is, to the best of our knowledge, missing from the literature is education in the concept of the smart city and of its ins and outs for citizens. Indeed, the smart city concept remains fuzzy for the wider public, who fails to understand what lies behind the smart city and what there is in it for them. We argue that educating citizens to the concept of a smart city would itself alleviate this issue and would not only be a benefit but also a prerequisite to meaningful citizen participation in smart cities. Therefore, we formulate the second research motivation: “Lack of initiatives to educate citizens to the concept of a smart city”.

In order to help younger citizens understand what lies behind the smart city, we developed a workshop aiming at introducing the concept of the smart city in all its complexity. In this section, we present this workshop and its validation in several primary and secondary schools in Belgium. This will help us answer the research question RQ2c: “*Can a workshop impact children’s understanding of the smart city concept?*”. Via this use case, this section will provide a tool to manage participation on a small scale (RQ2)

This section is structured as follows. In Section 7.1, we explain how we develop the workshop and describe its different parts. Furthermore, we explain how we collected and analyzed the data in the different in-school sessions. In Section 7.2, we describe in detail how an in-school session of the workshop takes place, to give the reader a first overview of how the workshop is conducted in practice. In Section 7.3, we analyze how the perception of all the students evolved thanks to the workshop. In Section 7.4, we reflect on the relevance of the workshop for research as well as the lessons learned for practice. We then detail the limitations (Section 7.5) and further research leads (Section 7.6) that the workshop induced to finally summarize the contributions (Section 7.7).

7.1. Methodology

In this section, we explain how we developed SmartCity4All. Then, we describe how the workshop is conducted. Finally, we explain how we collected data about the perception of children and how we analyze it.

7.1.1 Designing the Workshop

In order to develop the SmartCity4All workshop, we followed several design cycles in line with the best practices of design science research as shown in Figure 31 (Hevner et al., 2004). First, we performed an initial literature review to find ideas about the structure of the workshop. Thanks to this review, we relied on participatory design principles, as this method is helpful for including children in planning processes (Fails, 2012; Hennig and Vogler, 2016). Moreover, we also relied on future workshop techniques, as they enable non-experts to imagine innovative solutions to solve issues in urban planning (Jungk and Mullert, 1987). This initial literature review also constituted the rigor cycle, as we identified research gaps in the knowledge base to be answered by this workshop. Second, having an initial version of the workshop based on these literature sources and knowledge about smart cities, we improved it in close collaboration with two researchers expert in digital education. One has experience with training teachers to introduce programming to children, and both have experience with teaching programming to children. Third, we were able to test the workshop through a first in-school session that enabled us to improve it based on the class experience and the children's and teacher's feedback. Finally, we got early feedback on the workshop content and first in-school session from conferences on digital education. The feedback was provided by teachers (mostly secondary school teachers) and researchers in digital education, working in Belgium, France and Switzerland. These presentations and the testing of the workshop documented in this study also contributed to the relevance cycle. Indeed, we ensured that the workshop contributes to its environment and answers the educational needs of children and the objectives of the teachers.

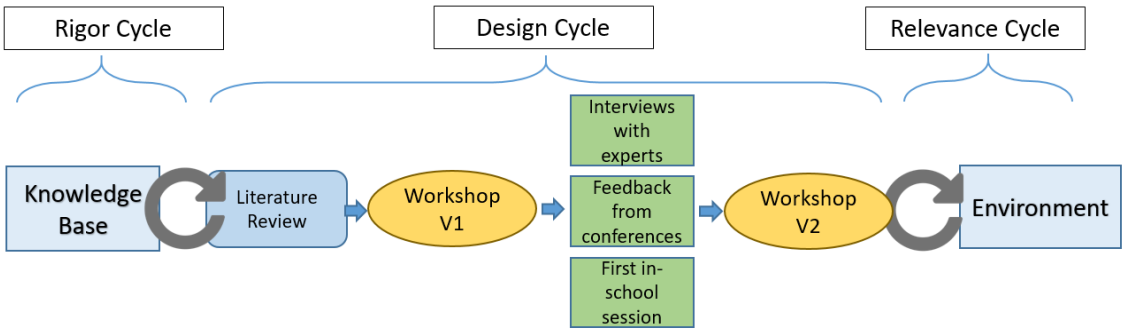


Figure 31. Design science research Methodology for SmartCity4All

7.1.2 Description of the Workshop

The workshop is divided into three parts: (1) a theoretical popularization of the smart city concept, (2) the realization of a city model with the children, and (3) the identification and resolution of urban issues on the model, with or without technology.

7.1.2.1. Theoretical vulgarization of the smart city

A visual support in the form of a poster representing the six smart city dimensions is displayed (cf. Figure 32). Children are provided with examples of solutions and are asked to link them with the dimension(s) they think match best. Examples of solutions include, among other things, providing online

administrative services to citizens so that they don't wait long at the city hall, smart lighting systems, smart waste bins or applications for citizens to report defects in the city.

Figure 32. Poster used for the theoretical introduction (with six illustrative examples)

7.1.2.2. Realization of a model with the children

A city model in the form of a 2D paper plan with an empty map printed is presented to children. They are then divided into four groups of even size. Each group is given a box holding 15 buildings from the board game[9]. Sufficient variety in the buildings' functions is ensured for each box beforehand. Then, each group simulates urban planning decisions by selecting three buildings to place on the city model and presents their choice to the class. Groups can subsequently change their selected buildings according to others' choices and place them on the city model (Figure 33), while justifying the chosen location. Once each group has placed their buildings, they can propose one modification to the city model: adding a building, moving a building, etc. Children are then asked to list ways of deciding if a given proposal should be accepted or rejected. The pros and cons of each are subsequently discussed.

[9] https://www.belvue.be/en/node/85

Figure 33. City Model built by Children

7.1.2.3. Identification and resolution of issues

From the city model built during the previous step, children reflect on the urban issues that may result from the building configuration (identification). The identified issues are represented on the city model (e.g. toy cars aligned to represent congestion, checkers piled to represent garbage overflowing from bins).

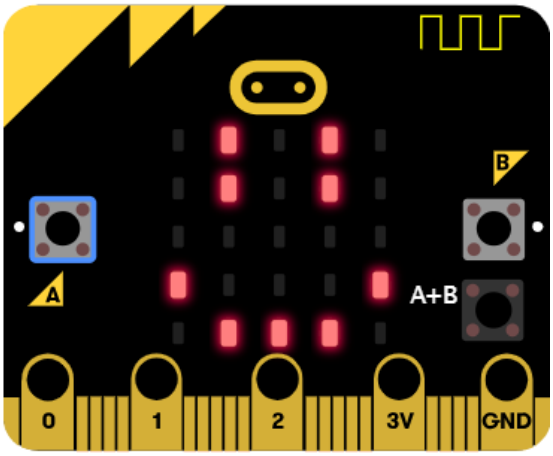


Figure 34. Micro:bit representation

Then, children reflect together on several possible solutions. One solution chosen by children is implemented using programmable devices suitable for novice programmers such as Makeblock or micro:bit and is integrated into the city model for assessment.

7.1.3 Data Collection

In order to collect data to test the workshop in real-life conditions, we decided to perform field experiments in classrooms following the best practices of educational research (Ehrenberg and Lindquist, 2006; Cobb et al., 2007; Creswell, 2013). These experiments took place in classrooms with children from various school years and education types as detailed in Table 33. The schools were recruited on voluntary basis based on the network of schools present in the School-IT project. This project aims at introducing programming and digital skills in schools in Wallonia (Belgium) by providing education material and experts.

Table 33 In-school sessions of the workshop that were organized.

Workshop format	School year	Education type	Participants (including females)
2x100 minutes	2nd Secondary	General	25 (11)
2x100 minutes	3rd Secondary	General	16 (6)
1x90 minutes	3rd Secondary	General	14 (7)
1x90 minutes	5th Secondary	General	15 (11)
1x90 minutes	5th Primary	Specialized	16 (7)
1x90 minutes	5th Primary	Specialized	10 (4)
2x100 minutes	2nd Secondary	Differentiated	16 (0)
2x100 minutes	2nd Secondary	Differentiated	7 (0)
2x50 minutes	1st Secondary	General	22 (9)
2x50 minutes	2nd Secondary	General	25 (12)
2x50 minutes	2nd Secondary	General	21 (6)
2x50 minutes	2nd Secondary	General	23 (14)
2x50 minutes	1st Secondary	General	21 (2)
2x50 minutes	2nd Secondary	General	20 (10)
2x50 minutes	2nd Secondary	General	24 (12)
1x150 minutes	2nd Secondary	General	24 (13)
Total			**299 (124)**

However, the teaching hours available for the workshop did not always match the plan as initially devised, which involved two sessions of 100 minutes each (in Belgian secondary schools, one teaching hour corresponds to 50 minutes). In one instance, the workshop had to be held in full during one session. In some cases, fewer teaching hours than planned were available. We thus had to work with these constraints and adapt the workshop to the specific constraints faced by the teachers. This resulted in three different formats being designed. Furthermore, an opportunity to us was given to conduct the workshop with four classes visiting our university. Again, there was a specific timing constraint to take into account, which resulted in the creation of a fourth format. The four devised formats are detailed in Table 34.

Table 34. Formats of the Workshop

Teaching hours	Conduct
2 sessions of 100 minutes	The first 100-minute session is devvoted to the first two steps of the workshop. The second session is devoted to the third step. The steps are conducted as described earlier.
2 sessions of 50 minutes	The first 50-minute session is devoted to the first two steps of the workshop. However, the animators present themselves one example per dimension in the first step. In the realization of the model part, the model modification round is skipped. The second session is devoted to the third step. Less time is given to the children to complete the exercise and less time is spent on the discussion after the presentation of the solution exercise.
1 session of 150 minutes	The city model was built beforehand by the children in the context of another class activity. Thus, the realization of the model part was skipped and the identification of issues could be started straight after the theoretical introduction. This allowed conducting the first and third steps as described earlier.
1 session of 90 minutes	Due to timing constraints, the theoretical introduction was accelerated by discussing less examples with the children. The discussion on participation methods was also skipped in order to have enough time to build the city model. Rather than a hands-on exercise, the third part was replaced by a brief introduction to the micro:bit programming interface and a demo on how to build a voting system with it.

When feasible, we collected data through two questionnaires following a pretest-post-test design (Grieve, 1981; Dimitrov and Rumrill, 2003). The use of pretest and post-test questionnaires allows measuring the impact of an activity on a group of individuals. This matches perfectly with the goal of our research, which is to assess if the proposed workshop has an impact on 12-14-year-old children.

More precisely, we asked the children to complete the pretest questionnaire before the workshop took place and the post-test questionnaire after the workshop. Ten minutes were allocated for each. All questions were open-ended in order to allow richer answers from children. The questions in the pre-test were the following:

- For you, a city is: …
- For you, a smart city is: …
- Mention the positive and negative points of a group discussion: …

In the post-test questionnaire, the third question was related to the workshop instead of group discussions in general in order to collect feedback for future improvements. On top of the three questions, we also asked to additional questions in the post-test:

- What is the “smart city” project you would like to see in your city?
- How would you ask the public's opinion on a “smart city” project?

Although 299 children participated in the workshop sessions, the data collected through the questionnaires relates to a smaller sample. This was caused by several issues that occurred during the data collection process. First, due to time constraints, the questionnaire could not be completed by the children participating under the 1x90 minutes format, as requiring them to do so would not have left enough time to complete the workshop. Nonetheless, valuable observations and feedback from the teachers could be collected. Second, the workshops under the 2x50 minutes format were hosted by a substitute teacher who was in charge of the classes only for the time of the workshop. This caused various confusions that prevented data collection for an important part of the children. Third, non-attendance to class by some children resulted in them taking only the pretest or the post-test. Overall, 52 (resp. 59) children completed only the pretest, and 130 complete questionnaire pairs were collected.

The results reported in the Extensive Validation Section (7.3) are related to these 130 children only. Relevant insights from the isolated questionnaires were nonetheless extracted and are discussed in the Discussion Section (7.4).

7.1.4 Data Analysis

As all the questions asked in the questionnaire are open-ended questions, we relied on manual coding of answers in order to draw conclusions on the collected data. The full list of questions asked can be found in Appendix 9.7. Two researchers performed the coding independently and compared their respective results. The answers not coded alike by the two researchers were discussed with a third analyst in order to reach a consensus.

Instead of defining a final list of codes before the analysis, an exploratory coding methodology was used, where few codes were defined and refined throughout the coding process (Saldaña, 2014).

The first question, asking children to give their **definition of a city**, was not analyzed. Its goal was to start to questionnaire with a question for which each child would have an answer to give, in order not to daunt answering from the beginning.

