CATÓLICA LISBON
BUSINESS & ECONOMICS

MASTER THESIS:

Participation in "Smart Cities": A user-centric evaluation of the smart city-concept.

Student: Lars André

Supervisor: Cláudia Isabel de Costa

Dissertation submitted in partial fulfillment of requirements for the degree MSc. in Business Administration, at the Universidade Católica Portuguesa, September 2015'.

ABSTRACT

Title:

Participation in "Smart Cities": A user-centric evaluation of the smart city-concept.

Author:

Lars André

This dissertation is addressing the smart city concept through identifying citizen participation as an essential part of the framework.
Several smart city examples were analyzed and a high variety, not only in terms of affected areas, but also concerning the multiple ways how individual programs integrate citizens, was recognized. Three ways to participate in a smart city were identified:

1. *Citizens help the government collecting data*
2. *Citizens being involved in using the data generated by the government*
3. *Citizens being involved in government activities.*

Through elaborating on the smart city concept, the presence and importance of citizen engagement was clarified. Further, participation itself was put into focus. Therefore, several subject-related topics were explored and the identified participation methods were specified.
Furthermore, quantitative research was conducted in form of a survey, examining the key findings of the literature review. To facilitate the allocation of trends to several groups, a cluster analysis has been conducted and five clusters could be created:

The "Creatives", -"Alternatives", -"Techies", -"Greens" and -"Normals".

Major research results were:

The majority associates a smart city with a rather technical nature.
Privacy is standing out as the main concern.
Respondents are the least confident about developing an application or a service.

Combining those results with the key findings based on the literature review, the urge for city administrations to modernize and to embrace the smart city concept was identified. The dissertation concludes with recommending governments to overcome those barriers by the implementation of so-called "living-labs" and "toolkits".

ACKNOWLEDGEMENTS

As this dissertation represents the final work for reaching my MSc-degree and therefore also stands for the end of my student-life, I would like to thank everyone, who supported me on the way reaching this goal:

Professors, who provided me with knowledge and tools, inspired me with latest topics in research and prepared me for a best possible start into the working-life.

Colleagues, more precisely friends, who shared the same path and experiences becoming the best companions imaginable and supporting one whenever needed, even if it is "just" for having a good time.

Family (My), for letting me go my way and who always support me in whatever I do and decide. Who always believe in me and who are always there for me, even though far away.

Lisbon, which is after two years still able to amaze me. The city provided me with the best study environment possible and was a big part of this experience. I will never forget this place and am still happy to have made this decision.

Special thanks to my supervisor, Cláudia Isabel de Sousa Costa, who made this dissertation possible. Who provided important guidance through this work but also left me the freedom to pursue this topic in my own way.

TABLE OF CONTENTS

LIST OF FIGURES

INDEX OF ABBREVIATIONS

ANOVA:	Analysis of Variance
APP:	Application
GDP:	Gross Domestic Product
H:	Hypothesis
ICT:	Information and Communication Technology
IoT:	Internet of Things
IT:	Information Technology
KMO:	Kaiser-Meyer-Olkin
NIST:	National Institute of Standards and Technology
OGD:	Open Government Data
PSI:	Public Sector Information
RQ:	Research Question

1. INTRODUCTION

1.1 BACKGROUND

Nowadays, a population trend called Urbanization is recognizable, changing the way we live significantly. By the year 2050, 70% of the world's population, a total of 6.4 billion people, should live in cities (Berst 2014). Furthermore, these 6.4 billion citizens should be responsible for producing 80% of the global GDP (Lee et al. 2014). This trend leads inevitably into an intensification of existing problems, such as environmental pollution, energy shortages or the lack of a sufficient water supply. Therefore, city leaders will be constrained to find adequate solutions. (acatech - Deutsche Akademie der Technikwissenschaften 2013)
Concerning the importance of urbanization, technological progress can be seen as an opportunity to overcome certain challenges and to ease the transition towards bigger and more crowded cities, still enabling residents to maintain a high quality of life. In recent years, this technological change was mostly present in a digital way, influencing the way we communicate tremendously.
From the rise of the Internet to the miniaturization of electronic components, all those developments influence how we act on a daily base. New technologies, such as *"Cloud Computing"* or *"Big Data-analytics"*, allow us to take huge amounts of data, store them, transform them into new knowledge and make it accessible from anywhere. The rise of the so-called *"Internet of Things"* (IoT) aims to enhance every "thing" with a part of Information Technology (IT) to make it communicable and to include it into a huge network. Therefore one should be able to "sense the world" and to make everything "smart". (For more information about the Internet of Things, please refer to the Appendix 6.1)

By applying the IoT on a smaller scale within a city, this concept can also support the overcoming of urbanization-related challenges, creating a so-called *"Smart City"*. In such a city, *Information and Communication Technology (ICT)* is being implemented into the city's infrastructure, making it "aware" of its own condition. Such a city can be defined as "smart", when investments in human- and social capital are being made, as well as modern (ICT) and traditional communication infrastructure. This should fuel sustainable economic growth and ensure a high quality of life. Moreover, natural resources should be managed wisely and an approach of participatory governance should be followed. (Caragliu et al. 2011)

1.1.1 Smart City Examples

As a good example of an existing smart city, *Barcelona* can be mentioned. Their smart city strategy puts their citizens into the center and wants to ensure them a better quality of life and economic growth. Their projects include a smartphone application (Apps4Bcn), which allows residents to assess and contribute to city policies, a technology platform, which integrates and analyzes data collected by the city, or a bus network, which is based on vertical, horizontal or diagonal routes. (Das & Kaushik 2013) Moreover, the city deployed a free access public Wi-Fi and hosted a so-called "hackathon", where people with diverse backgrounds come together to build soft-and hardware to analyze existing data and also to create new one. (Global Urban Datafest 2015)

Hamburg, as another example, implemented a smart traffic management system, providing information about traffic bottlenecks and constructions, accessible via smartphone or tablet. A smartphone application (Switchh) makes it possible to see route- and transport options, like bus, taxi or ferry, monitor the incurring costs and additionally provides the possibility to connect itself to another car-sharing application.

In *Amsterdam*, smart city campaigns are more connected to improve the environmental friendliness. They developed an automatic street lightning system, which adjusts itself to weather conditions using sensor data. The electricity, which is saved through the solution, will then be used to power the city's Wi-Fi networks.

Furthermore, *Rio de Janeiro* also implemented smart city solutions. Their approach was the creation of an operations center, which integrates information from 30 different city agencies in order to support weather monitoring and –forecasting the city's traffic management, as well as the coordination for emergency responses. (Das & Kaushik 2013)

In terms of a *smart city application*, "SeeClickFix" can be named. The application is used by several cities in the United States of America and enables citizens to contribute to the creation of a smart city. Residents are able to report certain issues (e.g.: a broken light) to the city administration, which then is able to monitor the incidents and take care of them. This happens through a picture combined with the respective geodata (location) and makes the city able to respond quickly to secure the citizens' quality of life. (SeeClickFix 2015)

1.1.2 Analyzing the State of the Art

Analyzing those smart city solutions mentioned above, one can see a broad area of services covering a wide range of applications (from environmental protection over policy creation to traffic management). In order to categorize such diverse solutions, six "smart" dimensions were created, reaching from smart living over smart mobility to smart environment, -economy, -people and -governance. (Giffinger et al. 2007) Moreover, those solutions differ in their nature concerning their inclusion of residents. Some provide ready-to-use information to the users and others rely on their input, requiring them to participate. Effectively, three ways of participation can be emphasized looking at the given examples in the previous section.

1. *Citizens help the government collecting data*
2. *Citizens being involved in using the data generated by the government*
3. *Citizens being involved in government activities.*

As this variety can be identified as one of the key differentiators between the various smart city programs and is of major importance when designing smart city solutions, it will represent the core part of this work and will be defined for further elaboration.

Moreover, in order for the city administrations to target their smart city campaigns in an effective way and reaching a wide acceptance among their citizens, knowing their residents' opinions and preferences would be of great value. What they appreciate of a city being smart, what prevents them to accept the concept and most importantly, if they just want to act as a receiver of relevant information or if they would even be willing to participate. As the broad range of solutions is also affecting a broad range of people, citizens should be clustered into several groups, which then can be connected effectively with their respective mindset towards a smart city.

Additionally, putting together the mentioned variables, influencing the establishment of smart city solutions, a "city profile" can be created. It can then be used for developing smart city solutions, ensuring a high attractivity to certain groups of citizens and therefore guarantee a high success rate of providing value to residents.

1.2 AIM

This dissertation aims to identify the role of citizen participation within a smart city. Moreover, their present knowledge of the concept, as well as their attitude towards given benefits and obstacles, will be examined. After elaborating on a common definition of a smart city and its respective dimensions, obstacles of a smart city, identified by the literature, will be presented. The same as a smart city itself should provide problem-solving capabilities to communities, this work should, through its focus and elaboration on participation, provide insights and ways how to minimize those given obstacles. Furthermore, the presence of participation in several smart city-related components will be underlined. Moreover, several success factors for creating a smart city will be introduced to build a base for the later assessment of research results. Having identified three major ways of participating in a smart city, they will be further considered and deepened. Furthermore, participation itself will be covered as well as how to encourage citizens to do so. This should provide the reader with a sufficient base for interpreting the following quantitative research. Beforehand, certain clusters of people will be identified through an array of psychographic questions related to attributes associated with the smart city concept. Those clusters should enable the results to be more feasible and convert them into more actionable data for the city administrations. The research itself, conducted through a survey, will elaborate on three research questions:

Research Question 1: How conscious are citizens of the smart city concept?
Research Question 2: How is the concept of a smart city perceived?
Research Question 3: How is the citizens' willingness to participate in a smart city?

The outcomes of the research will then be combined with the previous identified clusters in order to recognize certain trends and preferences across groups.
As a foundation, the citizens' foreknowledge of the smart city concept should be evaluated. Moreover, their mindset over major benefits and obstacles will be assessed and the participation aspect will be further elaborated. Therefore, the citizens' readiness to participate, as well as their attitude towards the different participation methods, will be clarified.
The results should underpin the importance of participation being a substantial part in the smart city concept and should provide insights into the residents' mindset towards promoting the smart city concept through their contribution. Finally, the results can create a sort of "city profile", as mentioned previously, in order to create targeted and effective smart city

campaigns. Moreover, through combining research results with key findings, identified in the literature review, recommendations for city administrations can be developed. For additional exploration of the rationale, further research will be suggested.

1.3 SCOPE

In order to make the reader familiar with the smart city concept, it will be introduced in a surficial way. Considering the length of this dissertation, it is not possible to address the whole scope and variety of the overall topic, especially regarding its actuality and the continuity new research is being conducted. As citizen participation is considered as central element, it also dominates the focus of this work.

Considering the smart city concept, several smart city components will be analyzed towards their presence of participation in order to foster its universality. Moreover, the concept of participation will be deepened by taking into account the concept itself as well as how to encourage participants to do so.

Three methods of participation in a smart city were previously identified and will be addressed further in the work. Even if there are certainly more ways how citizens can interact with their city to finally support the creation of a smart city, the here presented ways of participation were seen as sufficient to cover the most comprehensive areas. Taken together, the here considered elements reflect the areas of the smart city- and participation concept, which were elaborated as vital in order to be able to answer the identified research questions and to interpret their results. Moreover, the success factors related to the smart city, as well as the encouragement of citizens to participate, were included for the purpose of elaborating on recommendations concerning the smart city campaigns and to develop further research topics.

2. SMART CITIES

2.1 HOLISTIC APPROACH

In order to further discuss and to deepen the topic of the Internet of Things, an array of topics, which could not be covered in this literature review due to the lack of space, were placed into the appendix (see Appendix 6.1). They contain sections about enabling technologies, smart connected products and the creation and capturing of value out of those. Therewith the

concept of an Internet of Things should be explained more deeply, giving the reader a comprehensive view about the topic.
In order to fully understand the following discussion, it is recommended to devote oneself to those topics.

The next sections will identify several challenges and trends of our modern world, which request an innovative approach in order to solve arising problems. Therefore, the smart city concept will be introduced as a potential solution for improving our quality of life and the way we live and interact in cities by making our environment "smart".
Afterwards, the focus will be put on elaborating on the term smart city more closely, before moving the work's focus towards participation.

2.2 THE CHALLENGES OF OUR MODERN WORLD

Urbanization was identified as one of the key drivers of the 21st century, together with globalization and industrialization. (Lee et al. 2014) The today's movement of people into cities is increasingly high, being one of the major challenges of the current century. Since 2007 more people live in cities than in rural areas, consuming 75% of the total produced energy. In 1900, only 13% of the people were living in cities, whereas by 2030 60% of the world population should do so. They would represent a degree of urbanization of 80% in industrial nations and 55% in developing countries. (acatech - Deutsche Akademie der Technikwissenschaften 2013) By 2050 this number should raise further with 70% of the world population, a total number of 6.4 billion people, living in cities (Berst 2014) and generating 80% of the global GDP (Lee et al. 2014).
Those numbers just underline the changes cities are going through and the challenges they have to face. Existing problems such as energy shortages, lack of a sufficient water supply or environment pollution, will be intensified and city leaders will be urged to find adequate solutions. (acatech - Deutsche Akademie der Technikwissenschaften 2013)
In order to remain attractive for citizens, it is important for cities to manage and adapt their infrastructure, which they provide to the inhabitants, especially in developing countries. Moreover, factors such as a sustainable development and chances of gaining prosperity and human well being will be affected by an increasing urbanization and are important to be respected in a city's organization. (Doran & Daniel 2014)

2.3 THE RISE OF THE SMART CITY

The previously mentioned challenges, that future cities have to face, emphasize the need of innovative solutions and put pressure on city leaders to modernize. One effective way would therefore be to integrate information- and communications technology (ICT) into the city's infrastructure, creating the so-called "Smart City". (Berst 2014) Through the interconnection of different parts of the city with the help of digital technologies, information can flow faster and can be used for intelligent decision-making. (Menychtas et al. 2011)
Moreover, such a connected smart system can improve almost every area where it will be applied, e.g.: energy use, transportation, healthcare and services. All those sectors should be integrated into a holistic vision, forming a collective entity. (Ben Letaifa 2015)
The smart city should represent a homogenous body with which citizens can interact. Therefore, it will be possible to receive information about the traffic-, electrical power- or pollution situation. (Smart Cities Committee 2015) Cities will be able to prosper and to maintain their function as "seedbeds for creativeness, innovation, entrepreneurship and spatial competitiveness" (Kourtit et al. 2012).

Through the integration of ICT into the city's infrastructure, new services for citizens can be created or already established ones can enhance their quality. These services are vital for a city's competitive advantage and support the city's administration in order to cut operational costs. (Sofronijevic et al. 2014) Some of those services could be related to traditional public services such as transportation, parking, lighting, garbage collection or maintenance (see smart city examples 1.1.1).
Moreover, the extensive amount of new data can increase transparency of the government's actions towards the citizens and increase their awareness of the status of their city.
Through encountering those benefits, citizens should be more willing to actively participate in the management of the public administration and also should stimulate the generation of new services upon the already existing ones. (Cuff et al. 2008)

2.4 DEFINING THE SMART CITY

A smart city can be seen as a system of systems (See Appendix 6.1: IOT, Smart Connected Products), where "(…) emerging opportunities to introduce digital nervous systems, intelligent responsiveness, and optimization at every level of system integration" exist (Policy Department A: Economic and Scientific Policy 2014). Moreover, it should be vital to interconnect those systems with each other in order to "break the silos" and to create higher efficiency in the city's administration. (Doran & Daniel 2014)
A major point of critique in the discussion about a smart city's definition is the too strong focus on ICT and that "technology deployment alone is not sufficient to make a smarter city" (Doran & Daniel 2014).