The **definition of the smart city** given by the respondents was first analyzed with hypothesis coding (Schuster and Weber, 2006), according to the two smart city orientations commonly found in literature and practice. The *technology* orientation denotes the presence of information and communication technologies (ICT) in the smart city. The *participation* orientation refers to the involvement of citizens in decision-making. We expanded this classification with two additional codes. The *problem-solving* code is present when a smart city is defined as a city that attempts to solve general problems (such as pollution), and the *citizen problem* code was assigned when it is specified that the problem the city is working on solving is one faced by the inhabitants of the city. Three codes regarding misconceptions of the smart city were added. The *people* code denotes a city that is smart because its citizens are smart themselves. The *autonomous* code refers to a city defined as being automatized, able to work without the citizens. The *futuristic* code is linked to the technological orientation, but implies that the definition mentions technology related to science fiction (e.g. flying cars, serving robots). The seven codes are not exclusive. For instance, a definition stating that a smart city uses flying cars to ease citizen travel would fall under the technology, problem solving, citizen problem, and futuristic labels. In addition to the labels, the smart city dimensions mentioned in the definition were also noted. In the aforementioned example, the smart city dimension at hand would be mobility.

The question asking children about the **smart city project** they would like to see in their city was coded following the smart city dimensions and the codes used to analyze the smart city definition. As a project proposal corresponds to suggesting a solution to a problem, the problem-solving code was not used in the analysis of this question.

The question regarding the **advantages and disadvantages of group discussions** was analyzed by extracting all the individual elements mentioned and grouping the ones referring to the same idea together into categories following exploratory coding practices. Categories were rather defined and refined incrementally. In the post-test, the question was formulated in a different way, to consider the particular case of the smart city workshop. No category was defined beforehand as well.

The answers to the question regarding the **participation processes** children would use in order to ask the public's opinion on an issue were analyzed by extracting any explicitly mentioned citizen participation process. For each process, four characteristics were noted. The *decision* indicates whether the participation process results in a decision (vote) or merely consists in polling the public (poll). The *digital* character indicates whether the proposed process involves ICT. The *method* refers to the concrete means used (e.g. application, website, door-to-door). Lastly, the *location* is the location where the

participation process is implemented (e.g. city hall). It may occur that one or several of these four characteristics do not appear explicitly in the proposed process. In these instances, the process was described only with the elements that could be extracted. In cases where a respondent proposed several participation processes, all of them were noted and described separately.

7.2. First In-School Session

In this section, we describe extensively the first in-school session of the workshop to give the reader more information about how SmartCity4All takes place in practice.

During the first step of the workshop, we observed that students were able to link the provided examples with the smart city dimensions fairly accurately. The economy and governance dimensions were however underrepresented. One explanation is that these dimensions concern aspects that children encounter less in their everyday life. On the contrary, the living and environment dimensions were over-represented. One explanation is that the living dimension is inherently broader that the others. As for the environment dimension, it is also recurrent in the smart city definitions in the pretests. We believe that the prominence of environment concerns is due to the numerous news on climate mobilization at the time of the workshop.

In the second step, the students successively placed three buildings per group and then one building per group. Every group chose to add a building to the model. Figure 35 shows the buildings chosen by the students and their location. We observed that although some buildings were placed somehow arbitrarily, others were placed anticipating potential issues. An example is the placement of the public transport facility nearby the train station by group 2. They placed it there to ease the access to public transports for people arriving in the city from the train station, and said they wanted to allow workers to reach the multinational corporation placed by group 1 in the periphery easily. Another example is the placement of the police station at the middle of the model to allow fast interventions anywhere.

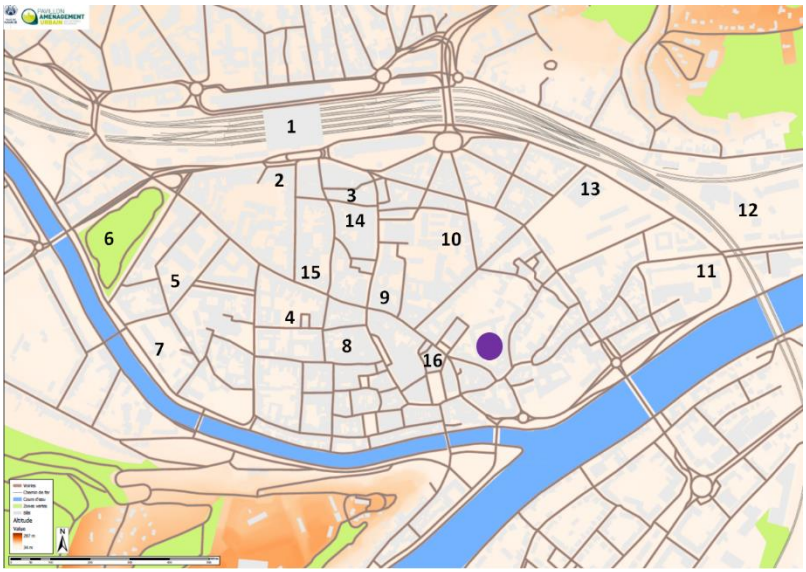


Figure 35. Completed Model

After the city model was completed, discussions emerged about the misplacement of the mall, as it would cause congestion when placed in the city center. All students agreed to move it elsewhere, but were divided as for its new location. Students were thus asked to list decision processes to solve such an issue and to vote for their preferred one. Table 35 lists the six decision-making processes thus obtained and the number of votes each received. We were surprised by the maturity of the students' reflection at this point. They considered issues such as ensuring the representativeness of voters. They suggested public displays as a way to consult senior citizens who cannot use a computer or don't own one. The decision process that received the most votes is the online voting.

Table 35. Decision-Making Processes

Decision Process	Votes
Elected Officials Voting	0
Citizens Voting	0
Shared Decisions (elected and citizens)	10
Only children voting	2
Petition	1
Internet voting (public display and website)	11
Blank	1
Total	25

In the third step of the workshop, students worked in groups of two with the micro:bit to implement a voting system that allows consulting citizens on a possible relocation of the mall. The system takes the form of a single micro:bit that can be interacted with through its buttons to cast a vote “in favor”, “against”, or “blank”. The micro:bit would then display a smiley as visual feedback that the vote was cast, and send the vote through radio to a centralized vote counter. The code for this voting system is show in Figure 36.

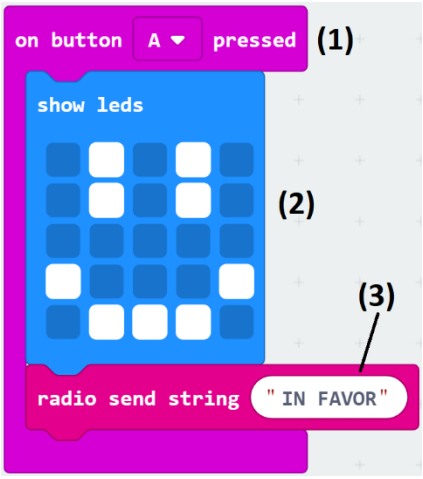


Figure 36. Micro:bit Code for Voting System

Due to the limited time available and to the fact that most students knew neither programming concepts nor the micro:bit, the centralized vote counter was developed beforehand and brought to the workshop. It is represented in Figure 37 as a cardboard box holding one micro:bit per voting option. Once every child had successfully implemented the voting system, they discussed the real-life limitations of such a voting system deployed in a city. Issues such as vote privacy and the possibility of voting multiple times were raised.

Figure 37. Micro:bit Counter for the voting system

7.3. Extensive Validation

In this section, we report extensively on the data collected through the pretest and post-test questionnaire. This allow us to understand how the children's perception of the smart city evolved thanks to the workshop.

7.3.1 Smart City Definition

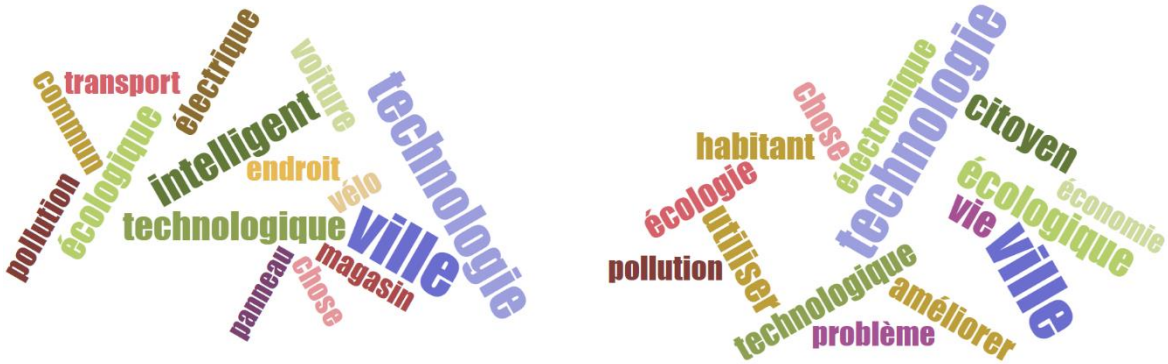


Figure 38. Smart City Definition Wordcloud

In order to have a first overview of how children defined the smart city before and after the workshop, a word counting was performed to capture the most frequent terms. The word cloud represented in Figure 38 shows the most frequent terms in the smart city definitions given by the children in the pre- and post-test questionnaires respectively, aggregated into a single text chunk. After manually correcting the spelling mistakes, punctuation and numerals were removed and the characters were lowercased. Each word was then lemmatized (i.e. broken down to its basic form) using the Morphalou (Romary et al., 2004) lexical database for the French language.

One can observe in the pretest word cloud that the most frequent terms apart from "city" refer to technology, environment and transportation modes (bike, car). On the post-test word cloud, there is still a strong presence of words related to technology and environment. However, words evoking a more humane aspect (citizen, inhabitant, problem, improve) of the smart city emerge. This shows that whereas the smart city was defined as a city using technology and dealing with environment and transportation issues before the workshop, there was a shift towards the smart city using technology in order to improve things and solve issues for citizens.

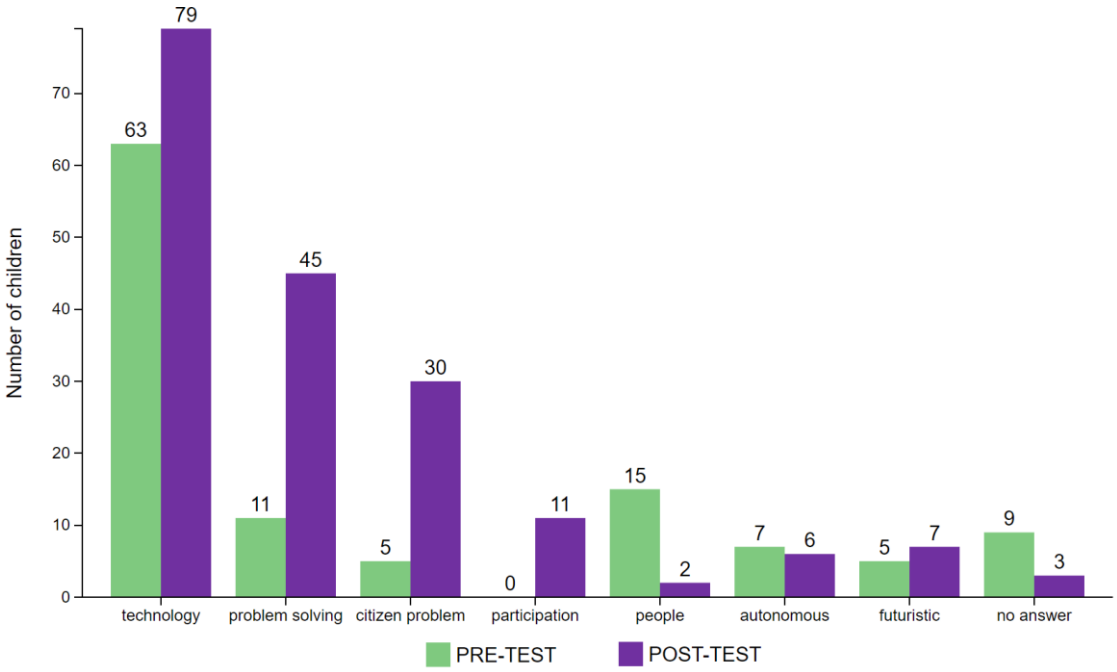


Figure 39. Evolution in the Smart City Conceptions

As detailed in Data Analysis Subsection, the smart city definitions given by children were tagged with seven non-exclusive codes. Figure 39 shows the number of definitions that were assigned the different codes, as well as the number of children who did not provide an answer to the question (9), either by writing that they don't know or not writing anything. One striking observation is the relative prominence of the *technology* (63) code compared to the others. The *problem-solving* (11) and *citizen problem* (5) codes were rarely assigned, and the participation character was not found in any of the 130 definitions. As for the misconceptions, the smart city as a city inhabited by smart *people* appears 15 times. The *autonomous* (7) and *futuristic* (5) misconceptions are more marginal, with less than 10 occurrences for each. It should be noted that 35 of the 130 definitions were an answer that did not match any code. In most cases, they corresponded to children defining a smart city as an environmentally friendly city, thus relating to the environment dimension but not to any code. Overall, the misconception codes have more assignations than the problem-solving, the citizen problem and the participation codes. No significant difference between males and females was found. The number of codes assigned for the post-test is shown in Figure 39. The *technology* code (79) is still strongly present after the workshop. However, a substantial change can be observed for the *problem-solving* (45), *citizen problem* (30) and *participation* (11) codes. As for the misconceptions, the numbers of assignations for the *autonomous* (6) and the *futuristic* (7) codes remain similar to the pretest results, thus marginal. The *people* code on the other hand went down from 15 to 2 assignations, showing success for the workshop in deconstructing this misconception. In total, 3 children did not provide an answer to the question and 19 definitions did not match any code. These numbers amount to approximately half those observed in the pretests.

Although comparing the assignation numbers for each code before and after the workshop provides very interesting insights, it is essential to analyze the transition between these different visions. In order to achieve this, a fingerprint was associated with each smart city definition from the tags assigned. In total, five distinct fingerprints similar to the initial codes were defined (see Table 36).

Table 36. Fingerprints associated with the smart city definition

Fingerprint	Description
Technology	Only the *technology* code was assigned
Good	Either the *problem-solving*, the *citizen problem* or the *participation* code was assigned, regardless of the other present codes
nothing	The question was answered, but no code was assigned
misconception	None of the *problem-solving*, the *citizen problem* or the *participation* code were assigned AND either the *people*, *autonomous* or *futuristic* code was assigned
no answer	The question was not answered

Figure 40 shows a Sankey diagram representing how children shifted from one fingerprint to another in the smart city definition they gave in the pretest and the post-test. The most frequently assigned fingerprint in the pretest questionnaire is *technology*, concerning 50 children. Almost half of them (23) were assigned the *good* fingerprint in the post-test. However, a significant part (18) kept the *technology* fingerprint. The remaining children were assigned the *nothing* (5) or the *misconception* (6) fingerprint in the post-test. Among the 12 children who were assigned the *good* fingerprint, most of them (9) retained it. The others received the *technology* (1) or the *nothing* (2) fingerprint. Out of the 35 students who were assigned the *nothing* fingerprint, only 10 retained it. The remainder fell into either the *good* (14), the *technology* (8), the *misconception* (2) fingerprint or did *not answer* the question (1). As for the 24 children who were assigned the *misconception* fingerprint in the pretest, most of them shifted toward either the *good* (7) or the *technology* (7) fingerprint. 3 children were assigned the *nothing* fingerprint and 1 did *not answer* the question, while 6 retained *misconception*. Finally, 8 of the 9 children who initially did *not answer* the question did provide a smart city definition in the post-test and were assigned either the *good* (2) or the *technology* (6) fingerprint. The remaining children did *not answer* the question.

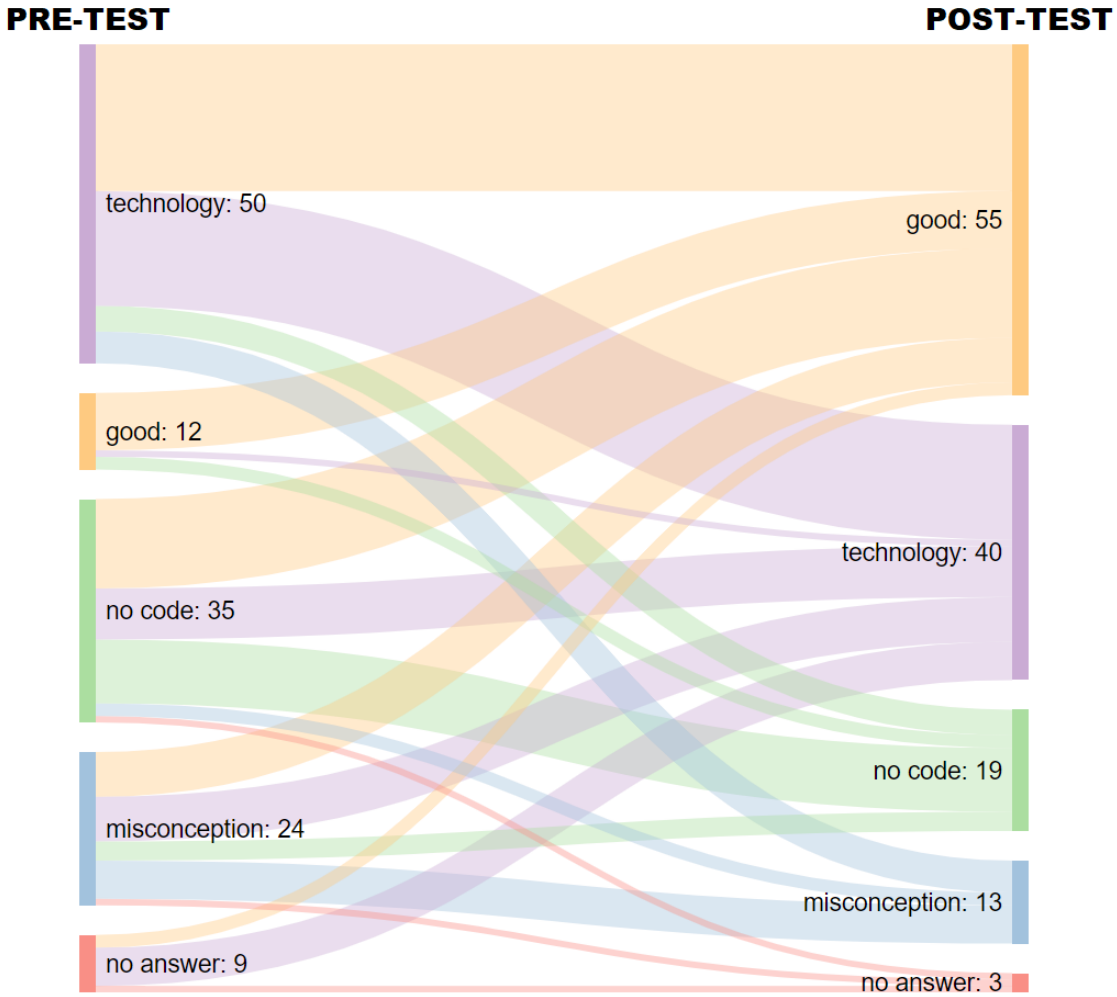


Figure 40. Fingerprints evolution (Sankey Diagram)

Overall, a substantial difference in the fingerprint frequency distribution when comparing the pretest and the post-test can be observed. Following the pretest, fewer than 10% of the children gave a definition corresponding to the *good* fingerprint, making it the least frequently assigned besides the *no answer*. As for the other fingerprints, *technology* had a slight decrease, whereas the frequency of *nothing*, *misconception* and *no answer* diminished drastically with important shifts observed toward the *good* fingerprint, which is the top fingerprint in the post-test.

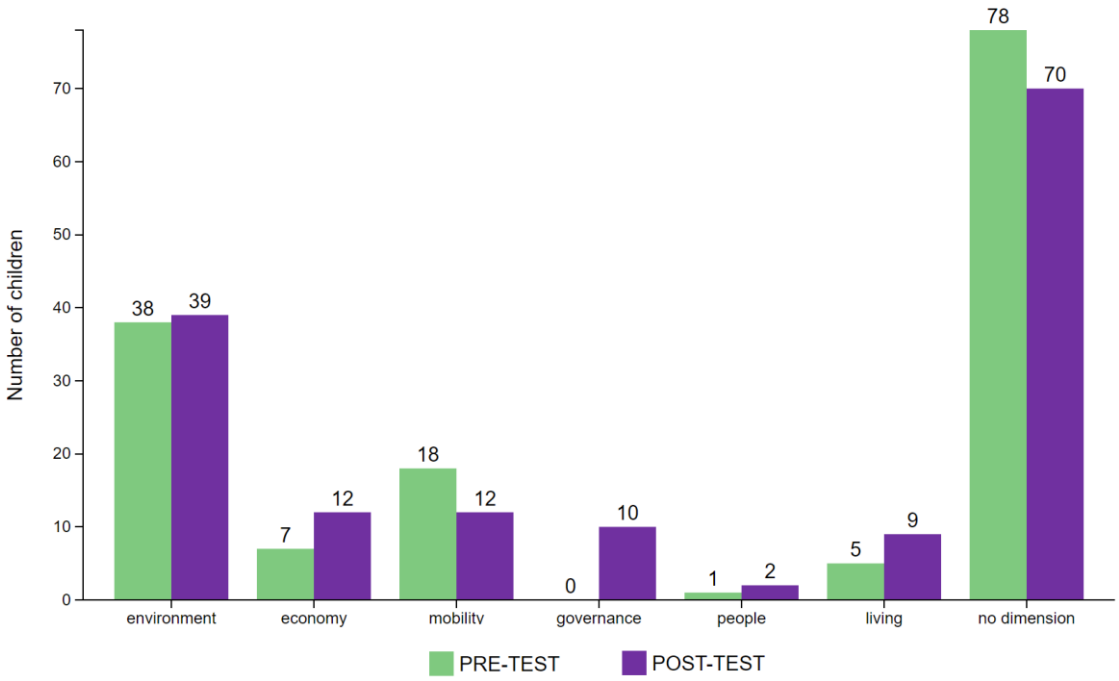


Figure 41. Evolution in the smart city dimensions

As shown in Figure 41, the smart city dimension mentioned the most in the definitions given by the children in the pretest is the *environment*. In many instances, a smart city is defined as a city that respects the environment, an ecological city. For example:

- “A city that is connected, ecological”
- “An ecological city, with less pollution and more greenery”
- “A city where energy is consumed in moderation, intelligently that is eco-responsible. It's a city with a lot of technology”

At the time the workshop was given, mobilization for climate was a popular news topic. The creation of movements such as “Youth for climate” helped children feel concerned by this issue. This explains the prominence of the environment dimension in the proposed definitions.

Another recurrent dimension is *mobility*. This dimension often appears with the technology orientation, as children frequently exemplify the use of technology with modes of transportation. It also appears along with the environment dimension. Some children pushed their thinking further when they defined a smart city as environmentally friendly by providing concrete solutions. The use of public transport or bikes instead of cars is a frequently suggested idea in the definitions.

- “Green spaces, space, less cars, thoughtful spaces”
- “It is a city with many systems like traffic lights and it is also a city of the future”
- “A city with fewer cars and more bicycles”

Conversely, the *economy*, *people*, and *living* dimensions are mentioned marginally. The *governance* dimension appeared in none of the 130 proposed definitions. They cover aspects of urban life that are of lesser concern to children, such as employment, citizens’ level of qualification and public services. However, due to its larger scope, more occurrences of the living dimension were expected. Instead of mentioning areas such as health and tourism, 4 of the 5 definitions falling into the living dimension discussed examples of using technology to improve security

- “A city that thinks about what it does (ecology) and tries to make people's lives perfect, public transport very well served, cycle paths, electric scooters, pedestrians and which is a safe city (camera) and parking”
- “A city where there are surveillance cameras, hybrid buses, electric cars for rent, ecological transportation, touch-screen billboard”

The majority of the proposed definitions do not explicitly mention any of the six smart city dimensions. For the main part, they correspond to definitions where misconceptions of the smart city appear, where the smart city is solely defined by the presence of technology, or where no answer is given to the question.

- “A city where there are only intelligent people”
- “It's a city with technology”
- “A city that evolves over time”

Two differences can be observed between the pretest and the post-test. First, the economy and the living dimensions occur more frequently in the post-test and the mobility dimension is less frequent. This can be explained by the fact that the examples given by the children in their definitions were mainly related to mobility as it is an area they are more familiar with in their daily lives. The first step of the workshop consisted in discussing examples from all six smart city dimensions, which were in some instances reused by the children in their definition. Also, some children retained several dimensions and listed them as a definition.

- “A city where residents put in place ways to improve daily life by putting in vegetable gardens, composts, etc.”
- “A city that is environmentally friendly, economical, mobile and safe for buildings and citizens”
- “It is a city that finds solutions for the economy, the well-being of its citizens”

The second difference is that the governance dimension appears in 10 post-test definitions whereas it was absent in the pretest. This can be explained by the fact that the workshop involved discussing citizen participation and building a voting system. Therefore, some children have defined a smart city as a city that involves citizen participation.