Lee et al., therefore proposed a definition, describing a smart city through the identification of three main factors: "(...) technology (infrastructures of hardware and software), people (creativity, diversity, education) and institutions (governance and policy)" (Lee et al. 2014). A smart city should be an "(…) interplay among managerial and organizational innovation, innovative technology and innovation in policies" (Nam & Pardo 2011).

This scope of a smart city is a major key point when defining the concept, as it illustrates the focus of a smart city not only being its investment in the newest ICT but also in which areas this technology will be applied and who will be affected by its introduction. This clearly distinguishes the framework from others such as the "intelligent" or "digital" city, which primarily focus on the usage of ICT. (Lee et al. 2013)

Smart City initiatives should include the use of those information- and communications technologies in order to "(…) engage citizens and improve municipal operations and the quality of life by better managing economic development and use of natural resources, among other things" (Violino 2014). According to one of the most widely used definitions in the literature, a city can be considered as smart, "when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance" (Caragliu et al. 2011).

Those definitions clearly show the enhanced impact of a smart city. Not only the introduction of ICT's is making a city smart but also their beneficial application to create a positive outcome is part of the framework. Carrying together the above definitions, major elements of the concept are:

Figure 1: Elements of the smart city definition

Elaborating the different areas, which should be influenced by a smart city, one can see that most of the elements are addressing the optimization of existing resources or policies, resulting in a more responsible dealing with them or enhancing people's quality of life. Concerning the impact on citizens, the information flow could be eventually described as one-sided, resulting in mainly receiving the benefits of a smart city. Regarding the definition of a smart city, this is not exclusively the case in that framework. Here, a two-sided flow of information is encouraged, involving citizens to actively participate in the creation of a smart city through their own input. The role of the government is therefore not only providing smart services to residents but also to coordinate and support their development by citizens (Ben Letaifa 2015).

2.5 DIMENSIONS OF A SMART CITY

Giffinger et al. have identified six dimensions of a smart city, as briefly mentioned in the introduction. Several factors influence each dimension itself. Together they should act as indicators for a city's performance as a smart city. Moreover, those dimensions can be used to categorize smart city solutions into the different areas and to measure the success and diversity of a city's "smart-landscape". Although, measuring "smartness" is not always easily possible, as the concept is interconnected and influenced by human decisions. (Lazaroiu & Roscia 2012)

The six dimensions are as follows:

Figure 2: Dimensions of a smart city

Source: (Giffinger et al. 2007)

2.6 OBSTACLES OF A SMART CITY

In order to create a future outlook concerning the development of a smart city, one can refer to a survey carried out by the Forrester Group. One of the major findings of the survey was that “smart city solutions must start with the “city” not the “smart”” (Bélissent 2010). They also point out a predominant technology vendor push instead of a city government pull in the market. This implicates the necessity of city administrations to more actively focus on the introduction of smart city solutions and of technology vendors to adapt their solutions more into the context of the respective city. (Bélissent 2010) Zanella et al defined further obstacles, which they categorized into three dimensions: Political (decision making power of stakeholders), technical (interoperability of heterogeneous technologies) and financial (lack of a clear business model). (Zanella et al. 2014)

As these obstacles are considered to overcome, their importance should be tested out of the citizens’ perspective. Therefore, they will be incorporated into the following research, being part of testing the residents’ attitude towards a smart city. Moreover, with this work focusing on citizen participation and the contemplation of the smart city concept out of the citizens’ perspective, insights can be used to focus on overcoming obstacles and to successfully start with the city not the smart.

2.7 EMPHASIZING PARTICIPATION IN SMART CITIES

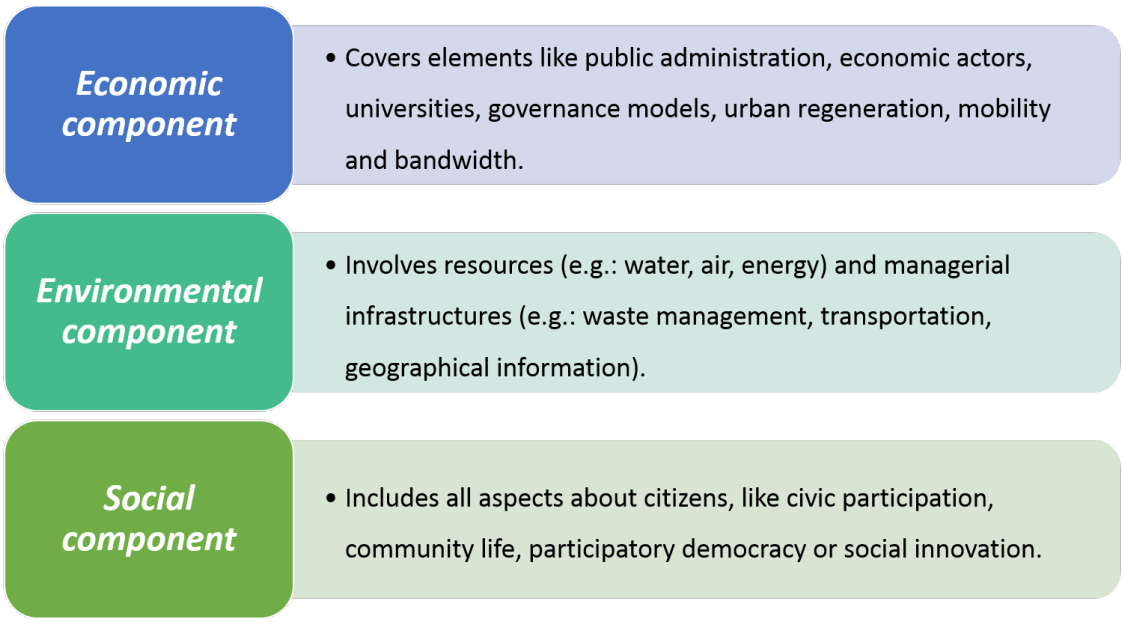
The following sections focus on presenting the reader several components of a smart city, which can be found in the literature. More precisely they will cover the concept, its features and requirements. These parts will consecutively be analyzed towards the presence of participation throughout the text as well as summarize the outcome.

2.7.1 Concept

Considering the smart city concept as a whole, through the interconnection of elements, such as water, electricity, transport or infrastructure, real advantages can be created. The gained real-time information can be used for several applications: Streets can report their condition, water networks can report possible leakages and the garbage bin tells the system when it is full to optimize the routes of the garbage trucks. (Berst 2014) The implications are almost endless. Through sensor networks, even static infrastructures can be made dynamic, increasing the amount of available solutions.

However, the development to a smart city should be seen as a dynamic process, in which perpetually new solutions will be developed together with politics, administration and economy, which will then be offered to the citizens or companies of a city. (acatech - Deutsche Akademie der Technikwissenschaften 2013) In this description participation is not emphasized as part of the smart city development, even though it should be part of it by definition and vital to introduce. According to the article "Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation", smart cities have such a potential to modernize because "they are not events in the cyber-sphere, but integrated social, physical, institutional, and digital spaces, in which digital components improve the functioning of socio-economic activities, and the management of physical infrastructures of cities, while also enhancing the problem-solving capacities of urban communities" (Schaffers et al. 2011). This explanation on the other hand includes information about a participatory approach, as the enhancement of problem-solving capabilities for urban communities can definitely rely on the citizens' contribution. According to the "Smart City Model" developed by Doran, a smart city's goal is to integrate three main components:

Figure 3: Components of the smart city concept



Source: (Doran 2012)

Here, the last component reflects noticeably the need of a smart city to emphasize on its citizens and to put them into the focus of the framework. Therefore, the social component reflects one of the goals a smart city should achieve. Participation is listed here as part of the social component, although a more detailed consideration of the term is not provided.

2.7.2 Features

As a pre-condition for a smart city to be established, Blakrishna elaborated on three major, mainly technical characteristics, which should be fulfilled: Real world awareness (connecting physical and virtual world), knowledge engineering (adding "smartness" through interpreting and making sense of collected data) and maximization of synergies (new insights will be linked across several areas) (Balakrishna 2012). After establishing those characteristics, a city should then be able to provide some fundamental features, which are essential for a fully smart city:

Figure 4: Features of a smart city

Source: (Doran & Daniel 2014)

The in the above pictured mentioned terms open government and -data, should be explained briefly, as they might not be familiar to the reader:

Open government: Two-way communication and interaction between government and its citizens, enabled through technology. (Oszlak 2013) (See also Chapter 3.3.3)

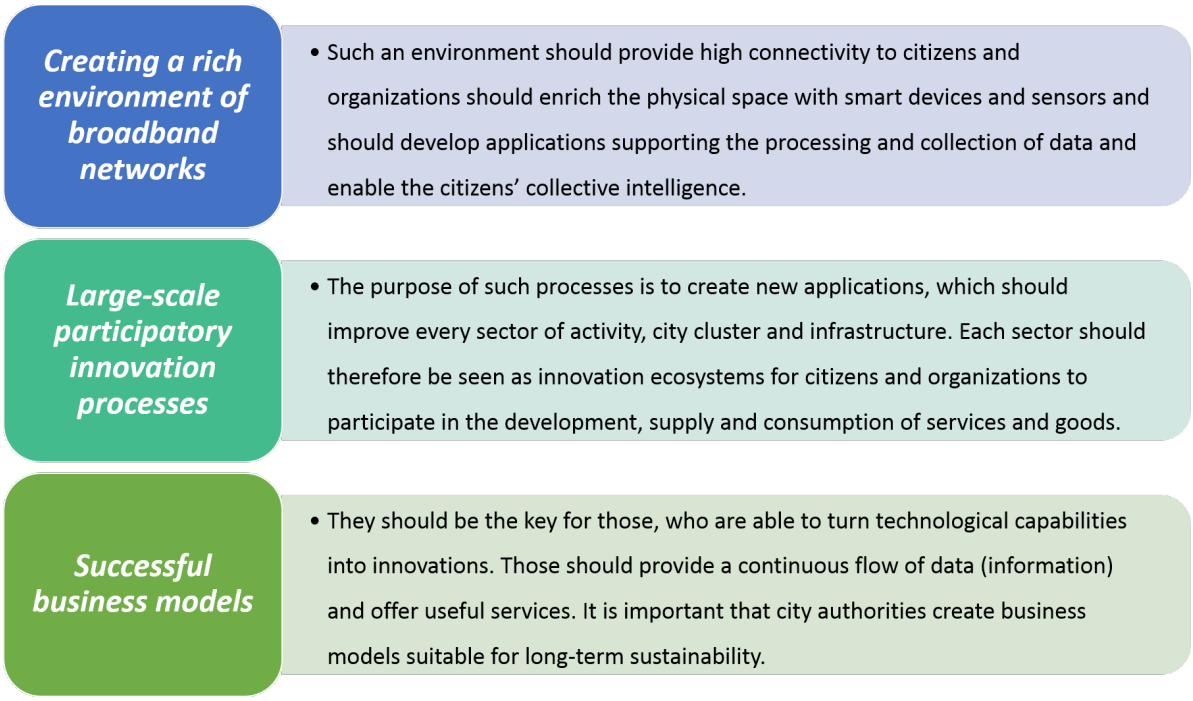
Open Data: The free provision of machine-readable data from the city for developers to create new applications. (Smart Cities Committee 2015)

Mentioning the participation of a city's residents particularly in the features they should receive, fosters their importance when establishing a smart city. They should not only receive information about their city, but should also be empowered to actively participate in the decision making process. Nevertheless, participation is here just mentioned on a rather political base. The possibility of including citizens into the creation of new services or encourage them to collect and provide data by themselves is not mentioned.

2.7.3 Requirements

Having identified the presence of participation in both, the concept of a smart city itself and also its features, another element to be considered is a smart city's infrastructure and what it requires in order for a city to be labeled smart. Following the suggestions of Schaffers et al., three tasks have therefore be fulfilled.

Figure 5: Requirements for a smart city



Source: (Schaffers et al. 2011)

2.7.4 Outcome

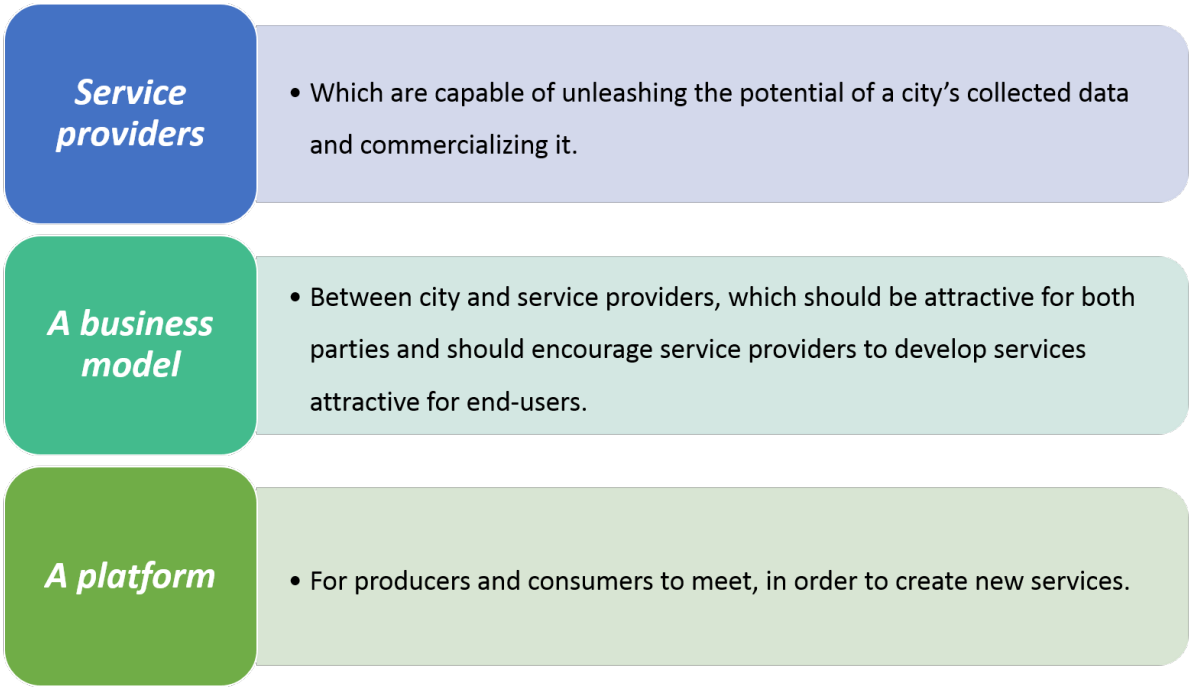
Those mentioned requirements close the loop in analyzing smart city elements concerning participation. From mentioning participation in a surficial way in the smart city concept, to presenting it clearly but not entirely in a smart city's features, with the previously mentioned requirements the image of participation is now comprehensive and reflects predominantly the

identified methods when looking at smart city examples (see chapter 1.1.1). Incorporating those tasks into the discussion about the importance of the participation of a city's inhabitants, finalizes the citizen-centric view of a smart city. As we can see above, residents should not only be the targets of smart city campaigns, receiving the outcome "ready-to-consume". They are a major part of the smart city architecture and their contribution is vital for the smart city concept to be successfully implemented and developing its full potential.

2.8 FRAMEWORK FOR SUCCESS

All in all, making a city smart, implies various elements to be included into the vision. It is a very complex framework, which has many facets and elements to be taken care of.
In order to accomplish this process in an effective manner, the Smart Cities Committee developed a framework concerning the successful introduction of a smart city. They claim the ecosystem to be as important as the needed ICT infrastructure and defined three main "ingredients" for such an ecosystem:

Figure 6: Ecosystem for success



Source: (Smart Cities Committee 2015)

Schaffers et al. furthermore describe cities as “innovation ecosystems empowering the collective intelligence and co-creation capabilities of user/citizen communities for designing innovative living and working scenarios” (Schaffers et al. 2011). This goes in favor with the lastly mentioned “ingredient” and also supports the previously elaborated importance of participation.