- “It is a city that uses technology to communicate with citizens”
- “It is a city in which everyone has the right to have their own opinion and to share it, namely through technology”

As in the pre-test, the majority of the definitions do not mention any smart city dimension. Although the misconceptions and the absence of answer are less present, some children still define a smart city by the sole presence of technology in it. Unlike the pretests, some children also define the smart city as a city that works to solve problems, without explicitly mentioning the dimension into which these problems fall.

- “A city that innovates and finds solutions to the problems of its citizens”
- “A city that uses technology to solve problems”
- “A more technology-oriented city, a self-managed city”

Overall, the dimension frequencies are more well-balanced after the workshop. This suggests that the workshop was successful in giving an overview of the areas concerned by the smart city.

7.3.2 Smart City Project

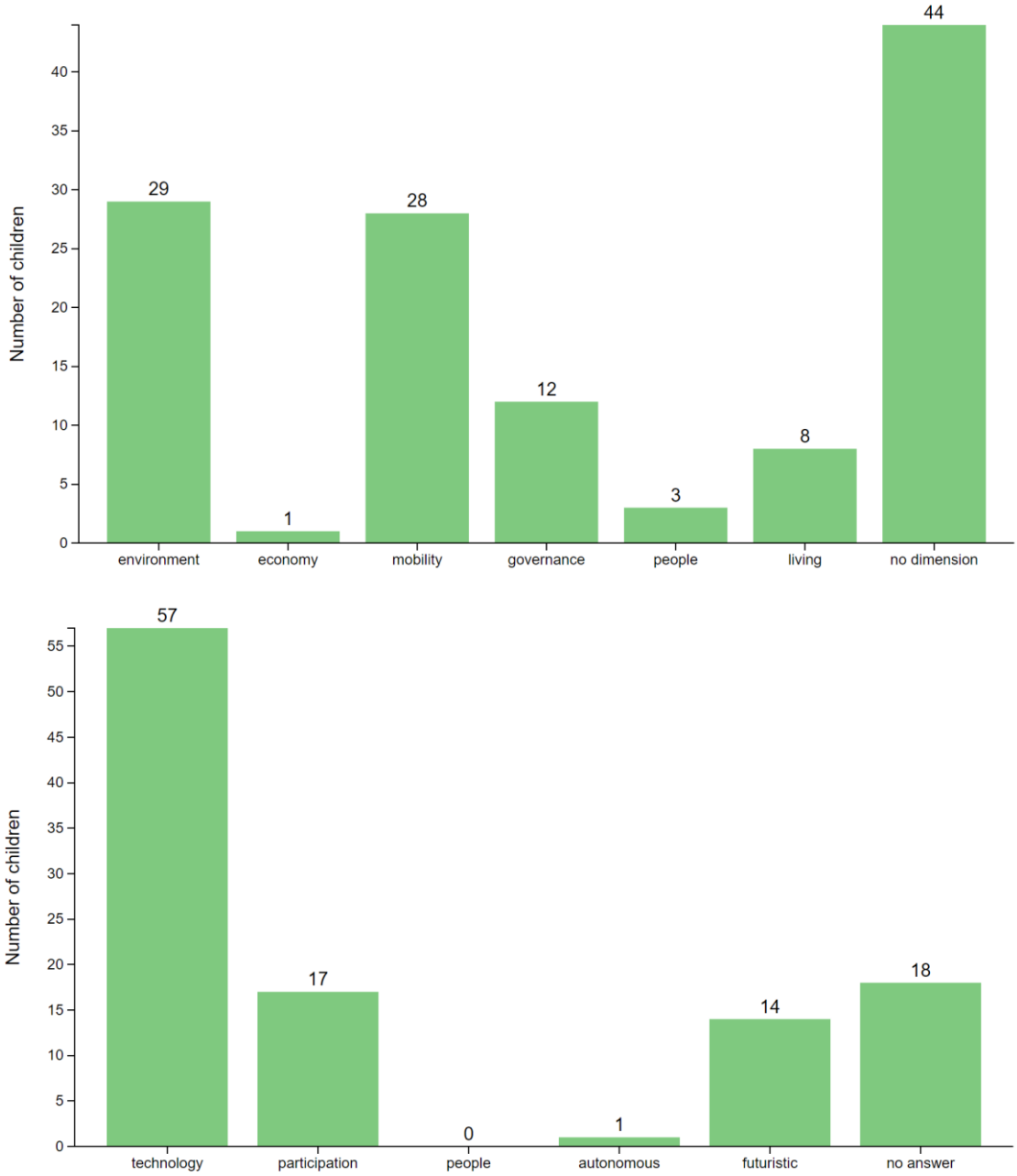


Figure 42. Conceptions and dimensions for the smart city projects

At the end of the post-test questionnaire, children were asked to propose a smart city project they would like to be implemented in their city. The mapping of their chosen project to the conceptions and dimensions of the smart city is shown in Figure 42. As for the orientations of the suggested ideas, the first observation is that half of the projects involve *technology*. This is in line with the results observed regarding the definition of the smart city.

The other two present orientations are the *participation* and the *futuristic* ones. The strong presence of the participation orientation could be explained by the focus of the workshop on participation methods. However, it shows that the opportunity to give one's opinion is considered essential enough to be picked by children as the smart city project they would like the most. To some extent, it also suggests that children are willing to give their opinion on city-related issues that concern them.

- “I would like to see the creation of a website in my city that would have a system of voting on ideas and projects set up by the inhabitants. There could also be a community forum, etc.”
- “Electric voting panels”
- “A voting system, the fact that citizens are more listened to, a more in-depth involvement of political decision-makers within the city”

The futuristic orientation also emerged on a recurring basis. This can be explained by the phrasing of the question, suggesting that children could propose a project beyond what can realistically be achieved.

- “Flying cars”
- “Have classes at home thanks to holograms”

Finally, 20 children did not provide any answer to the question, or stated that they don’t know what smart city project to propose. A type of response we eliminated from this are answers stating that no smart city project is wanted, as the city is already fine as-is. Four children answered the question as such.

The smart city dimensions mentioned in the proposed projects were extracted as well. Overall, two dimensions stand out, namely *environment* and *mobility*. As for the environment dimension, it can be explained in the same way as the prominence of this dimension in the smart city definitions. We believe that the strong awareness raising about climate change at the time of the workshop and the movements demanding actions from officials were echoed in the children’s answers. Regarding mobility, it covers issues that impact children in their daily lives. As a result, they are more prone to come up with project ideas in that area. In some instances, the children’s personal context made mobility projects emerge. Also, we observed that environment and mobility appear together in many project proposals, as the most frequent solution suggested to tackle environmental issues is to promote public transport and bikes at the expense of cars.

- “Much more public transport and green spaces”
- “Buses, I would like buses or public transport in my village”

As for the *governance*, *living*, *people* and *economy* dimensions, they appear less frequently. As explained earlier, these dimensions cover aspects that are of lesser concern to children in their daily lives. Hence, it is more challenging for them to come up with project suggestions in these areas. Nonetheless, some children did mention these dimensions, either by reusing the examples presented during the first step of the workshop or by proposing to implement voting systems. The governance dimension is more frequent than living, people and economy as it is at the core of the second and third steps of the workshop, in addition to being discussed with examples along the others.

- “Lights in the streets that light up when you pass by and are off when there is no one there”
- “Smart bins with a sensor to know when they are full”

Finally, there are many project proposals in which no dimension is explicitly mentioned. They mainly include the lack of an answer, answers stating that no project is wanted and projects that solely propose to add technology to the city.

- “Wi-fi located everywhere”
- “All technology, it is the future that comes to us”
- “That we use more computer technology”

7.3.3 Participation Methods

One question in the post-test questionnaire asked children to propose participation methods to collect the public’s opinion on an issue. Due to an issue in submitting the post-test to one class, only 114 children instead of 130 could answer the question. 21 of them did not propose any participation process,

80 proposed one process, 13 children noted two processes and 1 child listed three. In total, 108 participation methods were described.

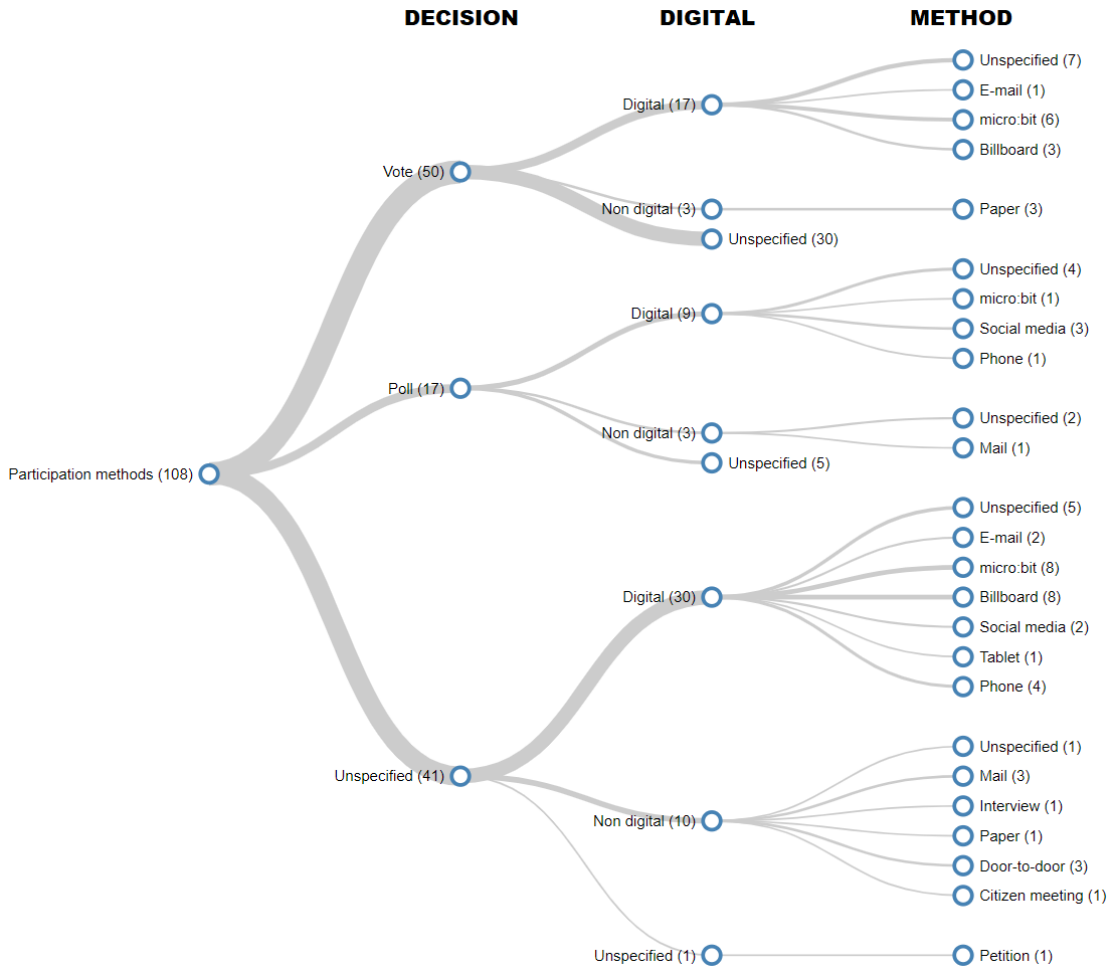


Figure 43. Suggested Participation Methods (Tree Diagram)

Figure 43 shows a tree diagram comprising all the participation methods proposed by the children. The second, third and fourth level nodes of the tree are related respectively to the decision, digital and method characteristics. A path in the tree defines a participation method characterized by each node it crosses. The number of times a participation method was proposed is noted between parentheses along each leaf node. The greater order frequencies are noted along the internal nodes of the tree.

Concerning the decision, 50 of the proposed participation methods consist in a vote and 17 consist in a poll. For the 41 remaining, it was not explicitly stated. As for the digital character, the use of technology is most prominent (56), whereas 16 methods do not involve technology and 37 do not indicate whether technology is entailed. The predominance of digital participation methods partly results from step 3 of the workshop, which consists in developing a digital voting system. Indeed, 15 participation methods involved reusing the system developed during the workshop with micro:bit and 11 involved participation through a billboard, most likely inspired by the micro:bit as well. However, this was alleviated during the second step of the workshop by discussing the importance of using several participation methods in a real-life context. With regard to the method, no method appears to stand out in terms of frequency besides the micro:bit and the billboard. Various methods such as social media (5), phone (5), mail (4) and e-mail (3) were proposed marginally. Considering the workshop target audience, having no more than 5 method proposals involving social media is something we found very surprising. The location was mentioned in 15 process proposals. The suggested locations were the city, including in the streets (12), the city hall (1), a school (1) and the citizens' home (1).

In a substantial number of instances, either the decision, the digital or the method characters was not specified. One possible explanation is the phrasing of the question, which did not indicate that these elements were required in the answer, and therefore many children omitted them. Nonetheless, a broad diversity can be observed in the process methods, both digital and non-digital. This suggests that citizen participation and the means to implement it is a topic that can be discussed with children in their early secondary studies. For example, it has occurred frequently during the workshop sessions that some children criticized the micro:bit voting solution because technology may introduce an entry barrier to participation.

7.3.4 Group Discussions

In the pretest, children were asked to list the positive and negative points of a group discussion, whereas in the post-test that question was focused on the workshop. The goal is to determine what are the most important positive points that a group discussion should have and what are the most important drawbacks that a group discussion should avoid, and to confront them with the results reported for the workshop. Also, since several different formats were tested with children, it is also of great interest to compare these formats in terms of how children experienced them. Due to an issue in submitting the post-test to one class, only 114 children could answer the question in the post-test, compared to 130 for the pretest.

Regarding group discussions in general, children mentioned the opportunity to give one's own opinion (50), the opportunity to hear the opinion of others (43), the fact that more ideas are able to emerge (11), the opportunity to change one's own or others' opinion (9), and the opportunity to learn new things (7) as positive points. 21 children did not mention any positive point. The negative points raised by children were disagreements (30), conflicts (29), interruptions (11), noise (7), and having to wait one's turn to speak (6). 31 children did not mention any negative point.

Concerning the workshop, 36 (resp. 61) children did not mention any positive (resp. negative) point. However, due to the post-test being completed several weeks after the workshop in some instances, children sometimes answered that they don't remember the positive and negative points of the workshop (6). Nonetheless, substantially fewer children mentioned negative points for the workshop than for group discussion, which is an encouraging result. The most mentioned positive points of the workshop are the opportunity to give one's opinion (22) and to hear others' (11), the opportunity to learn new things (15), and the fact that it was fun (7). As for the negative points, disagreements (15), the non-participation of some classmates (6), stubbornness (5) and the influence of others on one's opinion (5) were the most frequent.

Overall, the main positive and negative points are fairly similar for both group discussions in general and the workshop. Nonetheless, some discrepancies are to be noted. First, the opportunity to learn new things was raised twice more frequently for the workshop. One possible explanation is that group discussions usually involve participants knowledgeable of the topic at hand, whereas the topic of the workshop is an entirely new concept for children. Second, the fun character of the workshop was raised in several answers. The workshop involves the construction of a city model and a hands-on activity on a computer, which are expected to be perceived by children as more playful than a mere discussion (5 children mentioned the activity on computers as a positive point). Third, more surprisingly, the opportunity to change one's own or others' opinion and the fact that more ideas are able to emerge were mentioned respectively 2 and 3 times for the workshop. One possible explanation is the fact that children were divided into small groups for activity involving a group discussion, namely the building of the city model. The model was than constructed by building up the results of these smaller scale group discussions, with children not immediately given the opportunity to question the choices of other groups than their own during the model construction. Some answers may concern the part when the part when the decisions of the groups are shared to build the model, rather than the discussion that led to these

decisions, inside each group. This could explain why the two aforementioned positive points were less frequently raised in the post-test.

It was observed that some positive and negative points are specific to one of the workshop formats. All the children that mentioned the opportunity to change one's own or others' opinion, the influence on one's opinion by others, the stubbornness and the non-participation of some classmates were given the 2x100 minutes format. The length of the workshop was raised in three instances, all by children given the 1x150 minutes format. It was the most frequently raised negative point for this format. This shows that a session of 150 minutes (that is, 3 class hours), is too long to maintain the children's interest. As for the 2x50 minutes format, no positive or negative point is more prominent with respect to other formats. This result can be explained by the large number of children who did not provide any positive or negative point (respectively 28 and 42 out of 59 children). The issue with some classes taking the post-test several weeks after the workshop and thus not answering that they do not remember the positive and negative points concerns exclusively the 2x50 minutes format.

7.4. Discussion

In this section, we explain how SmartCity4All addresses the two previously formulated research motivations.

7.4.1 An innovative small-scale participation opportunity

Concerning the lack of innovative participation opportunities for children in the smart city (Motivation 1), the workshop constitutes a solid basis for children to be informed about the concept, to enable their participation and to let them develop smart city solutions themselves. This method could be integrated into the participation ecosystem of a smart city (Simonofski et al., 2018; Berntzen & Johannessen, 2016) along with other methods. Indeed, we believe the workshop will be complementary to existing participation methods. For instance, within a living lab, an urban innovation ecosystem often encountered in smart cities (Cossetta & Palumbo, 2014), the workshop could take advantage of the infrastructure of the lab as well as the expertise from researchers, businesses and public agents. Another possible complementarity might come from the use of the workshop to facilitate participatory budgeting meetings. Indeed, these meetings can be abstract and complex for citizens and the workshop would provide an interesting, fun and tangible support to the discussions. Additionally, other complementarities could be found with urban planning meetings (Hennig, 2014), e-participation platforms (Berntzen & Johannessen, 2016) or open data portals (Atenas & Havemann, 2015).

7.4.2 An introduction of the smart city to children

Concerning the lack of initiatives educating citizens to the smart city concept (Motivation 2), the results show that the workshop was successful in changing the children's initial vision of the smart city toward a more problem-solving and citizen participation oriented one.

Due to data collection issues, 21 children participated only in the third step of the workshop and therefore completed only the post-test. Consequently, these children only took part in the hands-on programming activity, which could be proposed as full activity in a smart city context. Hence, the question of whether the sole programming activity is sufficient to introduce the smart city to children properly, that is, in a way that covers its multiple perspectives, emerged.

While the post-test data from those children was not discussed in the Extensive Validation Section, it nonetheless gives an insight into what the impact of the workshop would have been, had it consisted only in the programming activity. In their definition of the smart city, 13 of the 21 children mentioned the technological orientation of the smart city. Strikingly, none mentioned anything related problem-solving, citizen problems, and citizen participation, despite the programming activity consisting in developing a voting system. Regarding participation methods, only 4 children proposed one in the questionnaire. These results hint that the third step of the workshop alone is not able to sensitize children to the other perspectives than technology, and that the other steps are needed to set the context of why developing a voting system is of interest in a smart city.

7.4.3 Lessons learned for practice

Throughout the classes where the workshop was given, we retained relevant lessons for other workshops to be organized in the context of smart cities. The workshop was given in four different formats (2x100min, 2x50min, 1x150min, 1x90min).

We would qualify the 2x100min format as ideal for a proper implementation of the workshop. Indeed, leaving one full session for the programming activity makes it possible to answer the children's questions in depth as well as discussing challenges and limitations of the smart city solutions. Furthermore, the

best evolution in the children's understanding of the smart city concept came from the classes where this format was used.

The 2x50 format also made it possible to devote one session to the programming activity. However, getting the children's interest and concentration in 50min was challenging. Furthermore, the discussions did not go as deep as with the 2x100min format. We would therefore not recommend using this format.

The 1x150min session was considered too long by the children in terms of concentration. Furthermore, in this session, the city model was constructed beforehand by the children for another class. This was detrimental to the quality of the workshop as the city was less realistic than in the other workshops and we were not able to discuss concrete urban issues as easily on that basis. Consequently, the students did not seem as engaged in the programming activity. Starting with the theoretical introduction and debating concrete urban issues is what really enables children to understand the purpose of the smart city solution.

Regarding the 1x90min format, we did not capture information about the children's understanding through questionnaires but we noted that the timing was too short to go in-depth into each part of the workshop. However, several students still showed interest and willingness to program after the presentation of the smart city solutions in micro:bit.

To sum up the lessons learned throughout the testing of this workshop, we would recommend that practitioners:

- Hold the programming activity in a separate session
- Devote enough time (75 minutes would be a minimum) for each of the two sessions
- Challenge the children as much as possible at each step of the workshop. For the theoretical introduction, we asked them about the limitations and real-life examples of the solutions. For the model construction, we discussed the real-life political process with them. Finally, for the programming part, we challenged their solutions in terms of feasibility, privacy, representativeness, etc.
- Keep the playful character and stimulate it as much as possible during each part of the workshop. Even though it was given to children of different ages, we observed that having a playful experience really helps to capture their attention and increases their willingness to learn.

7.5. Limitations

In this section, we explain the limitations of SmartCity4All.

7.5.1 Data collection methodology

All questions were asked in an open-ended way, as this has the advantage of allowing more creative expression compared to questions formatted differently (Boynton and Greenhalgh, 2004), which is what we aimed for in the data collection. However, one known drawback of open-ended questions is that they can deter some respondents from answering. This limitation was partially alleviated by the easy-to-answer first question that aimed to put participants in a more confident mindset.

7.5.2 Data quality

There was an issue with the post-test in one school that led to 59 children completing the post-test several weeks after the workshop. Overall, we observed a lower quality in those data, as children responded that they don't remember the workshop or refrained from answering more frequently than others.

Also, the quality of the data collected with the 15 children enrolled in a differentiated education program is lower as well. This was expected, since we observed that they were much less assiduous while completing the questionnaires. Although more workshop sessions would be needed to confirm that, this suggests that other data collection methods should be used in order to assess the workshop with this target group.

7.5.3 External factors

At the time the in-school sessions of the workshop were organized, one particularly recurring theme in the news was climate change, and youth mobilization for climate[10,11]. This appeared to be reflected to some extent in the questionnaire answers, judging by the prominence of the environment dimension compared to the others. The results of the workshop might have been slightly differed in that regard, had the news context been different. However, we cannot precisely assess the impact on the results.

[10] https://www.thebulletin.be/3000-pupils-march-climate-brussels, retrieved July 25th 2019.

[11] https://www.brusselstimes.com/brussels/53896/youth-strike-for-climate-descends-on-brussels-for-a-7th-time-greta-thunberg/, retrieved July 25th 2019.

7.6. Further Research

The workshop proposal and its first results were presented at several conferences and exhibitions and have sparked strong interest among the attendees. Valuable feedback was received from public servants, researchers in citizen participation, digital education experts and teachers. This feedback from practitioners along with the data collected following the in-school sessions shaped the two avenues for further research that are proposed in the remainder of this section. In order to address the next steps of our research in a way that best benefits practice, we plan to keep these practitioners involved.

7.6.1 Building a city model with tangible interaction

One limitation of the workshop that was observed throughout the sessions is that the problems with the city model raised during the second step are usually missing or misplaced buildings. Overall, very few issues were raised regarding the impact of the placed buildings on their vicinity (e.g. noise, road congestion, etc.). At the same time, some practitioners noted that the workshop could be improved if the city model could display information about the placed buildings and their impact. In order to address this issue, we plan to work on a new version of the model construction step by leveraging tangible interaction.

A first motivation for considering tangible interaction is that it is reported in the literature as playful (Hornecker and Buur, 2006; Marshall, 2007) and especially suitable for collaborative learning activities (Horn et al., 2012). These qualities are important positive points of the workshop that were raised by children in the post-test questionnaire and we are committed to preserving them. In addition, since tangible interaction is especially suited for collaborative work and discussions (Schneider et al., 2011; Horn et al., 2012), it could help to add the opportunity to question one's or others' opinion and the fact that more ideas are available when working in group to the workshop strengths.

Inspired by the reacTIVision (Kaltenbrunner and Bencina, 2007) framework and the URP system (Underkoffler and Ishii, 1999), the envisioned system would take the form of a table onto which a city map display would be projected. The buildings would be similar to those used in the current version of the workshop, but would be assigned a unique token that would be read once they are placed on the city map. It would allow for each building to be automatically recognized and to project on the map information that is specific to these buildings. Children could then observe how the city map reacts to the buildings and reflect on their decision to place them.

While introducing tangible interaction to the workshop is a promising avenue, it would be detrimental to two convenient aspects of the current workshop that should be acknowledged. First, one advantage of the workshop as it stands is that it is possible to transport the necessary equipment to any convenient place, which allowed us to move from class to class. Naturally, an interactive table is tedious to carry around. Second, another advantage of the workshop in its current format is the cost of the equipment. In total, the buildings and the city model are an expense under $100 and do not take any specific skill to set up. However, the construction of an interactive table as described requires much more resources, time and technical skills.