2.8.1 Value Creation in a Smart City

In general it is to say, that cities face new challenges when turning smart, especially because sectors, which did not necessarily interfere with each other, will now be interlinked and connected. When this connection is being made, it is important to do so in a value-creating manner. This means that the concept of a smart city should not be approached mainly through technology introduction, but more taking also into account elements, such as the society’s- and city departments’ culture or organizational conditions. (Smart Cities Committee 2015)
Moreover the significance of standardization of applications, services and also business models is of great importance. Schaffers et al. claim that nowadays there is still a lot of try and error and that there are little “off the shelf” solutions available. Through pushing forward the process of standardization, development- and maintenance costs would be dramatically reduced. Therefore, they also urge open-source communities to engage in the process and to exchange best practices. (Schaffers et al. 2011)

3. CITIZEN PARTICIPATION IN THE SMART CITY

Based on the key findings of the previous sections, the importance of participation was identified. This will be apprehended in this chapter and participation will be discussed as a key “ingredient” of a smart city.

3.1 INTRODUCING PARTICIPATION

As a fundamental part of the whole concept, the focus on ICT also influences the communication and relationship between citizens and their government. Through their implementation, government agencies can operate more efficiently and transparently and the relationship with its citizens can be strengthened through making democratic practices easier. (Albert 2007) This new way of interaction can improve public engagement and allows reaching a wider audience to contribute to political debates. (University of the West of England 2014)

However, technology alone is not the key. City administrations also have to engage in this process by “opening up” themselves, through for instance providing data to the citizens and encourage them to support the government in developing new public service-oriented applications using this data. (van der Graaf 2014)
Furthermore, a city’s inhabitants can be integrated into the participatory process through providing information and data to the city’s administration, which they collected by themselves. (Veeckman & van der Graaf 2014) Therefore, citizens are becoming part of the whole dynamic knowledge of the city, motivating them to develop certain new behaviors, like engagement in their neighborhood or the citizens’ ability to know and learn. (Foray 2004) In general, the underlying system and applications should be of an interactive, flexible and versatile nature, to allow an easy participation among the users. (Oksman et al. 2014) Therefore, this participatory approach illustrates a “shift from individuals as mere 'consumers' turning into 'producers' supporting the democratization of knowledge and information” (van der Graaf 2014).

Citizens should consider their city as something they can collectively tune through bringing in their own knowledge and therefore helping the city, seen as a social collective intelligence, to develop. (Foth et al. 2011) Engaging citizens and encouraging them to participate, demonstrates a way of taking advantage of the innovative potential of the public.

As previously elaborated, smart city campaigns are very diverse, affecting various areas of a city, where different clusters of people may have interest in. As participation is clearly identified as core element of the smart city concept, the next step is to examine the concept of participation more in detail and take into account the different ways of doing so.

3.2 ENCOURAGING PARTICIPATION IN A SMART CITY

According to the author Langton, “the quality of citizen participation is determined by citizenship education, elitism, technological complexity, financing, government agency behavior, and representativeness” (Langton 1978). In the Article “Further Dissecting the Black Box of Citizen Participation” it is concluded that participant competence is positively associated with the participation outcomes, meaning that the participants’ education is vital for a good outcome of the participation process. Nevertheless, the authors stress the fact that

this should not mean to exclude citizens with less competence from participating. (Yang & Pandey 2011)
Participation itself is a process where competences can be improved, meaning that all citizens should have an equal right to participate and express their opinions, irrespectively of their competence level. Moreover, the article emphasizes the importance of educating the citizens. They should be taught how to use the system, participation workshops should be organized, civic education should be strengthened and social capital should be build. Concerning the participation mechanisms implemented in the process, the authors underline their finding that "(…) using multiple mechanisms is more likely to lead to good participation outcomes" (Yang & Pandey 2011).

According to the previous conclusion it is best to use a certain type of mechanism for each individual situation, when designing a participation program. This results in a variety of mechanisms to be in place when finalizing the campaign. (Yang & Pandey 2011)
Besides the provision of the right participation mechanisms, another important factor is the citizens' motivation to participate in general. Malone et al. relate the motivation to participate to goals users want to reach such as "money, love and glory". (Malone et al. 2009) As the reward through money is not necessarily realizable for a government-designed campaign, it is more important to focus on the other two aspects of love and glory. (Malone et al. 2009)
Moreover, besides the discussed ability and motivation to participate, another factor, the citizens' satisfaction, is also important, as it is defined as the motivational feedback to re-enter the participation process. (Malone et al. 2009)

3.3 METHODS TO PARTICIPATE IN A SMART CITY

In the following section the attention of the work is drawn to several participation methods. As elaborated before, three key methods can be analyzed.

Citizens help the government collecting data
Citizens being involved in using the data generated by the government
Citizens being involved in government activities

The first method of citizens contributing in the collection of data will be discussed under the framework of co-creation, more precisely under the closely aligned principle of co-

production. Co-production also overlaps with the second participation method, as the design of new services and applications is also considered in the framework. The following section of "open government" focuses on the provision of "open data", which should be used to create new applications and services and is strongly aligned to the second mentioned participation method. The third method of citizens being involved in government activities will be explained using "urban planning" as an example, which will be covered in the next section. As a pre-condition, "e-government" will be discussed in this work, which describes the improved relationship between a government and its citizens, as ICT's should enable the government to incorporate the citizens' contribution through creating interaction and dialogue.

3.3.1 E-Government

The objectives of most governments are to save taxpayers' money, assure an effective and efficient use of resources and to realize a transparent way of making policies and decisions. Therefore, governments are increasingly faced with challenges how to strengthen citizen participation and engagement. (OECD 2010)

Through the creation of an e-government, Internet-based technologies can be used to "(…) make it easy for citizens and businesses to interact with the government, save taxpayer dollars, and streamline citizen-to-government communications" (Bush 2002). The development of an e-government is nowadays seen as a "must", as governments will not be able to save costs without applying ICT's in a smart way. (OECD 2010)

Moreover, the concept has been embraced by political leaders in order to legitimize their investment of public money in ICT's. (Gauld 2006) E-government is compiled by two elements, "(…) a regulating element, which shapes the framework of our information society, and a participating element, where the public sector applies information- and communication technologies" (Zwahr & Finger 2011).

Furthermore, the concept has several underlying assumptions, namely a two-way communication and the interaction between citizens and government, as previously mentioned. The government's task is to open up channels, which ensure the creation of dialogue and interaction with its citizens in order to take advantage of their possible contribution. This contribution can be realized in terms of policy choice, co-production of public goods and services and also the monitoring, control and evaluation of the government's performance. Citizens should embrace those advantages and involve themselves actively in their potential roles in the process. (Oszlak 2013)

The introduction of an e-government should be followed by an increase of available government information and services. Moreover, several service-delivering agencies will be interconnected reducing the citizens' uncertainty, which party to contact in case of need. As participation is also a key part of the e-government concept, ICT's can be used in two ways to improve it. On the one hand they can act in terms of consultation by facilitating policy responses to electronically articulated public needs. On the other hand an e-government is supposed to be related to the theory of a "direct" democracy, which means through emphasizing participation, finally a government's democratic system is being improved. (Gauld 2006)

3.3.2 Co-Creation

The concept of co-creation is vital, not only for the framework of participation, but also for a smart city itself. Co-creation can be emphasized as "(…) improving processes of idea generation and decision-making and promoting co-operation and creativity" (Steen et al. 2011). Additionally it can improve users' satisfaction and strengthen trust and loyalty amongst them (Steen et al. 2011). Another concept closely allied to co-creation is "co-production". Co-production was a result out of the separation between professionals and users. As a consequence it has been realized, that users can participate in the design and delivery of services and make them more powerful and effective through bringing in their own wisdom and experience. (Manchester City Council 2010)

In terms of a smart city, where participation is key, the concept of co-creation has to be deeply embedded into the system. Through engaging and involving users (citizens) it is not only possible to bring in their skills to create new services or applications, but also to rely on their experience, especially when it comes to data collection or provision, or to consulting functions, where best practice solutions can be needed. (Bovaird 2007)

3.3.3 Open Government

The term "open government" illustrates the provision of so called "open data", more precisely of "open government data" (OGD). Open government data consists of real-time information about things and people (van der Graaf 2014), also called as "(…) public sector information (PSI) that is made available for reuse as public good, as defined and regulated by Directive 2013/37/EU, the revised PSI Directive" (European Union 2013). This (non-sensitive) government information will be provided to citizens and businesses, whereas citizens can use the data to draw their own conclusions out of it and businesses can use it to apply those public assets for commercial purposes. (OECD 2010) As a consequence of the smart city concept,

this provided data comes from various smart-embedded devices (smart connected products, sensors etc.), causing a so-called "datafication" of the city and adding value to the city's "intelligence" through providing this real-time and location-based information to the people. (van der Graaf 2014) But just the provision of data is not enough to make the city intelligent. It is essential that citizens also have the right skills of processing and interpreting this data. (Schaffers et al. 2012) Therefore, the development of mobile applications is being pushed forward through holding urban competitions on open data, so-called "hackathons". Those applications should be used to create a digital layer of the smart city.

Citizens can support this creation in two ways, the already mentioned co-creation of mobile applications but also through participating in the collection of data (crowd-sourced information). (Hielkema & Hongisto 2013)

3.3.4 Urban Planning

The term urban planning refers to the process of developing urban settlements and communities. It requires the involvement of various components such as research and analysis, strategic thinking, knowledge of architecture and design, and implementation and management. (Taylor 1998)

This variety not only requires the involvement of multiple actors, but also implies a broad, varied and complex nature of the process's goals, which creates a high dependency on the actions performed by each actor. In the urban planning process, ideally traditional expert-driven top-down methods should be combined with bottom-up methods, engaging stakeholders and partners. Traditional planning methods are therefore outdated and a need for tools increases, which enable the involvement of the public into the decision-making process and assist citizens in their evaluation of the impact of policymaking. Finally those methods should also support the development and improvement of e-democracy, as mentioned before. (University of the West of England 2014)

Concerning the urban planning process there is to say, that it is more likely for a project to run smooth and without political or social resistance, the earlier ideas are presented and tested, as possible problems can already be detected in early stages. This argument supports the importance of the urban planning concept, as also economic risks of failure are being minimized. (Steen et al. 2011)

3.4 REALIZING PARTICIPATION

In this section two approaches will be elaborated, which are connected to the implementation of smart city solutions. They should facilitate the participation process itself and engage citizens into the innovation process. Those methods can contribute to all of the previously mentioned participation scenarios and should be considered as helpful support in terms of their realization.

3.4.1 Toolkits

When talking about open government and how citizens can contribute by using open data to develop value-creating applications, the provision of so-called "toolkits" can facilitate the whole participation process.

A toolkit is supposed to lower the barrier for citizens to enter the participation process, by dividing the task into several sub-tasks and distribute them according to the individual needs. This should also beneficially support the co-creation process. (van der Graaf 2014) Such an institutional hosted platform acts as a common base for citizens and institutions to meet and work together on solving need-related tasks. Therefore, value streams can be created between stakeholders, which they can use for their benefit, better addressing local needs and sensing the cities' dynamics. (Ballon & Van Heesvelde 2011)

3.4.2 Living Labs

When talking about the concept of co-creation in smart cities, so-called "living labs" are a useful contribution, as they engage citizens in the innovation process.

Living labs can be understood as "(…) user-driven open innovation ecosystems, which promote a more proactive and co-creative role of users in the research and innovation process" (European Commission 2010). The goal of living labs is the involvement of potential users at an early stage, which results in a technology push and an application pull. Ideas can therefore emerge easier and lead to adoptable innovative solutions. (European Commission 2010)

A living lab ecosystem is able to provide citizens the possibility to use future Internet technology and build innovative scenarios based on that. Possible scenarios can also be based on open data, eventually even collected by the citizens themselves, which can then be used to (co-) create applications. (Schaffers et al. 2011) A benefit in finding acceptance among citizens can be their natural motivation in shaping their environment through their "sense of place" and their "sense of being at home in a city" (Horelli 2013).

Moreover, citizens participating in living labs can have multiple roles during the process. The roles range from tester over contributor to co-creator in the development process. (Ratti & Townsend 2011)

3.5 OBSTACLES OF PARTICIPATION

According to the literature there was not enough attention given to the link between user participation and technological advancement, resulting in overestimated creative capacities of the citizens and underestimated technological capabilities (van der Graaf 2014). This statement can be supported by the fact that such smart systems will also include citizens, which are not educated in a technical way. For them it may not matter how the application and its underlying technology works, they want it to function properly and receive the benefits out of that service. (Rabari & Storper 2013) According to Balakrishna, major points, which hinder the implementation of the smart city model, would belong to the areas: Privacy & security, concerning the question of ownership and secureness of data, the ubiquitous access of data and services and the lack of testbeds for jointly creating and evaluating smart city solutions (Balakrishna 2012).
Similar as above, those presented obstacles will be incorporated into the following research. The residents' attitude towards those obstacles should be assessed in order to match the literature with the citizens' perceptions.

3.6 RESEARCH IMPLICATIONS

When summing up the previous literature research, several key elements can be identified, analyzing the citizens' role in a smart city.
Starting with the concept's broadness, a lot of people will be affected by the realization of a smart city. Therefore, it will be of great value to evaluate on different clusters of citizens in order to match them with the following research.
Afterwards, the residents' foreknowledge about a smart city would be of interest, as it can serve as an indicator for the awareness of the concept as well as a control variable for further research. When considering the smart city concept itself, a valuation of the respective benefits and obstacles can add value in understanding how citizens perceive a smart city.
As the main part of this work is focusing on how citizens can participate in a smart city, this should also be clearly emphasized in the quantitative research. Therefore, the three identified

participation methods will be considered in terms of their general attractiveness for the citizens as well as their characteristics concerning time and skills needed. Moreover, the importance of being rewarded for contributing should be assessed.
With that information, an overall picture can be drawn, how ready citizens are to contribute to their city getting smart and how their attitude towards the different participation methods is.

4. METHODOLOGY AND RESEARCH

In the following chapter, the previously mentioned research implications will be taken into account and will be used to formulate several research questions (RQ). To further assess those research questions and to prove their validity, they will be supported by several hypotheses. Based on those developed questions and hypotheses, qualitative research in form of a survey has been designed and executed (See Appendix: Survey). With its results, hypotheses and research questions could be evaluated and answered. The results should then be used to identify trends and implicate further research to be conducted (See Appendix: SPSS Output).

4.1 RESEARCH QUESTIONS AND HYPOTHESES

In order to assess the concept of a smart city, three Research Questions have been identified. Those questions orient themselves at the literature review and use various hypotheses to evaluate them. As already mentioned in the research implications, elements for conducting a cluster analysis were added to the survey in order to assess differences between several groups. Those clusters were also incorporated into the hypotheses, as they are of major importance when answering the research questions and enabling a categorization of the outcomes.

Figure 7: Research Questions and Hypotheses

4.2 SURVEY SET-UP AND DESIGN

In order to evaluate the previously established research questions and to verify the developed hypotheses, a qualitative research in form of an online survey has been conducted by using the online-tool "Qualtrics". The questionnaire was divided into three parts, according to the respective research questions.

Cluster Analysis & foreknowledge

In the first part, an array of psychographic questions was used in order to prepare the conduction of a cluster analysis and to be able to classify the respondents into several groups. The scales used for these questions were taken from the literature. Elements about innovativeness, environmentalism, creativity, emergent nature, concern about privacy and technological anxiety were included according to Bruner II (2013). Moreover, elements about social responsibility and social comparison information were used, which were taken from William O. Bearden, Netemeyer, & Mobley (1993). Those elements were chosen, as they are either connected with the concept itself (environmentalism, emergent nature, innovativeness), its obstacles (concern about privacy), or are part of certain characteristics, which could influence the evaluation of a smart city (creativity, technological anxiety, social responsibility

and comparison). After this first block, the first part of the survey was closed by generally asking the participants about their existing knowledge about a smart city. If they heard about it and if they would know what the concept embodies.