7.6.2 Expanding the workshop for adult participation

The workshop introduces the smart city to children and enables their participation within this paradigm. However, children are only a sub-group of the citizenry and the extension of the workshop to adults is a promising lead for further research. Indeed, throughout the workshop presentations that were given to practitioners, a recurring insight was that the target audience could go beyond the children and work with adults as well. One challenge that should nonetheless be acknowledged is the recruiting of participants. All the workshop sessions organized took the form of an in-class activity, thus not raising

any participant recruiting issue, since attendance at the activity was mandatory for the children. However, as mentioned by (Wijnhoven et al., 2015), there are several motivating factors for citizen to participate in their city, including the playfulness of the participation experience or the learning opportunities it provides. Therefore, as these two factors were explicitly mentioned by the children when discussing the positive points of the workshop, we are confident that adults would engage in it as well after some necessary adaptations, some of which were hinted at in the practitioners' feedback. These adaptations of the workshop are multiple. In the theoretical introduction step, more realistic and complex examples could be presented. In the construction of the model step, more realistic budget constraints could be imposed. Through a collaboration with public servants, scenarios based on real-life cases (e.g. the installation of a mall in the center of a city) could be used to structure the discussions and output a more concrete result. Additionally, more advanced roles could be assigned in the group discussion to reflect the roles and structure of a municipal council. In the solution step, more advanced techniques could be used to design smart city solutions with the adults. We intend to source these techniques from the end-user programming field and to fast-prototype them with the participants.

7.7. Contributions

The concept of the smart city is increasingly recurrent in political speeches, scientific literature and the news, as it is considered a promising solution to the modern challenges cities face. Researchers and more recently practitioners advocate involving citizens in the design of the smart city, as it is critical to the its success. However, the smart city concept remains obscure to the ider public, who as a result fails to feel involved.

In this section, we presented an evaluation of the SmartCity4All workshop aimed at introducing the smart city concept in all its complexity to children. The SmartCity4All workshop, built following the design science research methodology, consists of a discussion around the six smart city dimensions illustrated with real-life examples, the collaborative construction of a city model that serves as a work support, the identification of issues in the built mock city and discussion of what methods to use to ask for citizens' opinion on these issues, and the development of a voting system using a novice-level programming interface. The workshop was tested as an in-class activity with 299 children from several different schools.

When feasible, data about children's understanding of the smart city and their view on citizen participation methods was collected through a questionnaire completed before and after the workshop following a pretest-post-test design. In total, 130 questionnaire pairs could be collected and analyzed. The results show that the workshop was successful in shifting the children's vision of the smart city from a solely technologically based one to one where technology is at the service of citizens and is useful for solving issues faced by cities. During the sessions, children were enthusiastic about the proposed activity and critical thinking, especially when discussing participation methods. It shows that smart cities and citizen participation are concepts that can be discussed in a meaningful way with children.

The data collected during the evaluation of the workshop, its observed limitations as well as the feedback provided by multiple practitioners allowed to propose avenues for future research. In particular, we plan to study how tangible interaction can help to support the construction of the city model and to work on an adapted version of the workshop suitable for adult participation. In engaging in these avenues, we plan to work closely with multiple practitioners in order to pursue our research in a way that best benefits practice.

Overall, the contribution of this study is threefold. First, we provide a workshop methodology to introduce smart cities to children. Second, we provide a field validation of a workshop aimed at introducing the smart city to children. Third, we report on how children perceive the smart city and citizen participation.

PART III: Closing Comments

8. Conclusion

In this section, we summarize the contributions of this thesis. Next, we discuss their implications for research and practice. Thereafter, we present the limitations under which the research in this thesis was conducted and introduce leads for further research.

8.1. Contributions

This thesis introduces three main contributions that take the form of three management tools.

First, the CitiVoice Framework summarizes several means of enabling citizen participation from different research fields and categorizes it under three categories: citizens as democratic participants, citizens as co-creators and citizens as ICT users. Furthermore, these different means of participation are bundled into a framework to compare and evaluate citizen participation in smart cities. This framework has three main uses to manage participation at large scale: it can be an evaluation tool to determine if a city has implemented participation properly; it can be a governance tool to guide practitioners in their decisions relating to participation; it can be a comparison and creativity tool to compare best practices among smart cities.

Second, the UParticipate Guide allows project managers to perform ex-ante analysis before engaging in user participation activities and to make recommendations for a better situated participation. Through its conceptual model based on several literature sources, UParticipate describes the relationships of several influencing factors on user participation decisions. In addition, the decision support guide derived from this model gives practical guidelines to practitioners to help them determine which decision to make depending on the situation they are facing. UParticipate makes it possible to manage participation on a medium scale.

Third, the SmartCity4All Workshop constitutes an innovative small-scale participation method for involving children in the smart city. It has three main reported benefits. First, the workshop can impact the children's understanding of the smart city concept. Second, it enables children to debate about their ideal city they would like to inhabit and prepares them to engage in adult participation in the future. Third, it teaches children technological tools to solve urban issues and improve the lives of their fellow citizens.

8.2. Implications for Research

Regarding the expected implications for research, the different research activities allowed us to contribute to the defined research questions. Table 37 details the mapping between the three main contributions and the research questions.

Table 37. Mapping between Contributions and Research Questions

Research Questions	CitiVoice	UParticipate	SmartCity4All
RQ1: How to structure citizen participation in e-government?	X		
RQ2: How to appropriately manage citizen participation on different scales?	X	X	X
RQ2a: How can a city enable the participation of its citizens so as to become a smart city?	X		
RQ2b: How can the project managers' decisions related to user participation in e-government service development be supported, taking several influencing factors into account ?		X	
RQ2c: Can a workshop impact children's understanding of the smart city concept?			X
RQ3: Which stakeholders should be considered for citizen participation in e-government?	X	X	X

Regarding RQ1 ("*How to structure citizen participation in e-government?*"), CitiVoice has structured the citizen participation research field into three main categories: citizens as democratic participants, citizens as co-creators and citizens as ICT Users. These three categories are fueled by the scholarly literature and have been validated through their application to numerous large-scale projects in smart cities (Namur, Mons, Brussels, Linköping, Amsterdam, Ghent, etc.). The originality of this contribution does not come particularly from its holistic nature but from its view of participation as investment areas where priority choices have to be made depending on the smart city strategy and the context factors influencing the city. This research was thus integrative in terms of research fields.

Regarding RQ2 ("*How to appropriately manage citizen participation on different scales?*"), we took the Smart City as a use case for large-scale projects. Indeed, a city, even on a relatively small scale, such as Namur, has a great many diverse citizens that can participate. CitiVoice ensured the representativeness of the citizens using several criteria and its complementary participation methods listed. Furthermore, a full ecosystem of stakeholders (private, public, civil society) is active in the city and impacts how this participation is implemented. When validating CitiVoice, different stakeholders were able to give us feedback about it and were all positive, as CitiVoice is general enough to be relevant to all profiles. Finally, several context factors can also impact the way policy-makers will develop their participation strategy. In this thesis, we focused on the impact of these factors on participation and consequently suggested context-specific recommendations. All these different elements are essential to take into account when strategizing participation at large scale and CitiVoice integrate them as much as possible.

Then, we took the development of e-government service as a use case for medium-scale projects. Indeed, the development of an e-government strategy (and more so, of an e-government service) can be considered a sub-section of an overall smart city strategy. Consequently, fewer users are targeted, a more defined set of stakeholders are involved and the context factors are focused on the organizational level. Therefore, we claim that the UParticipate Decision Support Guide constitutes an appropriate tool at this scale. The main rationale behind this claim comes from the two projects that were used to validate UParticipate: the development of an e-portal for the city of La Louvière and the

development of an Open Data Portal for the city of Namur. In these two cases, UParticipate constituted an appropriate tool for analyzing the context factors that impact the choices around user participation and delivered appropriate recommendations to practitioners.

Finally, we took children's participation in classrooms as a use case for small scale projects. Indeed, these participation projects often focus on a small group of citizens (e.g.: ideation activities, participatory budgeting, …). Thanks to SmartCity4All, we were able to consider children as future adult participants and provide them with a workshop that introduce them to the smart city concept (the content on which they participate), guidelines on participating in a city (the method for participation) and the basic tools with which to develop smart solutions themselves (technological foundation to support participation). This workshop constitutes a solid basis for small-scale participation, as it provides various guidelines, good practices and technological support.

Through these three sub-questions, this research was integrative in terms of management levels. The respective contributions to RQ2a, RQ2b, and RQ2c have already been explained in respectively, sections 5.3.5, 6.5.5 and 7.7. Regarding the contribution to the smart city field (RQ2a), CitiVoice constitutes a tool that structures the participation field and enables city officials to invest in participation, having a clear view of the possitibilities offered. Regarding the contribution to the e-government service development field (RQ2b), we were able to formalize four influencing factors, three participation degrees and eight participation methods in a theoretical model thanks to several research activities. This constitutes a first essential step towards a situated participation in e-government service development. His modular nature will future researchers to build upon it. This theoretical model was then derived as the UParticipate decision support guide guide that can be improved by researchers and practitioners in the future. Regarding the contribution to the children participation field (RQ2c), SmartCity4All was successful in introducing the complex smart city concept to children in all its dimensions (technology, participation and problem-solving). Furthermore, on top of the pedogagical benefits, the workshop also contributed as being an instantiation of the "workshop" participation method. The enthusiasm, the suggested ideas and the critical thinking of children were noticeable and the setting of the workshop was an enabler in that regard.

Regarding RQ3 ("*Which stakeholders should be considered for citizen participation in e-government?*"). In the SLR that was performed at the beginning of this thesis (cf. Section 3.1.1), several stakeholders linked to participation were identified: political representatives, software developers, public servants and citizens. With CitiVoice, the focus was on the political representatives and the public servants that could use the framework to analyze their city. With UParticipate, the software developers and public servants could determine how to integrate users in the course of e-government service development. Finally, SmartCity4All enabled young citizens to participate directly in a smart city context. This research was thus integrative in terms of the stakeholders involved.

In addition to focusing on these research questions, we disseminated the research results through publications in workshops, conferences, book chapters or journals. The full list of publications is available at the beginning of this document.

8.3. Implications for Practice

The research performed throughout this thesis also intends to have a practical impact. In fact, through the design and validation of the three management tools, it already proved relevant to practitioners. In this section, we expand on the practical relevance of CitiVoice, UParticipate and SmartCity4All.

8.3.1 Impact of the Tools on Use Cases

The three management tools described in this thesis has already had a practical impact on real-life use cases.

First, the CitiVoice Framework provided relevant guidelines to the cities it was used on. For Mons and Linköping, it was merely used as an evaluation tool to help the smart city manager reflect on their strategy. For Brussels, it was used as an evaluation tool and, most importantly, as a governance tool. Indeed, city officials used the framework as a "check-list" to prepare a participatory budgeting project that took place in 2018. Thanks to CitiVoice, they gave particular attention to the representativeness of participants, the transparency of the course of action and the multi-channel aspect of participation methods. For Namur, CitiVoice had an important impact as explained in sections 5.3.1 and 5.3.2 of this document. We have, moreover, had the chance to participate in strategic meetings about the living lab strategy of the city and provide recommendations based on the insights from CitiVoice.

Second, the UParticipate decision support guide has also had an important impact on its use cases. For the e-government portal of La Louvière, we were involved from the start in studying the project, as explained in Section 6.3.2. Important strategic decisions were made by city officials based on the insights we provided, such as the development of an improvement questionnaire, the live prototyping of the portal in the town hall or the organization of representative workshops transversal to all departments to present the portal. For the Open Data portal, UParticipate also enabled the city to collect relevant feedback about their portal as well as concrete recommendations to further develop it. This research is more recent, but we intend to continue the collaboration to support the dissemination of Open Data to more citizens of Namur.

Finally, the SmartCity4All workshop had an important impact, as it was given to 299 children in total across 15 classes and 4 schools. We hope this workshop has introduced the smart city concept to all these children (and hopefully teachers) and made them interested in adult participation or technological development to solve urban issues. As mentioned in section 7.3 and 7.3, the enthusiasm shown by the children and the evolution of their perceptions are promising in that regard. Furthermore, we intend to extend the workshop to adult citizens to enable them to make their voice heard more easily to their city and effectively co-create smart city projects. We are currently discussing the launch of this project with representatives from the urban planning department of Namur.

8.3.2 FLEXPUB Project

As explained in Section 3.2.1, this research was carried out as part of the FLEXPUB Research project. As a reminder, the goal of that project is to provide guidelines to the federal government in Belgium on the development of flexible and innovative e-government services. Moreover, these guidelines will have a practical impact through the dissemination of three key operational deliverables that can be useful for relevant stakeholders (policy-makers, public servants and software developers):

- A general Blueprint for adaptive and innovative government
- A more specific Strategy for the development of flexible and innovative location-based e-government services
- A Toolkit with concrete recommendations and tools to practitioners

The goal of the FLEXPUB Blueprint is thus to suggest a vision of government. Three axes, nine key principles and a dozen of practical actions are suggested to reinforce the administration in its aim of an even more adaptive and innovative government. These three pillars call for an open, participative and collaborative government that has its foundations in geospatial data as shown in Figure 44. The research conducted in this thesis has had an essential role in suggesting the actions of the "Participative" pillar that is defined as follows in the strategy:

> "Participation is about involving all the stakeholders impacted by the digitalization strategy, by taking into account their evolving requirements, needs, ideas or necessary training. This participation is essential to be able to match the expectations of the stakeholders regarding the e-services.
>
> This entails the participation of two main stakeholder groups. The first are the external users – whether these are citizens or private or public sector organizations – that have to participate in the development of e-services. Thanks to this participation, the e-services will be better aligned with these stakeholders' requirements and, ultimately, more widely used, not only by the tech-savvy, but by all. The second stakeholder group to consider are the internal public servants whose jobs will evolve due to digitalization. As they will interact with the e-services in the back office, it is essential to accompany this change with appropriate change management actions."

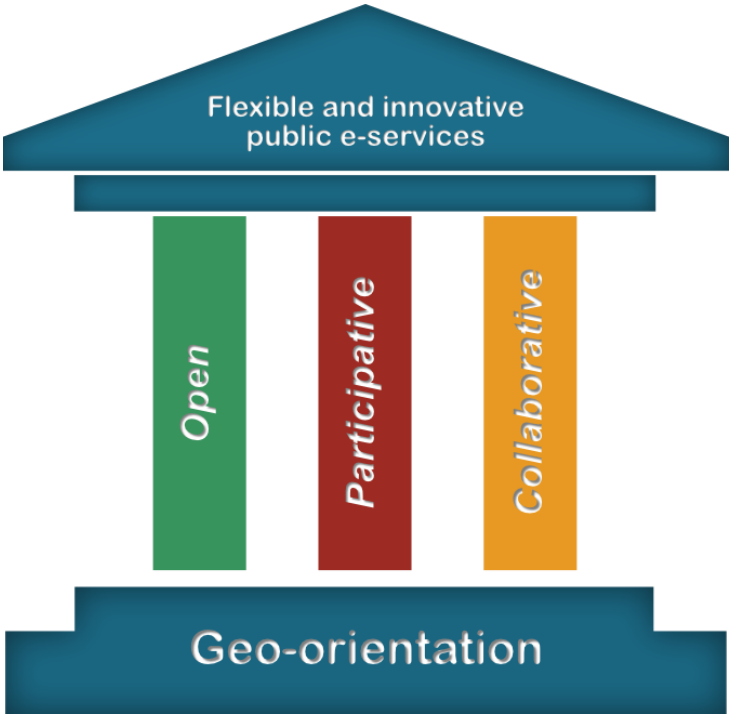


Figure 44. Pillars of FLEXPUB Blueprint

This Blueprint Vision also underlines the implications of the suggested strategic actions. This Blueprint, which purposely remains general in scope, is supplemented by a more detailed and specific approach in the Strategy for Location-based e-Services. The Blueprint and Strategy will follow a twelve-year timeline (2018-2030): 2030 and the finalization of the United Nations Sustainable Development Goals will offer the ideal occasion to evaluate what will by then be achieved regarding the position of the State in relation to citizens and society. These documents comprise guidelines, instructions, protocols and/or specifications dealing with the flexible management of geospatial e-services or issues related to adaptive or innovative governments. They will be written in such a way that the content can be easily consulted and provide quick answers to key questions. Figure 45 shows the strategic actions suggested in the FLEXPUB research project under the three pillars previously cited. Here also, the research conducted in this thesis contributed to embedding in research the actions to reach a participative government.

Open Government	Participative Government	Collaborative Government
Rethinks its information management system	Aligns with internal stakeholders	Rethinks organisational structures to actively serve the end-user
Ensures sustainable funding for public data quality and up-to-dateness	Integrates the input from citizens and external users	Strengthens coordination and sharing practices within a single administration
Guarantees personal data protection and security	Develops the appropriate methods and tools	Builds on common approaches to stimulate cooperation across governments

Figure 45. Strategic Actions suggested by FLEXPUB

Regarding the toolkit that will be derived from the Blueprint and the Strategy, UParticipate will be a part of it, since the kit is suited to the development of e-government services and will hopefully be used by practitioners. Contacts have been made with the Federal Public Service in charge of digitalization in Belgium (FPS BOSA), so that they will use it in the context of their user experience (UX) projects.

8.4. Limitations and Future Research

This thesis has introduced three tools to manage citizen participation in the context of e-government, but these are only the foundations for further research to be performed, given their inherent limitations and the research avenues they have opened up. Even though some limitations and research leads have already been discussed throughout this thesis, here we offer a more general overview.

First, we want to further explore the interconnections between the three managements tool presented in this thesis. Indeed, CitiVoice constitutes a generic framework that can be applied to different smart cities irrespective of their context. Therefore, a possible extension of CitiVoice can start from the context factors identified in Section 5.5. We have established that different cities implement participation activities differently depending on their context. By understanding the context factors and their impact on citizen participation, we aim to reach a more objective comparison of cites so that “we are not comparing apples and oranges”. Introducing weighting mechanisms for some criteria based on these factors might be particularly promising. Linked with this consideration, the UParticipate Decision Support Guide could be extended to other types of projects than e-government services developments, such as smart city solutions. Beyond this type of project, the addition of other influencing factors (based on the ones identified for smart cities) also opens up paths for further research. Finally, SmartCity4All was only given to children at this stage. As mentioned in section 7.6, we want to test the workshop with oldder audiences to see what needs to be adapted. Furthermore, we want to use tangible interaction with a tabletop interface so as to enhance the model construction part of the workshop. We hope that these improvements will ultimately help fuel the discussion on smart cities and identify additional participation methods. These insights will then be beneficial to improve and complete the CitiVoice Framework.

Second, with CitiVoice, we have performed an extensive literature review to structure the citizen participation research area and take a strategic look at it. However, citizen participation is a continuously evolving field and numerous other participation methods could ultimately be added as criteria in CitiVoice, elements of UParticipate or tangible technological improvements of Smart City4All. For instance, the use of big data to enhance participation would deserve proper investigation, as it could enable data-driven participation (Tenney and Sieber, 2016). Furthermore, the use of blockchain in government is also promising, as one of its promises is to deliver a proper decentralized governance for citizens (Ølnes, 2016) .

Third, CitiVoice has shown that citizen participation can be viewed as an investment area where different participation methods can be stimulated, depending on the objectives of the city. In the same vein, during the validation of UParticipate with the Open Data Portal of Namur, the combination of several participation methods was effective for collecting insights from users. Indeed, citizen participation channels are better used in combination with each other in order to reach as many citizens as possible and ensure the validity and representativeness of the input collected. However, in order to create a consistent ecosystem of citizen participation channels (that is, efficiently combining participation channels in a way that is complementary), it is essential to understand which citizens interact with which method, and hence to have socio-demographic information about the actual users of these methods. We thus suggest examining in further research the complementarity of participation methods in different contexts.

Fourth, the three management tools presented in this thesis have shown their relevance for practice, but might still be too over-intellectualized and ultimately of low value for decision-makers. Therefore, as a next step, we intend to develop user-friendly tools based on the ones developed in this thesis. For instance, if we take the example of UParticipate, the user-friendly tool would take the form of an easy-to-use online application that interested project managers can use to analyze their current situation and get insights on their decisions relating to user participation. In later implementation stages, this application could bring additional insights into the content of the participation methods matrix;

instantiation of the participation methods to the specific context; reports on previous use cases; references to scientific literature; or, contacts to relevant experts. This should be developed in close cooperation with potentially interested project managers.

Fifth, a more transversal future research step could be undertaken for the three management tools. For these three tools, we have embraced the perspective of public servants wanting to invest in participation and focused on the methods used. However, we left out of the scope of this thesis two important aspects regarding participation: the motivation of citizens to participate and the outcome of participation. Indeed, it is an essential first step that the city invests in participation methods, but convincing citizens to participate is also a challenge. Linked to this challenge lies the representativeness of the participants. Too often, only the same "usual suspects" group of citizens decide to use the participation methods offered by the city. Some citizens with lower incomes or less digital literacy might not feel concerned by the participation. Therefore, working on inclusive participation to touch a greater part of the population constitutes a promising research lead for the future. In order to better understand how to reach this inclusive participation, we believe that the SmartCity4All workshop will help us understand how to make necessary adjustments to reach different segments of the citizenry.

Furthermore, beyond the motivation, the outcome of participation is another key element to address. Depending on the outcome that is targeted by the public servants, the method(s) chosen will be instantiated differently. A deeper study on the wide variety of instantiation possibilities (we have provided one for the workshop method with SmartCity4All) is promising ot undertake in the future. Then, in line the instantiation chosen, proper guidelines should be issued to avoid facing possible drawbacks from participation. We believe that by having a complete set of instantiations of the methods and by understanding how they can function as an ecosystem, we will decrease the risk of drawbacks and choose the appropriate method.

Sixth, even though research gaps 3 (the lack of understanding of the abstract term "Citizen") and 4 (the lack of consideration for all stakeholders in participation) were not the primary focus of this thesis, we still tackled them by validating the tools in-depth with different stakeholder groups. However, more research is necessary in that direction. Regarding the term "citizen", a precise taxonomy of the profiles of citizens and their importance in participation are necessary. A good start could be to determine on a larger scale how citizens would like to be considered in e-government (e.g.: Do they care about participation or are they satisfied with an effective and efficient service delivery?). Regarding the other stakeholders, a more torought understanding of the roles, competences and motivations necessary to enable participation and how they could be distributed in government could represent a promising lead to follow. It will help gain greater understanding of the human, technical and organizational pre-conditions for participation.

Finally, another interesting future research step would be to study the replicability of the findings of this thesis from a public sector context to a private sector context. Citizen participation is certainly essential when developing a smart city strategy or when developing an e-government service. But how important are the employees of a company when designing the corporate strategy? Using frameworks like CitiVoice might give decision-makers pointers to know where to invest to let their employees discuss issues and reach "industrial democracy". Another important question could address the importance of user participation when developing private e-services. The mapping of UParticipate and its influencing factors to this private context might also reveal interesting findings (such as the adaptation of factors or methods or even their addition to the model).

9. Appendices

9.1. CitiVoice Interview Guide

This interview guide was used in order to collect information about citizen participation in smart cities for Namur, Mons, Brussels and Linköping.

Section 9.1.5 and the intensive use of probing for each question was used when identifying the context factors for Linköping and Namur.

9.1.1 General Questions

- Can you describe your function within the city?
- Can you describe what smart city developments mean in your city? Why do you focus on the things you focus on?
- How is the implementation of a Smart City generally going?
- Are you working after an overarching plan for smart city development that you apply, or are you project-based?
- Is there a national plan? Influence from international level?
- Is there a city-level plan? Influence of the political representatives?
- Do you know what reasons, problems, challenges have contributed to the city transformation towards a Smart City? What are the drivers?
- What is the current status of the smart city strategy? Which actors are involved?
- Do you consider your city to be currently a Smart City? What would you improve?
- When you are studying a "Smart City" project, are you asking about/looking for citizen participation in this project? Is it necessary? Is it desired? How is it reached?

9.1.2 Democratic Participation

- How was the smart city strategy formulated? Why was it formulated this way?
- Did the citizens have an impact on this strategy? Can you describe the process(es), what approaches and techniques were utilized? Why?
- How was the process facilitated?
- What were the challenges encountered so far? Has anything prevented participation? If so; what?
- How was the citizens' input taken into account?
- What role does the participation have in the enactment of democracy?
- Has it changed the top-down towards the bottom-up in current projects?
- Will it in future projects?
- Can you talk more about the role that citizens have in participation in smart city development as a democratic process? What role should citizens have to enact democracy in a city development project?

9.1.3 Co-Creation

- Do you implement direct interaction activities (town meetings, workshops, etc.)? Why/why not? Which ones?
- Do you currently use online platforms for citizen participation? Why/why not?
- Do you think that the use of online platforms can promote citizen participation?

- Are you currently utilizing Living labs/innovation ecosystems/hackathons/business collaboration as a way to co-create in the city?
- Do you think Living Labs/innovation ecosystems/hackathons/business collaboration can stimulate participation?
- Do you have examples about concrete autonomous participation projects?