Smart City

The second part of the survey opened with an info-page explaining the concept of a smart city more in detail. This was done in a comprehensive way by presenting the definition, as well as benefits and obstacles. Afterwards questions were asked about the concept, generally about its appealingness and also more detailed about the attractiveness of the benefits and the importance of the obstacles. A last question was asked about the general willingness to participate. This was done before introducing participation itself, to make sure that people are not yet biased by its importance.

Participation

The third and last part of the survey was again opened by an info-text. As this part was focusing on the aspect of participation inside the smart city concept, respondents had to be educated about its importance and how they can contribute developing a smart city. Therefore, three different scenarios of participation (elaborated in the literature review) were presented and explained. Afterwards the respondents were asked to rate those scenarios according to their willingness to participate, if they have the necessary skills and if the time needed to participate would present a barrier to them. The survey was then closed with three demographic questions about age, occupation and the participants' city size.

4.3 TARGET AUDIENCE AND EVALUATION METHODS

The survey was addressed to the whole population without any restriction, as a smart city can potentially be applied anywhere without a limitation in city size. Moreover, the general perception towards the concept should be evaluated and not towards already existing solutions.

The survey was carried out through a distribution in social networks (Facebook), Internet blogs (Smart city and Internet of Things communities) and personal contacts. The period of data collection was 10 days and was carried out in June 2015.

In order to be able to group the respondents, a factor analysis was executed, analyzing the psychographic elements of the first block. The created factors were then used to conduct a cluster analysis. The resulting clusters could afterwards be incorporated into further analysis.

The research questions were predominantly answered by applying descriptive statistics. Common methods were analyzing frequencies and cross-tabs. A one-way ANOVA has been used in case of analyzing differences between groups (clusters) and a correlation analysis has been applied for finding relationships concerning benefits/obstacles/participation.
In general, the level of confidence was adjusted to 95%. Moreover, considering the research results, the percentages describing the agreement about a certain element were calculated by adding up the answer possibilities: Agree and strongly agree. This is stated in the text always for the first result, any following percentages in that context should be seen in the same way.

4.4 RESEARCH RESULTS

The total sample size amounted 119 respondents from which 95.8% were aged until 35. 66.4% of the participants were students and 68.1% were living in cities with less than one Million inhabitants.

4.4.1 Cluster Analysis

Before conducting a cluster analysis, dimensions have been reduced through a factor analysis. Those factors have then been used for the cluster analysis, as this increases the probability of creating meaningful clusters. Without this method, the possibility exists, concerning highly correlated variables, that "(…) specific aspects covered by these variables will be overrepresented in the clustering solution" (Mooi & Sarstedt 2011). When conducting a factor analysis it is important to reach a high measure of sample adequacy. Therefore, the Kaiser-Meyer-Olkin (KMO) Measure is necessary to consider. In the case described here, some of the psychographic questions had to be excluded from the analysis in order to reach a number higher than 0.5. (IBM 2011) After excluding three variables it was possible to reach a KMO Measure of 0.67, which should be adequate for using the results. (IBM 2011) The results were five factors, which could be summarized as:

Technology (F1), Environment (F2), Creative (F3), Privacy (F4) and Health Conscious (F5)

As necessary criteria for choosing a factor was an Eigenvalue higher than 1, which is also called the "Kaiser criterion". (Mooi & Sarstedt 2011) Those factors were then used to conduct a cluster analysis as mentioned before.
The analysis consisted of two steps. First a hierarchical cluster analysis was executed. The results were then analyzed by looking at the coefficients of the clusters starting with the

highest one (just one cluster). The change in coefficients was observed the more clusters were added, looking for a "jump", which should estimate the optimal number of clusters, as "(…) succeeding clustering adds very much less to distinguishing between cases" (Burns & Burns 2009) In the case analyzed here, the determination was not completely clear, nevertheless a selection of five clusters has been interpreted as most logical.

As a next step a second cluster analysis was realized, using the method of K-Means Clustering, where a fixed number of clusters can be selected, in our case five. The results were then analyzed according to the final cluster centers, which show the included variables (factors) for each cluster. This again can be used for appropriately naming the clusters. In this case:

The "Creatives" (Cluster 1), the "Alternatives" (Cluster 2), the "Techies" (Cluster 3), the "Greens" (Cluster 4) and the "Normals" (Cluster 5)

4.4.2 RQ 1: How conscious are citizens of the smart city concept?

In order to assess this research question, several questions have been analyzed, beginning with the one, if people have ever heard of a smart city. For the majority of the sample this condition can be set as true (53.8%). To have a more detailed look at this number, the different clusters have been considered. In the outcome we can see that within their clusters the "Alternatives" were the ones having heard of the term the least (16.7%) and the "Creatives" and the "Techies" were the ones having heard of the term the most (66.7% and 65.5%).

In order to assess the participants' foreknowledge of a smart city the people who have heard of the term were asked the question: "In my opinion a "smart city" is:" and four solutions plus an "all of the above" and a "none of the above" option were presented. Vice versa, the people who were claiming not to have heard of a smart city were asked what they imagine a smart city to be. The same answering options were presented. It is to say, that the "all of the above answer" was the correct one. Nevertheless, most people answered from a rather technical perspective, claiming it to be "a city, which uses technology to make everyday life easier". This was similar for both groups, the ones having heard of it (68.8%) and the ones who did not (65.5%). Only 15.6% of the respondents, claiming to have heard about the concept, were using the correct answer "all of the above". In contrast, the ones not having known about it, more people were selecting the correct answer (20%).

4.4.3 RQ2: How is the concept of a smart city perceived?

The second research question about the perception of a smart city was supported by several hypotheses, starting with the concept's appealingness among groups. The majority of respondents found the concept appealing (88.3%), whereas 53.8 % found it somewhat appealing and 34.5% even extremely appealing. Including the clusters into the analysis through conducting an ANOVA did not show any further significant insights (p-value: 0.072). This trend goes hand in hand with the question, if people could imagine to live in a smart city, which was agreed by 90.8% of the respondents. Moreover, coherence between the two questions has been tested through creating two dummy variables for the people finding the concept appealing and the ones, who could imagine living in one. The result was in 95.2% accordance.

Considering the benefits and obstacles of a smart city, several trends could be recognized. In case of the benefits, a positive trend existed throughout the three of them. They were all rated as attractive with an acceptance of more than 80% (agree and strongly agree), led by the time-saving benefit (89.1%). In order to find a relationship between the answer possibilities, a correlation analysis has been performed, showing the correlation between the benefits to be positive. Nevertheless, the relationship was just moderate, as the correlation coefficients were lying between 0.3 and 0.49. (Mooi & Sarstedt 2011) Still those results implied that benefits are related to each other and most participants value all of them indifferently. This statement could be enforced, as an ANOVA did not show a connection between benefits and the clusters, meaning that there was no significant difference between groups.

Carrying on with the obstacles of a smart city, one pattern was recognizable. Most of the respondents were ranking privacy as the most important obstacle (73.7%, agree and strongly agree), whereas the other obstacles (technical and political) have only been rated with an importance of around 50% (56.8% and 51.7%). When analyzing the relationships between those obstacles, there were only two variables, which correlated with each other: Privacy and technical. Nevertheless this relationship could be seen as weak, as their correlation coefficient was below 0.3 (0.211). (Mooi & Sarstedt 2011) As privacy was the most equally distributed obstacle along the answer possibilities, an ANOVA should proof an eventual difference between clusters. Unfortunately, this could not be done significantly with a p-value higher than 0.05 (0.271).

Finally, the third hypothesis should be assessed, covering the respondents' readiness to support the government to introduce a smart city, which should be done through additional tax payments. The majority agreed on the fact (53.8%) and therefore an ANOVA has been

conducted to identify possible differences between clusters. With a p-value of 0.067 the analysis was not significant, but as the value was close to the tolerance level, it could be of significance when increasing the level. Due to that fact, a deeper look into the data has been applied through crosstabs between the question and the different clusters. With 20.2% of the total answers, the "Greens" were the ones most willing to support the government.

4.4.4 RQ3: How is the citizens' willingness to participate in a smart city?

Investigating on the third and last research question, four hypotheses have been established supporting its evaluation. Elaborating on the first one, a relationship should be found between the willingness to invest time and the willingness to participate in certain scenarios. Therefore, three ANOVA's have been conducted. All of the results were highly significant, implying that the people, who would invest their time to improve their city's smartness, would also be willing to participate in each scenario introduced.

The next step was to assess the different participation scenarios and if they are favored by certain groups. Looking at the frequencies of the different scenarios, one can realize most of the respondents having a positive attitude towards their willingness to participate. Each scenario was rated with around 70% agreement (Urban Planning: 69.7%, Report with App: 75.6%, App/Service Development: 70.5%), when combining the answers agree and strongly agree. The distribution between methods was almost equal, even though the method of reporting through an app was most favored with a slightly higher score. Conducting an ANOVA did not deliver new insights, as each scenario combined with the clusters could not provide enough significance between groups.

Furthermore, it should be analyzed if skills and time needed for the participation process are perceived differently by the various clusters. In terms of skills needed, most of the respondents estimated their skill level to be sufficient for participating in urban planning and in the reporting with an app (79.8% and 84%). Regarding the participation in app/service development, less than half of the participants were confident about their skills (47.9%). This finding was followed by performing an ANOVA to identify differences between the clusters. As the results were not significant for all participation methods, no difference between skill level and cluster membership could be identified.

Continuing the analysis, the various methods were considered according to the time needed to participate. The majority of respondents identified time as a barrier when participating in urban planning (42%, agree and strongly agree) and app/service development (40.2%). Reporting with an app was considered to demand the least time when participating (23.5%). Analyzing the differences between clusters through an ANOVA, again no significant

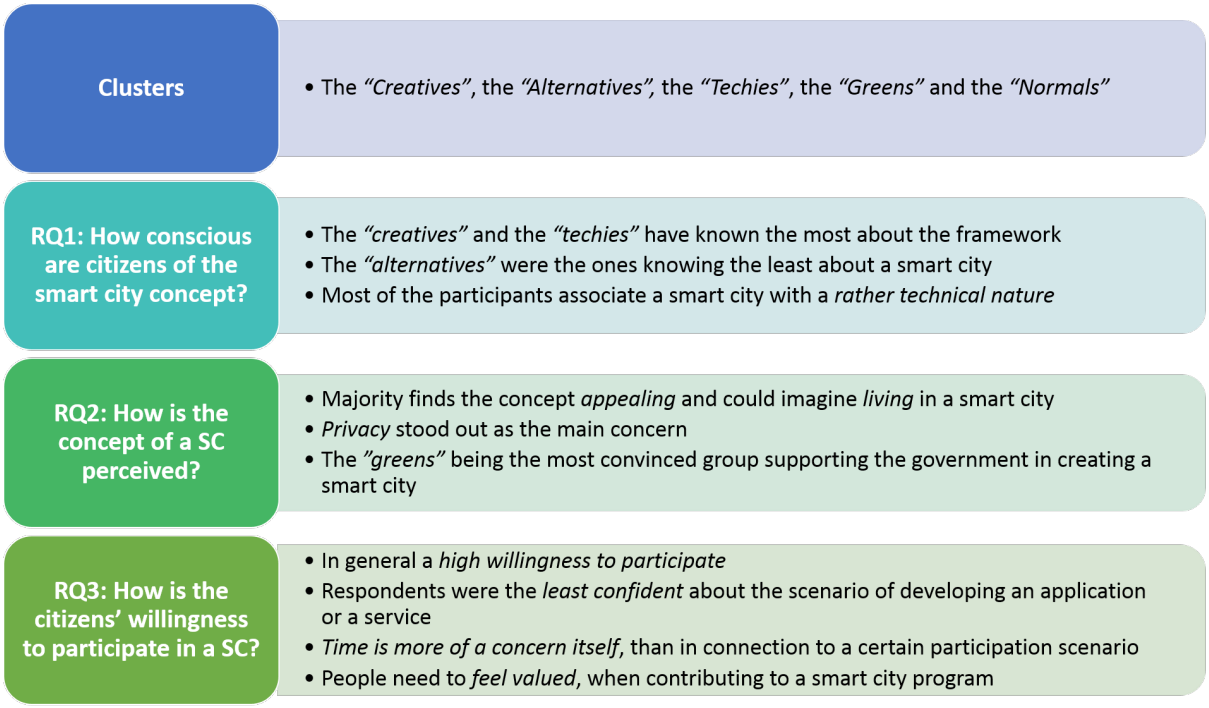
differences could be recognized. Only when looking at the correlation between the participation methods, a positive relation between them was identifiable (although just moderate with coefficients around 0.3). This implied that rather the time itself affects their decision than the specific participation method.

Finally it was important to know if people need to feel valued in terms of their participation input. As there was a strong acceptance of 91.6% about that fact, it can be set as true. An ANOVA could not give any further insights about differences between clusters.

4.5 RESEARCH KEY FINDINGS

In order to summarize the previous research, the following graphic presents the key findings, based on the conducted questionnaire.

Figure 8: Key findings of the research



5. CONCLUSION

This chapter represents the concluding element of this work. After reviewing the work again in a comprehensive manner until the research results will be presented, those outcomes will then be interpreted in the next part, discussing the consequences more in detail. There, the research results will first be combined with findings from the literature review and discovered insights will further be used to create recommendations to citizens as well as city administrations. Subsequently, further research topics and limitations concerning the work itself will be discussed. Finally, the work will conclude with presenting the author's own view on the topic.

5.1 FINAL REVIEW

This dissertation introduced the reader to the concept of a smart city. Through elaborating on topics such as urbanization, an importance for action was clarified, whereas a smart city should serve as a major contributor in solving such matters. Several examples of already established smart city solutions were presented to the reader, illustrating their impact and diversity. This diversity was then incorporated, when analyzing the solutions more in detail. Introducing a smart city does not only affect multiple areas of a city, it also affects a wide array of different people. Moreover, not only the wide range of solutions can be recognized by citizens, residents are also involved in different ways into smart city programs. After analyzing the mentioned examples of smart cities, three different participation methods have been identified:

Citizens help the government collecting data
Citizens being involved in using the data generated by the government
Citizens being involved in government activities

Having evaluated on the diversity of smart city campaigns, participation was identified as major contributor in terms of characterizing different solutions as well as a vital element to include. Therefore, research should be conducted, examining the smart city concept in the eyes of residents and also evaluating the different participation methods in terms of appealingness and potential barriers to participate, respectively skills and time. Those findings should enable cities to create a sort of city profile, which should contribute to an effective targeting of smart city campaigns.

Before focusing on the research, the literature has been analyzed, according to the respective topics. After elaborating on several definitions of the smart city term, a common set of characteristics has been identified, which ideally has to be included into the framework:

Use of ICT, effective use of natural resources, improve quality of life, improve municipal operations and engage citizens through participatory governance.

Moreover, certain key elements have been considered such as the dimensions and obstacles of a smart city. Afterwards, the work's focus was shifted to emphasizing the importance of participation, by analyzing several elements according to their existence of participation (namely the concept, its features and its requirements). It was observed that all elements incorporated participation as a part of them, highlighting its importance. Furthermore, the literature was analyzed specifically focusing on participation. After its introduction, it was elaborated how to encourage citizens to contribute and the different identified participation methods were analyzed more closely.
Subsequently, the key findings of the literature review were incorporated into conducting quantitative research. Therefore, three research questions (RQ's) were identified, supported by several hypotheses.

RQ1: How conscious are citizens of the smart city concept?
RQ2: How is the concept of a smart city perceived?
RQ3: How is the citizens' willingness to participate in a smart city?

Through performing a questionnaire, those RQ's should be able to be answered. Respective of the broadness, not only in the affected areas, but also from the people, which are affected by a smart city, a cluster analysis has been conducted. Therefore, several psychographic questions have been included into the questionnaire. Through a combination with the research results, trends should be easier to allocate and decision-making should be supported.
Elaborating on the questionnaire, following clusters and key research results could be identified:

Clusters:

The “Creatives”, the “Alternatives”, the “Techies”, the “Greens” and the “Normals”.

Foreknowledge:

"Creatives" & "Techies" have known the most about the framework.

"Alternatives" have known the least about the framework.

Majority associates a smart city with a rather technical nature.

Perceivedness:

"Privacy" standing out as the main concern.

"Greens" the most convinced group supporting the government.

Participation:

Respondents are the least confident about developing an application or a service.

Time as a concern, but more related to itself than in connection with participation scenarios.

Contribution of participants has to be valued.

For city administrations to conduct a research similar to the one in this work can be of great importance when planning smart city campaigns, as it can provide valuable information regarding how to include citizens. Moreover, the realization of a cluster analysis can add significant value to the insights, as decision-makers not only know how to design campaigns more attractively but also who is more sensitive to what kind of characteristic and to target them with the right information in order to reach a successful accomplishment of the program.

This outlining of a city’s residents concerning their attitude towards a smart city and their willingness to participate was earlier referred as “city profile”.

5.2 DISCUSSION

5.2.1 Combining Research Results with Literature Review

Examining the previously collected key findings from the conducted research, several similarities to the elaborated literature review can be recognized.

The overall appealingness of the smart city concept among the respondents can be explained through the mentioned “sense of place” and “sense of being at home” (see chapter 3.4.2: Living Labs). Through feeling at home at a place, citizens might appreciate the creation of a smart city even more, also connected with benefits, which they will be able to experience. The importance of citizens having the right skills of processing and interpreting the data created by the smart city architecture (see chapter 3.3.3: Open Government) can be underpinned with the finding of citizens feeling the least confident about their participation skills when it comes to the development of applications and services. Here, a need for action is required. Furthermore, acknowledging the contribution in the participation process is of great importance, as it serves as motivational feedback to re-enter the participation process (see chapter 3.2).

Another important way of interpreting the research results is through elaborating on them in order to support the overcoming of identified obstacles, as mentioned in the respective parts.
The importance of maintaining privacy for example is clearly reflected in the research results, as privacy was identified as the most important obstacle among the others. However, analyzing the research results can also lead to the determination of certain trends, which can help to tackle some of the presented hurdles. For example, the overall positive attitude towards participation goes hand in hand with the mentioned necessity to start with the city not the smart. It provides a foundation from the citizen side, as integrating residents into smart city campaigns does not present a major hurdle for the city. Therefore, overcoming the previously stated obstacle is more connected to the government’s - than to the citizens’ side. This statement can moreover be supported by the mentioned observation that smart city solutions are being more pushed from technology vendors rather than pulled by the city governments. This fosters even more the necessity for the city administrations to embrace this trend, as technology providers as well as citizens are ready to cooperate.

5.2.2 Recommendations

In this part of the work, identified key findings will be incorporated into frameworks presented by the literature and recommendations will be elaborated. Hereby, the focus will mainly lie on the city administrations how to advance their smart city campaigns the most reasonable way in order to ensure an optimal use of resources for a maximized outcome for all parties involved.

Key findings of the previous section, which are of importance for this part, are:

The importance of citizens having the right skills of processing and interpreting the data created by the smart city architecture.
Acknowledging the contribution in the participation process is of great importance.
Smart city solutions are being more pushed from technology vendors rather than pulled by the city governments.

Those elaborated elements already present a clear imperative to city administrations to embrace the smart city concept and on the other hand provide important essentials to include into their smart city campaigns.

Thereby, the point of linking the right tasks to the people with the right skills is not only an educational undertaking of gaining those skills but also represents a coordinational challenge. Therefore, the previously introduced toolkits can be considered as an important contributor. As a toolkit divides a task into several sub-tasks and distributes them according to individual needs, this could increase transparency for potential participants and lower their barrier to contribute. Moreover, in the previous research, time was identified as an obstacle for participation. The introduction of toolkits could also work in favor for overcoming this barrier, as the creation of sub-tasks will also divide the time needed to participate and add transparency to the participation process.

Furthermore, the literature stated the creative capacities from citizens to be overestimated and the technological capabilities to be underestimated. In order for city administrations to assess and prevent this development, the creation of the so-called Living Labs could be beneficial. Living Labs involve potential users at an early stage, resulting in a technology push and an application pull as well as a facilitated way for ideas to emerge. Through their introduction, city administration could counter the previously mentioned trend and ensure the creation of adoptable innovative solutions.

Moreover, as a precondition for a smart city to be successful, the concept itself should be embraced in a value creating way by not only focusing on ICT but also by taking into account the respective culture of the society. By assessing the previously introduced success factors, an ecosystem out of three elements is considered to be vital for a smart city's success besides

the introduction of ICT. The first element of service providers can be elaborated as existing, as a technology push was clearly identified. The second factor on the other hand, emphasizing the need of a business model between service providers and city administrations, most likely needs further focus, as a lack of government pull was recognized. The third factor instead is focusing on the creation of a platform for producers and consumers to meet in order to create new services and is key when it comes to the involvement of citizens into smart city campaigns. The previously elaborated necessity of toolkits and living labs is hereby going hand in hand with the presented success factors, as they embody exactly such platforms requested by the model.

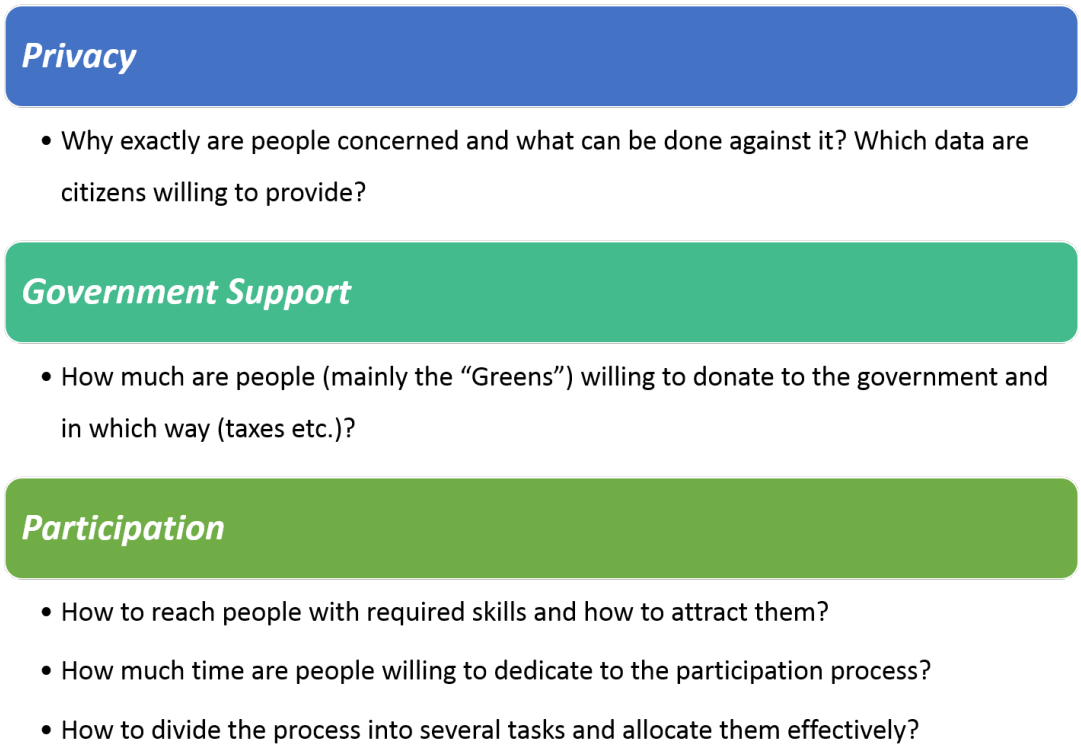
Throughout this work, several key findings were discovered through elaborating on existing literature, conducting quantitative research and combining essential findings with each other. As a key focus of this work, participation was identified, as it acts as a key differentiator between several smart city programs and is deeply integrated into the framework itself. In general there is to say that participation was not considered as a hurdle as the majority was willing to do so over several scenarios. However, from the city side the importance to modernize and to embrace the smart city concept could be identified.
In order to solve both, the obstacles identified for citizen participation as well as the request for city administrations to innovate, the provision of toolkits as well as the introduction of living labs has been identified as vital for the successful implementation of a smart city.

5.3 FURTHER RESEARCH

The key findings identified through conducting quantitative research and combining it with existing literature can now be used to recognize trends and serve as a base for conducting further studies. Possible topics can be of interest to analyze:

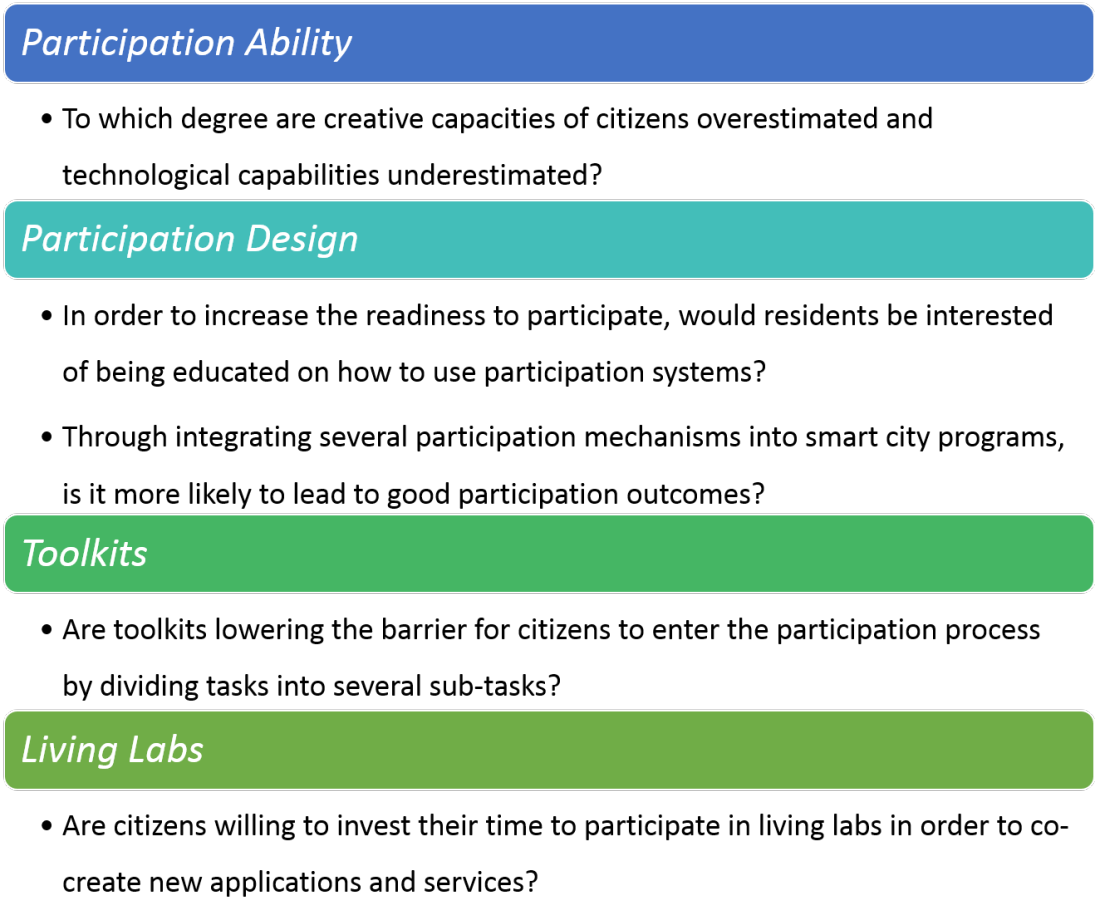
Based on research results:

Figure 9: Further research based on research results



In order to further assess the literature:

Figure 10: Further research based on the literature



5.4 LIMITATIONS

There are several limitations, which can be identified within this work. The study, which has been conducted, cannot be seen as representative with an amount of 119 respondents, as it should be applied to the whole population. Also the age distribution shows a clear inequality, as more than 90% of the respondents were aged until 35. Moreover, the distribution via social networks implies a certain restriction, as the majority of the respondents were personal contacts. Distributing the survey in topic-related Internet blogs should have reduced this effect, but on the other hand might imply the inclusion of respondents, who might be biased. Furthermore, according to the dominantly positive results, it could be assumed to have set up the survey in a biased way. However, the smart city is still in a concept phase with very little people having made experiences with it. This makes it difficult to assess the framework just by its description. Concerning the scaling it is important to emphasize that the scales for conducting the cluster analysis were used from the literature. Nevertheless, the results were not clear enough to apply them without concern. The scales for the rest of the survey were self-developed, as the literature did not provide accurate solutions.

5.5 AUTHOR'S PERSPECTIVE

In my perspective, a connected and integrated world through an "Internet of Things" or a "Smart City" on a smaller scale is vital in terms of creating awareness and enabling the ability to consequently learn from each other and to optimize certain circumstances.
The following example should illustrate this necessity:

The effectiveness and importance of the concept of the Internet of Things can be easily illustrated taking the human body as an example. Our sensory organs are one the most important parts of our organism. They sense and collect information, which is then transferred to the brain with help of our nervous system. The brain receives, processes and stores this information. As a next step, commands will be send by the brain based on that information, telling our body parts what to do. This ability allows us to continuously learn new things based on different situations and was a necessary contributor for our species to have survived throughout the years.

Now imagine this process to be slowed down and you putting your hand into a fire. Your nervous system would not be able to send those signals on time to your brain. Vice versa it would be also to slow to transfer commands from the brain back to your body parts. This would result in heavy burnings and generally limit your ability to learn.
If you even go one step ahead and remove this nervous system, all parts would act autonomic and independent from each other.
Unfortunately, this last scenario is the most applicable one to how the world is connected today. Most of the research, knowledge creation or implementation is done separately, like in silos, with no one exactly knowing what the other parts are doing.
Through the Internet of Things this should be changed. (Smart Cities Committee 2015)

Since I was introduced to the topic of the Internet of Things in an Innovation course during my Bachelor studies, the topic is steadily thrilling me. I started to really gain knowledge about the topic while writing my Bachelor Thesis about the Internet of Things. During my Master studies I continued informing myself about that topic through reading several blogs and shared my enthusiasm with family and friends. As I was approaching the end of my Master studies, the direction of the topic for my thesis was already clear. Thankfully, the seminar I was enrolled for allowed me to further pursue my interests. Even though addressing the topic of user involvement, I was able to find a way to combine both interests: Smart Cities. Fortunately my supervisor agreed on combining the topic of user involvement with Smart Cities and after researching on that area the foundation for this dissertation was created.
I enjoyed writing this dissertation and conducting research, which could proof itself as insightful. Naturally, I will keep my interest in that topic alive. Working for a big IT-Company, also engaged in several Internet of Things initiatives, possibilities could arise, turning my interest into my profession.

6 APPENDIX

6.1 THE INTERNET OF THINGS

Definition

Concerning a world more connected than ever and rising possibilities through technological advances, creating a holistic Internet of Things is the ultimate condition.
In an Internet of Things all objects in our everyday life will be "(…) equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet" (Atzori et al. 2010). *(See Appendix: IOT, Internet Evolution)* Therewith all products will be enhanced with an IT-part, which will also be responsible for an increased functionality of those products. (*See Appendix: IOT, Smart Connected Products*) Huge amounts of product usage data will be available and can open all new possibilities to companies offering services and better performing products to customers. This will be enabled through the so called, Cloud Computing, where this data can be externally stored, analyzed and even being interpreted through applications. (Porter & Heppelmann 2014) *(See Appendix: IOT, Cloud Computing & Big Data)* Also on a bigger scale, through e.g.: adding embedded Sensors to the network, even more data will be produced but can offer a wide variety of new services and applications to citizens, companies or public administrations, using and interpreting those created data blocks. (Zanella et al. 2014) *(See Appendix: IOT, Sensors)* An Internet of Things can be applied in almost every given industry and can support areas such as home- and industrial automation, intelligent energy management or traffic management (Bellavista et al. 2013).