9.1.4 ICT Use

- How do you use technology to enable citizen participation?
- Is there an investigation on the Internet of Things, or on sensors in the City, underway or already being implemented?
- What about Open Data?
- What about Citizen Science activities?
- What about Augmented Reality or Virtual Reality applications?
- What about Public Displays?
- How do you integrate the input of citizens in the development of these ICT tools? Why?

9.1.5 Context Factors

- In order to elicit the context factors underlying the participation activities performed, we asked probing questions to understand the underlying context factors that drove the decisions of the cities.

9.2. Comparative Analysis of Linköping and Namur using CitiVoice

The following table shows the detailed evaluation of the citizen participation strategies of Namur and Linköping using the CitiVoice Framework.

	Evaluation Criterion	Namur	Linköping
Citizens as Democratic Participants	**Citizen Selection**		
	Representativeness of participants	No assurance of representativeness of citizens(often the “usual suspects” present)	No assurance of representativeness of citizens
	Offering of support for group process	No support	No information
	Presence of competent facilitators	For urban planning, they used a specialized NGO (Tr@m) and experts for some specific themes.	No information
	Agreement on the goals of the smart city strategy		
	Evidence that citizens helped to define goals and objectives	The goals were not defined by the citizens	There is no current strategy that speaks in terms of smart city but rather in terms of digitalization. Needs more information regarding the process of defining these goals.
	Citizen-oriented goals and objectives	The political will to transform Namur into a smart city aims to include the population in public life through digital means.	The goal of the digitalization strategy is to improve the administration internally and the quality of life of citizens in several domains.
	Correlation between participation activities and achievement of goals		
	Formalization and transparency of the course of action	The course of action is not made available to the citizens.	The course of action is not made available to the citizens.
	Evidence of interaction between citizens and other actors	One-way interaction: citizens are informed of the advancement of the city but have no opportunity to influence it.	No evidence of interaction.
	Evidence of the influence of citizens’ input in ies for the projects	No opportunity for the citizens to influence projects. It was done by intermediaries in negotiation with the political representatives.	Goals not defined by the citizens – rather drawing from national and supra-national visions and strategies (EU and national digital agendas).

Citizens as Co-Creators	**Direct Interaction**		
	Application of traditional techniques	Group discussions are sometimes organized to sensitize citizens about urban planning and let them give their opinion. Namur also coordinates the actions of citizens that organize themselves.	Different forms of group discussions (dialogues and workshops) are frequently used in city planning and development. The university has been involved to hold problem-solving workshops.
	Application of citizen-centric requirement engineering method	The e-government services are only developed internally.	They develop the e-government services with internal public servants as proxies for the citizens.
	Living lab		
	Development of a Living lab strategy	The TRAKK is a multidisciplinary and co-creation space that aims to promote creative projects in the Namur region (TRAKK 2014).The NID will be developed to foster citizen participation in Urban Planning.	They developed the Ebbepark community – formal and informal stated focus on community development for products and services with collaboration with companies from the private sector.
	Organization of citizen-oriented activities	The TRAKK is used by companies in the digital industry, developers and the creative class.	Use of online platform to gather ideas from the community. Furthermore, Linköping has had reoccurring hackathons, which has included partnerships between municipal companies, private sector, university and citizens.
	Online platforms		
	Presence of an existing or specifically designed online platform	A platform has been deployed by the city of Namur to let citizens give their opinion on cultural matters.	Digital platforms have been used in several city development projects as well as by the administration to collect citizens' ideas about various domains.
	Use of platform by citizens and impact on public life	The platforms are used at small scale by the more literate citizens.	Varying degrees of participation between projects
Citizen as ICT users	**Infrastructure**		
	Presence of ubiquitous computing components	There is a smart mobility project relying on sensors and a visualization display currently ongoing.	The possibilities and value of sensor-technology is being evaluated
	Development of Innovative ICT-based projects	The city of Namur plans to develop intelligent "bus stops" using "augmented reality".	No information

	Open Data		
	Implementation of Open Data Strategy	Open Data Portal that aims to be accessible to all citizens, even the non-developers. Not all datasets are published.	Linköping publishes data on website. The PSI directive encourages municipalities to open up their data in order to promote the creation of new products and services.
	Use of Open Data by citizens	Collaboration with universities to increase the use of the data for app development.	Some examples such as Hackathons and competitions.

9.3. Participation Decisions questions

The following questions were used in order to identify the participation decisions made by project managers and software developers when developing e-government service.

In section 9.3.1, the questions were asked in in-depth interviews. In sections 9.3.2 and 9.3.3, the questions were asked in questionnaires.

9.3.1 Semi-Structured Guide for In-Depth Interviews

- Does your organization include the users in the development of its e-services?
    - *[If YES]*
        - Why does your organization include users in the development of e-services? *[Open Question]*
        - At which stage does your organization include the users in the development of e-services?*[Open Question]*
        - How does your organization collect the requirements of users? *[Open Question]*
    - *[If NO]*
        - Why does your organization not include users in the development of its e-services? *[Open Question]*

9.3.2 Questions asked in the questionnaire sent to Public Servants

- Does your organization include the users in the development of its e-services?
    - *[If YES]*
        - Why does your organization include users in the creation of e-services?
        - At which stage does your organization include the users in the creation of e-services?
        - How does your organization collect the requirements of users?
    - *[If NO]*
        - Why does your organization not include users in the creation of its e-services?

9.3.3 Questions asked in the questionnaire sent to Citizens

- Would you like to participate in the development of e-government services?
    - *[If YES]*
        - How would you like to participate in the development of e-government services?
        - At what stage would you like to participate in the development of e-government services?

9.4. Satisfaction Survey La Louvière

The following survey has been put online by the city of La Louvière following our recommendations in order to improve their e-government strategy.

9.4.1 General Questions

- For which administrative process did you use the e-government portal of La Louvière? *(Open Question)*
- How did you hear about the e-government portal?
  - By flyers
  - By word of mouth
  - Via the city's website
  - Via e-mail
  - By moving to the administration
  - Via social networks
  - Via the press
  - Other:
- Did you use the logo [?] which is to the right of the approach (whose legend is...) in order to have more information on your steps?
  - Yes
  - No
- *(If yes)* Did you have enough information about the process? (Open-ended question)
- *(If not)* Why didn't you use it?
  - I didn't need it
  - I didn't see it
  - Other: ...

9.4.2 Likert Questions

The following questions will be asked using a 5-point scale from "Strongly Disagree" to "Strongly Agree".

Accessibility

- The structure of the e-government portal allows me to find the required procedures and information quickly and easily.
- The e-government portal provides clear and easy-to-follow instructions, including via the logo [?]
- The e-government portal is interactive and visually attractive for its users.

Communication on online administrative procedures

- I have received enough information about the existence of the e-government portal.
- I have received enough information about the advantages of the e-government portal.
- I have received enough information to use the e-government portal (especially via videos and tutorials).

Quality of online administrative procedures

- Using the e-government portal allows me to complete administrative procedures more quickly and where I want.
- It is possible to carry out all the required procedures using the e-government portal.
- The e-government portal allows me to follow the evolution of the administrative procedures (via the follow-up emails concerning each procedure)

Future Use

- I intend to use the e-government portal again in the future.
- I will recommend to my entourage (friends, family) to use the e-government portal.

9.4.3 Final Questions

- Within the limits of reasonableness and technical possibilities, what administrative procedure would you like to see appear on the e-government portal? *(Open-ended questions)*
- Do you have any other comments/questions/reactions regarding the e-government portal? *(Open-ended question)*

9.5. Public Values Interview Guide

The following interview guide and ranking game were used to understand the link between public values and user participation decisions.

9.5.1 Semi-Structured Interview Guide (Qualitative)

9.5.1.1. Public Values

- When were you first involved with project X?
- How did you get involved for the first time?
- What motivated you to participate in the project?
- What does the project/organization mean to you?
- Which goals are the most important to achieve in the project?
- What were your expectations about the project?
- What did you expect from the other participants of the project?
- What did you think the result would be?
- Is the reality now different from what you initially expected?
- What do you think are the most important characteristics that you need to have in order to contribute to the project?
- Do you think it is important to think about the general interest, or rather about your own interest?

9.5.1.2. User Participation

- Why does your organization include users in the creation of e-services?
- At which stage does your organization include the users in the creation of e-services?
- How does your organization include the users?
- How often does your organization use this method?
- Why did you choose this particular method?
- Did the method successfully implemented the chosen value?
- Can you give me an example in which it is difficult to make a decision? How did you deal with this situation?

9.5.2 Ranking Game (Quantitative)

What are/were the most important values for you in the context of your project? *[Present randomly the different public values and ask to rank from most to least important]*

9.6. Open Data Questionnaire and Interview Guide

The following questions were used to collect insights about impediments users face when using the open data portal of Namur.

The interview guide and the questionnaire follow a very similar structure and were thus not separated. In the interview, the focus was set on qualitative insights to dig deeper into the main impediments identified through the questionnaire.

9.6.1 Introduction

- Can you provide your name or a brief description of the project you worked on? (this will be used to aggregate the answers by project) *(Free text)*
- What is your background? *Multiple choice (management, computer science, mathematics, science, other)*
- How confident are you with: *(Answer with 5-point Likert Very confident/Confident/Neutral/Not confident/ Not confident at all)*
    - Programming
    - Data analysis
    - Open data portals

9.6.2 Start

- For each of the tasks below, please indicate how difficult it was, using the following scale *(5-point Likert Not a barrier/Light barrier/Moderate barrier/Serious barrier/Extreme barrier)*
    - Finding the idea
    - Finding an idea applicable to Namur
    - Finding “Use-case” examples of Open Data
    - Understanding the requirements of potential users of the project
    - Conducting a feasibility study of the idea

9.6.3 Search and evaluate

- For each of the tasks below, please indicate how difficult it was, using the following scale. *(5-point Likert Not a barrier/Light barrier/Moderate barrier/Serious barrier/Extreme barrier)*
    - Search functionality
    - Search results presentation
    - Quality of metadata
    - Had to download the data to evaluate it
    - The tools for exploring of, analyzing of, or experimenting with data
    - Open Data portal language
    - License impedes the use
    - Must log in to evaluate and access the data

9.6.4 Access and prepare

- For each of the tasks below, please indicate how difficult it wa, using the following scale *(5-point Likert Not a barrier/Light barrier/Moderate barrier/Serious barrier/Extreme barrier)*
    - Wrong type of access (Manual vs. Automated)
    - Complex access with documentation
    - Filtering useful data
    - Relevancy of data formats
    - Data quality (e.g., missing essential information)
    - Lack of documentation to prepare data (e.g., conversion tables)

    - Data is inaccessible because of paywalls, limitations of infrastructure, or demands of registrations
    - No support (e.g., lack of documentation or forums)

9.6.5 Aggregate and transform

- For each of the tasks below, please indicate how difficult it was, using the following scale. *(5-point Likert Not a barrier/Light barrier/Moderate barrier/Serious barrier/Extreme barrier)*
    - Data cannot be combined
    - Data quality varies
    - Data availability varies
    - Tools cannot combine the data sources
    - No longitudinal data
    - Data infrastructure cannot be integrated
    - Data needs special knowledge to understand

9.6.6 Resource allocation

- Please rank the four phases from most-time consuming (1) to least time-consuming (4). *(4-point ranking)*
- Can you rank the four phases from the one in which you contributed the most (through your skills) (1) to the one in which you contributed the least (4). *(4-point ranking)*

9.6.7 Perceived usefulness

- Do you think the time invested in the following phases was useful to the final output of your project? *(5-point Likert Very useful/useful/neutral/not very useful/not useful at all)*
    - Start
    - Search and evaluate
    - Access and prepare
    - Aggregate and transform
- Have you applied the 4 phases above sequentially or iteratively? *Binary choice*
- Did you have to learn new technologies, techniques, concepts to carry out the Data Science project? *(Free text)*

9.6.8 Final questions

- Which open data portals did you use? *Multiple choice (Namur, London, New York, Paris)*
- Are there any reasons why you did not use specific portals? *(Free text)*
- Do you have additional comments on open data portals? *(Free text)*

9.7. SmartCity4All Tests

These questions were asked before and after the SmartCity4All workshop was conducted to understand the evolution in the children's conception of the smart city.

9.7.1 Questions asked in Pre-Tests and Post-Tests

If you have difficulty answering the questions, you can simply write the first words that come to mind, give examples, draw a picture, etc. There are no right or wrong answers. It's your opinion that counts!

- For you, a city is:
- For you, a smart city is:
- Mention the positive and negative points of a group discussion:

Positive points:	**Negative points:**

9.7.2 Questions only asked in Post-Tests

- What is the "Smart City" project you would like to see in your city?
- How would you ask the public's opinion on a "Smart City" project?

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