Internet Evolution

The Internet evolved so far in several steps. First of all was *"the web"* itself, being perceived as a productivity-centric network, connecting end-users with information. This connection was in the end optimized through the rise of search-engines. With an increasing amount of information available in the web, more people were also motivated to "join" the web, resulting in the second step of the Internet's evolution, the *"social web"*. In a social web connections are not only made between people and information but also people were able to

connect themselves with other users through social networks like Facebook. With more people being part of the Internet, information is not only connected to but also produced by the users. Backed up by advances in mobile technologies and the evolvement of an "anytime and anywhere" paradigm to access this information, the third step of the Internet's evolution was being introduced, the *"semantic web"*. In a semantic web all the existing information is being taken and transformed into knowledge. The final step would than be to not only connect information or people with each other but to connect everything with each other, which makes sense to connect with. If this is done, the Internet will be turned into an *"ubiquitous web"*, where everything is aware of everything and would provide an intelligent platform enabling smart services. (Balakrishna 2012)

Enabling Technologies

Moore's Law

Moore's Law is based on an observation made by one of Intel's cofounders, Gordon Moore. He claimed that the amount of transistors on a chip is doubling about every two years. (Intel Corporation 2005) Even though this observation was just empirical, it is still valid since 1960 and there is no end in sight of this development. (Zehnder 2010) This has several implications. One the one hand the amount of sensors doubles on the same space, resulting in a performance improvement per cm^2. But on the other hand the same amount of transistors is now fitting on only half of the space than before, which allows improving the devices building size. Additionally to the improvement in space or performance, it is important to mention that also prices improve themselves. Nowadays we reached the point, where the cost of a transistor equals the cost of printing one single letter in the newspaper. (Intel Corporation 2005)

Cloud Computing

In context of the Internet of Things, Cloud Computing plays a very important role. The cloud will be responsible for collecting, allocating and analyzing all the data created by all the devices in the network. This data should then be transformed into knowledge. (Humphreys 2012) The next step would then be to take this knowledge and to combine it with experience to reach the end-goal of creating "wisdom". (Evans 2011)

„If all of these sensors act as the central nervous system for the planet, then the cloud is the brain." (Humphreys 2012)

The “National Institute of Standards and Technology” (NIST) from the USA defines Cloud-Computing as a model for “enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (…) that can be rapidly provisioned and released with minimal management effort or service provider interaction.” (Mell & Grance 2011)

Cloud Computing can also be categorized into three different service models:

Software as a Service (SaaS)

Availability of applications through the cloud. They can be accessed through a program or web-browser whereas the provider is responsible for the underlying cloud infrastructure.

Platform as a Service (PaaS)

Availability of platforms to run or develop own applications in the Cloud.

Infrastructure as a Service (IaaS)

Availability of scalable IT-infrastructure, such as processing or storage, depending on the customers’ demand. The provider is responsible for backups and updates.

(Mell & Grance 2011)

Big Data

As already mentioned above, data is important but is just useful when value can be created. This however requires an intelligent aggregation and processing of the data. (Smart Cities Committee 2015) This is where Big Data analytics comes into play. Big Data is used as a term in order to describe the massive volume of data (structured and unstructured) that is too large to be processed the traditional way. (Smart Cities Committee 2015) Through Big Data analytics it is therefore possible to find hidden patterns and unknown correlations in those huge datasets. (NEC 2014)

Sensors

Sensors are vital for a working Internet of Things. They will be responsible for data collection and monitoring of several conditions, just like the humans’ 5 senses. They create an interface between the real world and the digital world, by being able to realize physical changes in their environment such as light, temperature, humidity or speed. By adding processing power to the sensor and therefore making it “intelligent”, it should be able to realize the processing and interpretation of signals by itself. (Schön 2012) Sensors can nowadays be found almost

everywhere. Just by considering smartphones, which are ubiquitously present in today's society. They are equipped with a high variety of sensors, being able to measure the geographical location, the way the device is moving and whether it is being held horizontally or vertically. (Safety through Synergy) The Intel Technology Journal suggests an embedded sensor module to contain an embedded processor, as well as a communication module, a memory for offline storage, power control elements and an interface to the sensing board. Being equipped with those elements, embedded sensor modules should be able to be used for a high variety of areas such as microclimate sensing, micro pollution, home management, traffic monitoring or water quality monitoring. (Bowles & Douglas 2012)

Smart Connected Products

So far in this literature review we elaborated what an Internet of Things should be, how it is made possible and what it requires to be able to be realized. In the next step this work will focus on the elements out of which an Internet of Things will mainly be build of, Smart Connected Products. They are the content and information generators of an IOT and through their introduction, products will receive a whole new set of capabilities and a whole new approach can be pursued in the future.
But what are smart connected products exactly?
In the November 2014 Edition of the Harvard Business Review, exactly this topic was being discussed and they elaborated some main characteristics of smart connected products:

Three core elements

A product needs to contain three components in order to be called a smart connected product:

- Physical components: The product's mechanical and electrical components
- Smart components: The IT-parts (sensors, processors, data storage etc.) being equipped in the product, expanding the value of its physical components
- Connectivity components: The elements being responsible for creating a connection (wired or wireless) with the product (e.g.: antenna). There are three different kinds of connection possibilities.
  - One-to-one: Two products being connected.
  - One-to-many: A central system being connected to many products.

- Many-to-many: Many products being connected to multiple other types of products.

Four areas of capabilities

Through equipping the product with smart and connectivity components, a whole new set of functionalities can be realized, which can be divided into four groups. Each group sets the foundation in order to reach the next level.

- *Monitoring:* Monitor a product's environment, condition or operation.
  Example: Change in condition (e.g.: temperature) alerts customer.
- *Control:* The product is being controlled by remote commands or build-in algorithms are being triggered through pre-set changes in the environment.
  Example: If temperature gets too hot, the extinguishing system turns on.
- *Optimization:* Application of algorithms to historical or in-use data in order to optimize the products' performance.
  Example: Wind turbines adjust every blade individually to capture maximum wind energy.
- *Autonomy:* Connecting the previous three levels in order to reach a certain level of autonomy.
  Example: From low autonomy (robot vacuum cleaner) to high autonomy (self-diagnose needs, learn about environment, adapt to user preferences).

(Porter & Heppelmann 2014)

Thinking of the needs such a smart connected product can fulfill and how one can benefit from it, grouping together several related smart connected products can improve the overall performance of a single product even more. This is called a *product system*. This implies a shift in competition and unlocks new opportunities, as a firm is now not only competing based on a single product but also based on the performance of the whole system. Going one step further and taking several product systems together, also including related external information (e.g.: weather), a so-called *system of systems* can be created. (Porter & Heppelmann 2014)

This new smart connected products will heavily affect the industries, as new first mover advantages, entrance barriers and new entrants can arise and current companies have to be able to adapt to those market changes in order to not get obsolete. (Porter & Heppelmann 2014)

The Cisco Internet Business Solutions Group estimated for the year 2050, 50 Billion devices to be connected with the Internet. This would by then equal an amount of 6.58 devices per person on the globe. But they emphasize in their paper those numbers to be a rather conservative prediction, as it is not taking into account any changes in technologies that might happen in future. (Evans 2011)

Creation and capturing of value

Through an emerging Internet of Things, also companies will be heavily affected. They will be required to rethink their whole strategy about value creation and capturing. *The creation of value*, mostly related to manufacturing solid products, fulfilling customers' needs and influencing their willingness to pay, will now be influenced through products being equipped with new abilities and functionalities. These can even be enhanced through the products' ability of getting updates wirelessly. Moreover, companies are able to track their products and analyze their usage behavior. Furthermore, through the ability of connecting several products with each other, new services can evolve and the customer receives a whole different experience using the product. (Hui 2014)

Talking about *value capturing*, businesses also have to reconsider certain elements. The part of generating profit is not anymore limited to the sales of the products themselves. Through the products' capabilities, such as connectivity, new revenue streams, e.g.: through subscriptions, apps or value added services, can be encountered and therewith a recurring revenue created. Another appealing fact for companies in terms of the introduction of smart products would be the creation of a so-called "lock-in effect". Customers are more likely to stay with a companies' products due to personalized contents or user-interfaces, but also through the amount of devices in a system, creating network effects, the more there are. (Hui 2014)

6.2 SURVEY

Psychographics

Please rate the following attributes:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am willing to make sacrifices to protect the environment.	○	○	○	○	○
I would be willing to pay a 5% increase in my taxes to support greater governmental control of pollution.	○	○	○	○	○
The condition of the environment affects the quality of my life.	○	○	○	○	○
Pollution is not personally affecting my life.	○	○	○	○	○
Internet privacy is important to me.	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am concerned that someone will steal my identity.	○	○	○	○	○
I consider myself to be a creative person.	○	○	○	○	○

When I see a new product or service idea, it is easy to visualize how it might fit into the life of an average person in the future.	○	○	○	○	○
I keep up with the latest technological developments in my areas of interest.	○	○	○	○	○
Technical terms sound like confusing jargon to me.	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I enjoy the challenge of figuring out high-tech gadgets.	○	○	○	○	○
I like to experiment with new ideas for how to use products and services.	○	○	○	○	○
It is my feeling that if everyone else in a group is behaving in a certain manner, this must be the proper way to behave.	○	○	○	○	○
I prefer a routine way of life to an unpredictable one full of change.	○	○	○	○	○

I am continually seeking new ideas and experiences.	○	○	○	○	○

Part I

Have you ever heard the term "smart city"?

Yes

No

In my opinion a "smart city" is:

A city, which has intelligent citizens.

A city, which uses technology to make every day life easier.

A city, which is aware of its status and can adapt to changing conditions.

A city, which has a highly innovative industry.

All of the above.

None of the above.

I would imagine a "smart city" to be:

A city, which has intelligent citizens.

A city, which uses technology to make every day life easier.

A city, which is aware of its status and can adapt to changing conditions.

A city, which has a highly innovative industry.

All of the above.

None of the above.

Smart City Introduction

INTRODUCING THE SMART CITY:

A Smart City can be defined as an intelligent urban environment, which has Information and Communication Technology (ICT) implemented in its infrastructure, and is connected through a network (the Internet).

Sensors equipped all over the city build its "nervous system" and monitor the city's condition. Also a wide array of "things" can be included into the network through their enhancement with technology (IT).
All the generated data will be processed by the "cloud" and can be used for a wide amount of applications.
Also the citizen will have access to this information of their surroundings and can include them into their daily life.

Benefits for citizens of a smart city are:

Optimized Acting (e.g.: information about traffic or free parking spaces can be accessed)
Saving of Money (e.g.: utilities such as electricity or water consumption can be analyzed and optimized)
Healthier Life and Environment (e.g.: Pollution-levels of air and water can be identified)

Obstacles of a smart city can be:

Political (e.g.: decision making power of stakeholders)
Technical (e.g.: interoperability of heterogeneous technologies)
Privacy&Security (e.g.: Which data of who is made available to whom?)

Part II

According to the previous description, do you find the concept of a "Smart City" appealing?

Not at all appealing
Not very appealing
Neither appealing nor unappealing
Somewhat appealing
Extremely appealing

Could you imagine living in a "Smart City"?

Yes
No

Please rate the following benefits of a "Smart City" according to their attractiveness:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Saving Time (Optimized acting)	○	○	○	○	○
Saving Money (Efficient use of resources)	○	○	○	○	○
Environmental awareness (Pollution monitoring)	○	○	○	○	○

Please rate the following obstacles of a "Smart City" according to their importance:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Political (decision-making)	○	○	○	○	○
Technical (interoperability)	○	○	○	○	○
Privacy (data collection)	○	○	○	○	○

In order for the government to invest in information and communication technology (sensors etc.) to be able to realize the vision of a "Smart City", would you be willing to support it (e.g.: through additional tax payments)?

Yes

No

In general: Would you also be willing to invest some of your own time in order to support improving the "smartness" of your city?

Yes

No

Participation Introduction

PARTICIPATION AS A KEY FACTOR:

Per Definition, Participation is part of the "Smart City" concept and is also vital for its success. Therefore user-centric and bottom-up initiatives are important. Such a participative approach is also made possible through Information and Communication Technolgies. It empowers citizens to actively shape their urban environment by either participate in the **collection** of data or through the **co-creation** of applications and services based on the newly available data.

Part III

Following, three participation scenarios will be described:

Scenario I:
In terms of urban planning, a restructuring program of a city, citizens will be included into the decision-making process throughout the projects length. They can vote how the new/restructured place should look like and for which purposes it should be used.

Scenario II:
A mobile app makes it possible for citizens to report places, which need maintenance or something is damaged, to the city. A picture connected with GPS Data will be sent to the authorities, so they can take care of it.

Scenario III:
Data collected from the city's infrastructure (e.g.: traffic data from sensors) will be made available for the public, in order to create new applications/services for the city. Depending on the citizen's capabilities, he will be assigned to the respective development phase.

Please rate each scenario according to the given attributes. (Last task!)

Would you be willing to participate in such scenarios?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Scenario I (Urban Planning)	○	○	○	○	○
Scenario II (Report with App)	○	○	○	○	○
Scenario III (App/Service Development)	○	○	○	○	○

According to your skill level, you would be able to participate in those programs?

	Yes	No
Scenario I (Urban Planning)	○	○
Scenario II (Report with App)	○	○
Scenario III (App/Service Development)	○	○

Would the time needed for the participation process present a barrier for you to participate?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Scenario I (Urban Planning)	○	○	○	○	○
Scenario II (Report with App)	○	○	○	○	○
Scenario III (App/Service Development)	○	○	○	○	○

In general: Is it important for you to see, concerning the outcome of a participation process, that your input has been valued?

Yes

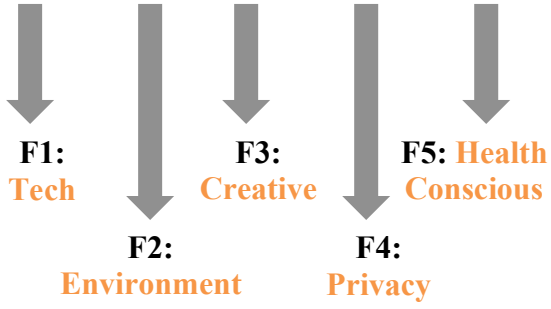
No

6.3 SPSS OUTPUT

Factor Analysis

Rotated Component Matrix					
	Component				
	1	2	3	4	5
I am willing to make sacrifices to protect the environment.	.009	**.707**	-.104	-.055	.432
I would be willing to pay a 5% increase in my taxes to support greater governmental control of pollution.	-.031	**.816**	-.094	-.057	.021
The condition of the environment affects the quality of my life.	-.016	.115	.074	.007	**.843**
Internet privacy is important to me.	.095	.002	-.091	**.795**	.317
I am concerned that someone will steal my identity.	-.049	-.073	.016	**.819**	-.281
I consider myself to be a creative person.	-.085	-.013	**.797**	-.027	.271
When I see a new product or service idea, it is easy to visualize how it might fit into the life of an average person in the future.	.336	.024	**.720**	-.060	-.207
I keep up with the latest technological developments in my areas of interest.	**.823**	.037	-.022	.123	-.131
I enjoy the challenge of figuring out high-tech gadgets.	**.841**	.062	.070	.065	-.049
I like to experiment with new ideas for how to use products and services.	**.717**	-.122	.158	.035	.269
I prefer a routine way of life to an unpredictable one full of change.	-.076	**-.660**	**-.395**	-.038	.094
Technical terms sound like confusing jargon to me.	**-.747**	-.028	-.031	.156	.023
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]					
a. Rotation converged in 5 iterations.					

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.669**
Bartlett's Test of Sphericity	Approx. Chi-Square	273.336
	df	66
	Sig.	.000



Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.709	22.577	22.577	2.709	22.577	22.577	2.596	21.631	21.631
2	1.887	15.725	38.302	1.887	15.725	38.302	1.642	13.680	35.311
3	1.396	11.631	49.933	1.396	11.631	49.933	1.376	11.466	46.778
4	1.203	10.023	59.956	1.203	10.023	59.956	1.360	11.330	58.108
5	1.073	8.938	68.894	1.073	8.938	68.894	1.294	10.786	68.894
6	.738	6.149	75.043						
7	.694	5.780	80.823						
8	.595	4.958	85.781						
9	.515	4.294	90.075						
10	.434	3.617	93.692						
11	.406	3.380	97.072						
12	.351	2.928	100.000						

Extraction Method: Principal Component Analysis.

Cluster Analysis

Number of Cases in each Cluster		
Cluster	1	15.000
	2	12.000
	3	29.000
	4	38.000
	5	25.000
Valid		119.000
Missing		.000

Number of Clusters	Delta Coefficients
2	69.4
3	62.7
4	54.1
5	44
6	33.4
7	22.6

Number of Clusters: 5

Final Cluster Centers

	Cluster				
	1	2	3	4	5
Tech	.09015	-1.77479	**.64994**	-.08320	.17035
Environment	**.44008**	-.33185	-1.17499	**.63081**	**.29940**
Creative	**.80748**	**.48754**	.16280	.18828	-1.19354
Privacy	-1.25090	-.29229	.08352	**.86571**	-.52192
Health Conscious	-1.15974	**.68410**	**.29740**	-.05336	.10360

Cluster 1: Creatives | **Cluster 2:** Alternatives | **Cluster 3:** Techies | **Cluster 4:** Greens | **Cluster 5:** Normals

Research Questions

Demographics

How old are you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	under 18	1	.8	.8	.8
	18-25	69	58.0	58.0	58.8
	26-35	42	35.3	35.3	94.1
	36-50	5	4.2	4.2	98.3
	over 50	2	1.7	1.7	100.0
	Total	119	100.0	100.0	

What is your occupation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Student	79	66.4	66.4	66.4
	Working	35	29.4	29.4	95.8
	Other	5	4.2	4.2	100.0
	Total	119	100.0	100.0	

How big is your city, where you lived the most?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	under 100.000	33	27.7	27.7	27.7
	100.000-500.000	24	20.2	20.2	47.9
	500.000-1Mio	24	20.2	20.2	68.1
	over 1Mio	38	31.9	31.9	100.0
	Total	119	100.0	100.0	

RQ1: How conscious are citizens of the smart city concept?

H1: Clusters have a different foreknowledge of a SC

Have you ever heard the term "smart city"?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	64	53.8	53.8	53.8
	No	55	46.2	46.2	100.0
	Total	119	100.0	100.0	

Have you ever heard the term "smart city"? * Clusters Crosstabulation

			Clusters					Total
			1	2	3	4	5	
Have you ever heard the term "smart city"?	Yes	Count	10	2	19	18	15	64
		% within Have you ever heard the term "smart city"?	15.6%	3.1%	29.7%	28.1%	23.4%	100.0%
		% within Clusters	66.7%	16.7%	65.5%	47.4%	60.0%	53.8%
		% of Total	8.4%	1.7%	16.0%	15.1%	12.6%	53.8%
	No	Count	5	10	10	20	10	55
		% within Have you ever heard the term "smart city"?	9.1%	18.2%	18.2%	36.4%	18.2%	100.0%
		% within Clusters	33.3%	83.3%	34.5%	52.6%	40.0%	46.2%
		% of Total	4.2%	8.4%	8.4%	16.8%	8.4%	46.2%
Total		Count	15	12	29	38	25	119
		% within Have you ever heard the term "smart city"?	12.6%	10.1%	24.4%	31.9%	21.0%	100.0%
		% within Clusters	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	12.6%	10.1%	24.4%	31.9%	21.0%	100.0%

Have you ever heard the term "smart city"? * In my opinion a "smart city" is: Crosstabulation

			In my opinion a "smart city" is:				Total
			A city, which uses technology to make every day life easier.	A city, which is aware of its status and can adapt to changing conditions.	All of the above.	None of the above.	
Have you ever heard the term "smart city"?	Yes	Count	44	9	10	1	64
		% within Have you ever heard the term "smart city"?	68.8%	14.1%	15.6%	1.6%	100.0%
		% within In my opinion a "smart city" is:	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	68.8%	14.1%	15.6%	1.6%	100.0%

Have you ever heard the term "smart city"? * I would imagine a "smart city" to be: Crosstabulation

		I would imagine a "smart city" to be:				
		A city, which uses technology to make every day life easier.	A city, which is aware of its status and can adapt to changing conditions.	A city, which has a highly innovative industry.	All of the above.	Total
Have you ever heard the term "smart city"? No	Count	36	6	2	11	55
	% within Have you ever heard the term "smart city"?	65.5%	10.9%	3.6%	20.0%	100.0%
	% within I would imagine a "smart city" to be:	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	65.5%	10.9%	3.6%	20.0%	100.0%

RQ2: How is the concept of a smart city perceived?

H2: The concept's appealingness is equally perceived among groups

According to the previous description, do you find the concept of a "Smart City" appealing?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all appealing	1	.8	.8	.8
	Not very appealing	4	3.4	3.4	4.2
	Neither appealing nor unappealing	9	7.6	7.6	11.8
	Somewhat appealing	64	53.8	53.8	65.5
	Extremely appealing	41	34.5	34.5	100.0
	Total	119	100.0	100.0	

ANOVA

According to the previous description, do you find the concept of a "Smart City" appealing?

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.145	4	1.286	2.217	.072
Within Groups	66.150	114	.580		
Total	71.294	118			

Could you imagine living in a "Smart City"?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	108	90.8	90.8	90.8
	No	11	9.2	9.2	100.0
	Total	119	100.0	100.0	

SCAppealing * Could you imagine living in a "Smart City"? Crosstabulation

			Could you imagine living in a "Smart City"?		
			Yes	No	Total
SCAppealing	1.00	Count	100	5	105
		% within SCAppealing	95.2%	4.8%	100.0%
		% within Could you imagine living in a "Smart City"?	100.0%	100.0%	100.0%
		% of Total	95.2%	4.8%	100.0%
Total		Count	100	5	105
		% within SCAppealing	95.2%	4.8%	100.0%
		% within Could you imagine living in a "Smart City"?	100.0%	100.0%	100.0%
		% of Total	95.2%	4.8%	100.0%

H3: Clusters value different benefits and identify different obstacles

Please rate the following benefits of a "Smart City" according to their attractiveness:-

Saving Time (Optimized acting)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	2.5	2.5	2.5
	Neither Agree nor Disagree	10	8.4	8.4	10.9
	Agree	61	51.3	51.3	62.2
	Strongly Agree	45	37.8	37.8	100.0
	Total	119	100.0	100.0	

Please rate the following benefits of a "Smart City" according to their attractiveness:-Saving Money (Efficient use of resources)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	4	3.4	3.4	3.4
	Neither Agree nor Disagree	17	14.3	14.3	17.6
	Agree	51	42.9	42.9	60.5
	Strongly Agree	47	39.5	39.5	100.0
	Total	119	100.0	100.0	

Please rate the following benefits of a "Smart City" according to their attractiveness:-Environmental awareness (Pollution monitoring)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	1.7	1.7	1.7
	Neither Agree nor Disagree	13	10.9	10.9	12.6
	Agree	51	42.9	42.9	55.5
	Strongly Agree	53	44.5	44.5	100.0
	Total	119	100.0	100.0	

Correlations

		Please rate the following benefits of a "Smart City" according to their attractiveness:-Saving Time (Optimized acting)	Please rate the following benefits of a "Smart City" according to their attractiveness:-Saving Money (Efficient use of resources)	Please rate the following benefits of a "Smart City" according to their attractiveness:-Environmental awareness (Pollution monitoring)
Please rate the following benefits of a "Smart City" according to their attractiveness:-Saving Time (Optimized acting)	Pearson Correlation	1	.410**	.329**
	Sig. (2-tailed)		.000	.000
	N	119	119	119
Please rate the following benefits of a "Smart City" according to their attractiveness:-Saving Money (Efficient use of resources)	Pearson Correlation	.410**	1	.438**
	Sig. (2-tailed)	.000		.000
	N	119	119	119

Please rate the following benefits of a "Smart City" according to their attractiveness:-Environmental awareness (Pollution monitoring)	Pearson Correlation	.329**	.438**	1
	Sig. (2-tailed)	.000	.000	
	N	119	119	119

**. Correlation is significant at the 0.01 level (2-tailed).

ANOVA

Please rate the following benefits of a "Smart City" according to their attractiveness:-Saving Time (Optimized acting)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.806	4	.701	1.400	.239
Within Groups	57.127	114	.501		
Total	59.933	118			

Please rate the following obstacles of a "Smart City" according to their importance:-Political (decision-making)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	23	19.3	19.5	19.5
	Neither Agree nor Disagree	34	28.6	28.8	48.3
	Agree	38	31.9	32.2	80.5
	Strongly Agree	23	19.3	19.5	100.0
	Total	118	99.2	100.0	
Missing	System	1	.8		
Total		119	100.0		

Please rate the following obstacles of a "Smart City" according to their importance:-Technical (interoperability)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	4	3.4	3.4	3.4
	Disagree	15	12.6	12.7	16.1
	Neither Agree nor Disagree	32	26.9	27.1	43.2
	Agree	54	45.4	45.8	89.0
	Strongly Agree	13	10.9	11.0	100.0
	Total	118	99.2	100.0	
Missing	System	1	.8		
Total		119	100.0		

Please rate the following obstacles of a "Smart City" according to their importance:-Privacy (data collection)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	2.5	2.5	2.5
	Disagree	7	5.9	5.9	8.5
	Neither Agree nor Disagree	21	17.6	17.8	26.3
	Agree	45	37.8	38.1	64.4
	Strongly Agree	42	35.3	35.6	100.0
	Total	118	99.2	100.0	
Missing	System	1	.8		
Total		119	100.0		

Correlations

		Please rate the following obstacles of a "Smart City" according to their importance:-Political (decision-making)	Please rate the following obstacles of a "Smart City" according to their importance:-Technical (interoperability)	Please rate the following obstacles of a "Smart City" according to their importance:-Privacy (data collection)
Please rate the following obstacles of a "Smart City" according to their	Pearson Correlation	1	-.117	.151
	Sig. (1-tailed)		.104	.052

importance:-Political (decision-making)	N	118	118	118
Please rate the following obstacles of a "Smart City" according to their importance:-Technical (interoperability)	Pearson Correlation	-.117	1	.211*
	Sig. (1-tailed)	.104		.011
	N	118	118	118
Please rate the following obstacles of a "Smart City" according to their importance:-Privacy (data collection)	Pearson Correlation	.151	.211*	1
	Sig. (1-tailed)	.052	.011	
	N	118	118	118

*. Correlation is significant at the 0.05 level (1-tailed).

ANOVA

Please rate the following obstacles of a "Smart City" according to their importance:-Privacy (data collection)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.223	4	1.306	1.309	.271
Within Groups	112.744	113	.998		
Total	117.966	117			

H4: The willingness to support the Government varies between clusters

In order for the government to invest in information and communication technology (sensors etc.)...

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	64	53.8	53.8	53.8
	No	55	46.2	46.2	100.0
	Total	119	100.0	100.0	

ANOVA

In order for the government to invest in information and communication technology (sensors etc.)...

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.171	4	.543	2.257	.067
Within Groups	27.409	114	.240		
Total	29.580	118			

In order for the government to invest in information and communication technology (sensors etc.)... * Clusters Crosstabulation

			Clusters					
			1	2	3	4	5	Total
In order for the government to invest in information and communication technology (sensors etc.)...	Yes	Count	9	6	9	24	16	64
		% within In order for the government to invest in information and communication technology (sensors etc.)...	14.1%	9.4%	14.1%	37.5%	25.0%	100.0%
		% within Clusters	60.0%	50.0%	31.0%	63.2%	64.0%	53.8%
		% of Total	7.6%	5.0%	7.6%	20.2%	13.4%	53.8%
	No	Count	6	6	20	14	9	55
		% within In order for the government to invest in information and communication technology (sensors etc.)...	10.9%	10.9%	36.4%	25.5%	16.4%	100.0%
		% within Clusters	40.0%	50.0%	69.0%	36.8%	36.0%	46.2%
		% of Total	5.0%	5.0%	16.8%	11.8%	7.6%	46.2%
Total		Count	15	12	29	38	25	119
		% within In order for the government to invest in information and communication technology (sensors etc.)...	12.6%	10.1%	24.4%	31.9%	21.0%	100.0%
		% within Clusters	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	12.6%	10.1%	24.4%	31.9%	21.0%	100.0%

RQ3: How is the citizens' willingness to participate in a smart city?

H5: People who would invest some of their time would also be willing to participate

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Would you be willing to participate in such scenarios?-Scenario I (Urban Planning)	Between Groups	7.893	1	7.893	7.327	.008
	Within Groups	126.040	117	1.077		
	Total	133.933	118			
Would you be willing to participate in such scenarios?-Scenario II (Report with App)	Between Groups	7.882	1	7.882	9.912	.002
	Within Groups	93.042	117	.795		
	Total	100.924	118			

Would you be willing to participate in such scenarios?-Scenario III (App/Service Development)	Between Groups	15.901	1	15.901	21.469	.000
	Within Groups	86.654	117	.741		
	Total	102.555	118			

H6: Different participation scenarios are favoured by different groups

Would you be willing to participate in such scenarios?-Scenario I (Urban Planning)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	2.5	2.5	2.5
	Disagree	17	14.3	14.3	16.8
	Neither Agree nor Disagree	16	13.4	13.4	30.3
	Agree	53	44.5	44.5	74.8
	Strongly Agree	30	25.2	25.2	100.0
	Total	119	100.0	100.0	

Would you be willing to participate in such scenarios?-Scenario II (Report with App)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	10	8.4	8.4	8.4
	Neither Agree nor Disagree	19	16.0	16.0	24.4
	Agree	48	40.3	40.3	64.7
	Strongly Agree	42	35.3	35.3	100.0
	Total	119	100.0	100.0	

Would you be willing to participate in such scenarios?-Scenario III (App/Service Development)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	1.7	1.7	1.7
	Disagree	10	8.4	8.4	10.1
	Neither Agree nor Disagree	23	19.3	19.3	29.4
	Agree	58	48.7	48.7	78.2
	Strongly Agree	26	21.8	21.8	100.0
	Total	119	100.0	100.0	

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Would you be willing to participate in such scenarios?-Scenario I (Urban Planning)	Between Groups	2.217	4	.554	.480	.751
	Within Groups	131.716	114	1.155		
	Total	133.933	118			
Would you be willing to participate in such scenarios?-Scenario II (Report with App)	Between Groups	5.209	4	1.302	1.551	.192
	Within Groups	95.715	114	.840		
	Total	100.924	118			
Would you be willing to participate in such scenarios?-Scenario III (App/Service Development)	Between Groups	1.037	4	.259	.291	.883
	Within Groups	101.517	114	.891		
	Total	102.555	118			

H7: Clusters perceive skills and time needed for participating in a different way

According to your skill level, you would be able to participate in those programs?-Scenario I (Urban Planning)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	95	79.8	79.8	79.8
	No	24	20.2	20.2	100.0
	Total	119	100.0	100.0	

According to your skill level, you would be able to participate in those programs?-Scenario II (Report with App)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	100	84.0	84.0	84.0
	No	19	16.0	16.0	100.0
	Total	119	100.0	100.0	

According to your skill level, you would be able to participate in those programs?-Scenario III (App/Service Development)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	57	47.9	47.9	47.9
	No	62	52.1	52.1	100.0
	Total	119	100.0	100.0	

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
According to your skill level, you would be able to participate in those programs?-Scenario I (Urban Planning)	Between Groups	.636	4	.159	.978	.423
	Within Groups	18.524	114	.162		
	Total	19.160	118			
According to your skill level, you would be able to participate in those programs?-Scenario II (Report with App)	Between Groups	.425	4	.106	.779	.541
	Within Groups	15.541	114	.136		
	Total	15.966	118			
According to your skill level, you would be able to participate in those programs?-Scenario III (App/Service Development)	Between Groups	.957	4	.239	.949	.439
	Within Groups	28.741	114	.252		
	Total	29.697	118			

Would the time needed for the participation process present a barrier for you to participate?-Scenario I (Urban Planning)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	4	3.4	3.4	3.4
	Disagree	36	30.3	30.3	33.6
	Neither Agree nor Disagree	29	24.4	24.4	58.0
	Agree	43	36.1	36.1	94.1
	Strongly Agree	7	5.9	5.9	100.0
	Total	119	100.0	100.0	

Would the time needed for the participation process present a barrier for you to participate?-Scenario II (Report with App)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	17	14.3	14.3	14.3
	Disagree	41	34.5	34.5	48.7
	Neither Agree nor Disagree	33	27.7	27.7	76.5
	Agree	22	18.5	18.5	95.0
	Strongly Agree	6	5.0	5.0	100.0
	Total	119	100.0	100.0	

Would the time needed for the participation process present a barrier for you to participate?-Scenario III (App/Service Development)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	5	4.2	4.2	4.2
	Disagree	25	21.0	21.0	25.2
	Neither Agree nor Disagree	41	34.5	34.5	59.7
	Agree	37	31.1	31.1	90.8
	Strongly Agree	11	9.2	9.2	100.0
	Total	119	100.0	100.0	

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Would the time needed for the participation process present a barrier for you to participate?-Scenario I (Urban Planning)	Between Groups	.870	4	.217	.205	.935
	Within Groups	120.710	114	1.059		
	Total	121.580	118			
Would the time needed for the participation process present a barrier for you to participate?-Scenario II (Report with App)	Between Groups	3.896	4	.974	.811	.521
	Within Groups	136.978	114	1.202		
	Total	140.874	118			
Would the time needed for the participation process present a barrier for you to participate?-Scenario III (App/Service Development)	Between Groups	1.155	4	.289	.274	.894
	Within Groups	120.005	114	1.053		
	Total	121.160	118			

Correlations

		Would the time needed for the participation process present a barrier for you to participate?-Scenario I (Urban Planning)	Would the time needed for the participation process present a barrier for you to participate?-Scenario II (Report with App)	Would the time needed for the participation process present a barrier for you to participate?-Scenario III (App/Service Development)
Would the time needed for the participation process present a barrier for you to participate?-Scenario I (Urban Planning)	Pearson Correlation	1	.302**	.267**
	Sig. (1-tailed)		.000	.002
	N	119	119	119

Would the time needed for the participation process present a barrier for you to participate?- Scenario II (Report with App)	Pearson Correlation	.302**	1	.354**
	Sig. (1-tailed)	.000		.000
	N	119	119	119
Would the time needed for the participation process present a barrier for you to participate?- Scenario III (App/Service Development)	Pearson Correlation	.267**	.354**	1
	Sig. (1-tailed)	.002	.000	
	N	119	119	119

**. Correlation is significant at the 0.01 level (1-tailed).

H8: The importance of the participation being valued applies to all groups

In general: Is it important for you to see, concerning the outcome of a participation process, th...

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	109	91.6	91.6	91.6
	No	10	8.4	8.4	100.0
	Total	119	100.0	100.0	

ANOVA

In general: Is it important for you to see, concerning the outcome of a participation process, th...

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.163	4	.041	.516	.724
Within Groups	8.997	114	.079		
Total	9.160	118			

8. REFERENCES

acatech - Deutsche Akademie der Technikwissenschaften, 2013. Smart Cities - Deutsche Hochtechnologie für die Stadt der Zukunft. *acatech bezieht Position*, (10), pp.1–22.

Albert, M., 2007. Digitization and Political Accountability in the Netherlands and the USA: Convergence or Reproduction of Differences? In *Proceedings of the European Conference on e-Government, ECEG*. pp. 309–319.

Atzori, L., Iera, A. & Morabito, G., 2010. The Internet of Things: A survey. *Computer Networks*, 54(15), pp.2787–2805.

Balakrishna, C., 2012. Enabling Technologies for Smart City Services and Applications. *6th International Conference on Next Generation Mobile Applications, Services, and Technologies, NGMAST 2012*, pp.223–227.

Ballon, P. & Van Heesvelde, E., 2011. ICT Platforms and Regulatory Concerns in Europe. *Telecommunications Policy*, 35(8), pp.702–714.

Bélissent, J., 2010. Getting Clever About Smart Cities: New Opportunities Require New Business Models. *Forrester Research, inc*, p.33. Available at: http://groups.open.org.nz/groups/ninja-talk/files/f/19710-2010-11-04T092134Z/getting_clever_about_smart_cities_new_opportunities.pdf.

Bellavista, P. et al., 2013. Convergence of MANET and WSN in IoT Urban Scenarios. *Sensors Journal, IEEE*, 13(10), pp.3558–3567.

Berst, J., 2014. Realizing the Potential of Smart Cities. *Electric Perspectives*, pp.50–52. Available at: http://arxiv.org/abs/hep-ph/9707493.

Bovaird, T., 2007. Beyond Engagement and Participation: User and Community Coproduction of Public Services. *Public Administration Review*, 67(5), pp.846–860.

Bowles, R. & Douglas, S., 2012. Sustainable Intelligent Systems. *Intel Technology Journal*, 16(3).

Bruner II, G.C., 2013. *Marketing Scales Handbook* 7th ed., GCBII Productions, LLC.

Burns, R.P. & Burns, R., 2009. *Business Research Methods and Statistics Using SPSS*, SAGE Publications Ltd.

Bush, G.W., 2002. About E-Gov - Presidential Statement. Available at: http://georgewbush-whitehouse.archives.gov/omb/egov/g-3-statement.html.

Caragliu, A., Del Bo, C. & Nijkamp, P., 2011. Smart Cities in Europe. *Journal of Urban Technology*, 18, pp.65–82.

Cuff, D., Hansen, M. & Kang, J., 2008. Urban sensing: out of the woods. *Communications of the ACM*, 51(3), pp.24–33. Available at: http://cacm.acm.org/magazines/2008/3.

Das, G. & Kaushik, M., 2013. A Tale of 100 Smart Cities. *Business Today*, pp.30–51.

Doran, M.-A., 2012. Des villes intelligentes: pourquoi et comment? *Journée de l'Informatique du Québec*, pp.1–39.

Doran, M.-A. & Daniel, S., 2014. Geomatics and Smart City: A transversal contribution to the Smart City development. *Information Polity: The International Journal of Government & Democracy in the Information Age*, 19, pp.57–72.

European Commission, 2010. *Advancing and applying Living Lab methodologies*,

European Union, 2013. *Opinion 06 / 2013 on open data and public sector information (' PSI ') reuse*,

Evans, D., 2011. The Internet of Things - How the Next Evolution of the Internet is Changing Everything. *CISCO white paper*, (April), pp.1–11. Available at: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:The+Internet+of+Things+-+How+the+Next+Evolution+of+the+Internet+is+Changing+Everything#0.

Foray, D., 2004. *The Economics of Knowledge*, MIT Press.

Foth, M., Bilandzic, M. & Satchell, C., 2011. Collective and Network Sociality in an Urban Village. In *MindTrek*. pp. 179–183.

Gauld, R., 2006. E-government: What Is It, and Will It Transform Government. *Policy Quartely*, 2(2), pp.37–43. Available at: http://ips.ac.nz/publications/files/b6f350ba06c.pdf.

Giffinger, R. et al., 2007. *Smart cities Ranking of European medium-sized cities*, Available at: http://linkinghub.elsevier.com/retrieve/pii/S026427519800050X.

Global Urban Datafest, 2015. A Smart Cities Hackathon 20-22 February 2015 - Barcelona, Spain. Available at: http://www.global.datafest.net/cities/barcelona-spain [Accessed August 8, 2015].

Van der Graaf, S., 2014. Smarten Up! Open Data, Toolkits and Participation in the Social City. *Digiworld Economic Journal*, 96(4), pp.35–52.

Hielkema, H. & Hongisto, P., 2013. Developing the Helsinki Smart City: The Role of Competitions for Open Data Applications. *Journal of the Knowledge Economy*, 4(2), pp.190–204.

Horelli, L., 2013. *New Approaches to Urban Planning*,

Hui, G., 2014. How the Internet of Things Changes Business Models. *Harvard Business Review*, pp.1–5. Available at: https://hbr.org/2014/07/how-the-internet-of-things-changes-business-models.

Humphreys, J., 2012. How The Internet Of Things Will Change Almost Everything. *Forbes*, pp.1–2. Available at: http://www.forbes.com/sites/ciocentral/2012/12/17/how-the-internet-of-things-will-change-almost-everything/ [Accessed May 7, 2015].

IBM, 2011. Kaiser-Meyer-Olkin measure for identity correlation matrix. , p.1. Available at: http://www-01.ibm.com/support/docview.wss?uid=swg21479963.

Intel Corporation, 2005. *Moore's Law*, Available at: http://download.intel.com/museum/Moores_Law/Printed_Materials/Moores_Law_2pg.pdf.

Kourtit, K., Nijkamp, P. & Arribas, D., 2012. Smart cities in perspective - a comparative European study by means of self-organizing maps. *Innovation: The European Journal of Social Science Research*, 25(2), pp.229–246.

Langton, S., 1978. What is Citizen Participation? *Citizen Participation in America*, pp.13–24.

Lazaroiu, G.C. & Roscia, M., 2012. Definition methodology for the smart cities model. *Energy*, 47(1), pp.326–332.

Lee, J.H., Hancock, M.G. & Hu, M.C., 2014. Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco. *Technological Forecasting and Social Change*, 89, pp.80–99. Available at: http://dx.doi.org/10.1016/j.techfore.2013.08.033.

Lee, J.H., Phaal, R. & Lee, S.H., 2013. An integrated service-device-technology roadmap for smart city development. *Technological Forecasting and Social Change*, 80(2), pp.286–306. Available at: http://dx.doi.org/10.1016/j.techfore.2012.09.020.

Ben Letaifa, S., 2015. How to strategize smart cities: Revealing the SMART model. *Journal of Business Research*. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0148296315000387.

Malone, T.W., Laubacher, R. & Dellarocas, C., 2009. Harnessing Crowds : Mapping the Genome of Collective Intelligence. *Elements*, 1, pp.1–20.

Manchester City Council, 2010. *Smart Cities Need Smart Citizens*,

Mell, P. & Grance, T., 2011. The NIST Definition of Cloud Computing Recommendations of the National Institute of Standards and Technology. *Nist Special Publication*, 145, p.7. Available at: http://www.mendeley.com/research/the-nist-definition-about-cloud-computing/.

Menychtas, A. et al., 2011. *D2.3B Online Service Delivery Baseline and Technical Requirements Report (post-review version)*,

Mooi, E. & Sarstedt, M., 2011. *A Concise Guide to Market Research*, Available at: http://www.springerlink.com/index/10.1007/978-3-642-12541-6.

Nam, T. & Pardo, T.A., 2011. Smart City as Urban Innovation: Focusing on Management, Policy, and Context. *Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance*, pp.185–194. Available at: http://dl.acm.org/citation.cfm?id=2072100\nhttp://ctg.albany.edu/publications/journals/icegov_2011_smartcity/icegov_2011_smartcity.pdf.

NEC, 2014. *Safety through Synergy - With Inter-Agency Collaboration.pdf*,

OECD, 2010. *OECD E-government Project: Towards Smarter and more Transparent Government*, Available at: http://www.oecd.org/gov/public-innovation/44934153.pdf.

Oksman, V., Väätänen, A. & Ylikauppila, M., 2014. *Co-creation of Sustainable Smart Cities: Users, Participation and Service Design*,

Oszlak, O., 2013. Open Govemment. *PA TIMES*, 36(1), pp.28–30.

Policy Department A: Economic and Scientific Policy, 2014. *Mapping Smart Cities in the EU*,

Porter, M.E. & Heppelmann, J.E., 2014. How Smart, Connected Products Are Transforming Competition. *Harvard Business Review*, (November), pp.65–88.

Rabari, C. & Storper, M., 2013. *The Digital Skin of Cities*,

Ratti, C. & Townsend, A., 2011. The social nexus. *Scientific American*, 305(3), pp.42–46, 48.

Schaffers, H. et al., 2011. Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation. *Lecture Notes in Computer Science*, 6656, pp.431–446.

Schaffers, H.., Ratti, C.. & Komninos, N.., 2012. Special issue on smart applications for smart cities - new approaches to innovation: Guest editors' introduction. *Journal of Theoretical and Applied Electronic Commerce Research*, 7(3), pp.II–V. Available at: http://www.scopus.com/inward/record.url?eid=2-s2.0-84872832626&partnerID=40&md5=6eaedf16bd2069b46ed1d74d20a78208.

Schön, S., 2012. *Datenschutz und Datensicherheit im Cloud Computing*,

SeeClickFix, 2015. Modern Request Management for Local Government. Available at: http://gov.seeclickfix.com [Accessed August 8, 2015].

Smart Cities Committee, 2015. *FTTH Smart Guide*,

Sofronijevic, A., Milicevic, V. & Ilic, B., 2014. Smart City as Framework for Creating Competitive Advantages in International Business Management. *Management - Journal for theory and practice of management*, 19(71), pp.5–16. Available at: http://www.management.fon.rs/index.php?option=com_content&view=article&id=243:smart-city-as-framework-for-creating-competitive-advantages-in-international-business-management&catid=39&lang=en.

Steen, M., Manschot, M. & de Koning, N., 2011. Benefits of Co-Design in Service Design Projects. *International Journal of Design*, 5(2), pp.53–60.

Taylor, N., 1998. *Urban Planning Theory since 1945*, Available at: http://books.google.com/books?hl=en&lr=&id=uIE3yXbrBu0C&oi=fnd&pg=PR4&dq=Urban+Planning+Theory+since+1945&ots=KGdX2jh1sz&sig=vvq5WJ-YH8tJIjzMls1k-T3Fs_s.

University of the West of England, 2014. ICT ENABLED PARTICIPATORY URBAN PLANNING AND POLICY DEVELOPMENT : THE URBANAPI PROJECT. *Transforming Government: People, Process and Policy*, 8(2), pp.205–229.

Veeckman, C. & van der Graaf, S., 2014. *The City as Living Laboratory: A Playground for the Innovative Development of Smart City Applications*,

Violino, B., 2014. SMART CITIES get SMARTER. *Computerworld*, 48(8), pp.24–31. Available at: http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=95882147&site=ehost-live.

William O. Bearden, Netemeyer, R.G. & Mobley, M.F., 1993. *Handbook of Marketing Scales: Multi-Item Measures for Marketing and Consumer Behavior Research*,

Yang, K. & Pandey, S.K., 2011. Further Dissecting the Black Box of Citizen Participation: When Does Citizen Involvement Lead to Good Outcomes? *Public Administration Review*, 71(6), pp.880–892.

Zanella, A. et al., 2014. Internet of Things for Smart Cities. *IEEE Internet of Things Journal*, 1(1), pp.22–32. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=6740844.

Zehnder, C.A., 2010. *Informatik – die Entwicklung einer jungen Wissenschaft seit ihrer "Geburt,"*

Zwahr, T. & Finger, M., 2011. *Critical steps towards e-Governance : a case study analysis*,