TALLINN UNIVERSITY OF TECHNOLOGY
School of Business and Governance
Ragnar Nurkse Department of Innovation and Governance

Jörgen Martin

EXPLORING SMART CITY GOVERNANCE FACTORS: COMPARISON OF VIENNA, AMSTERDAM AND HELSINKI

Master's thesis

Supervisor: Dr. Piret Tõnurist

Tallinn 2019

I hereby declare that I have compiled the paper independently
and all works, important standpoints and data by other authors
have been properly referenced and the same paper
has not been previously been presented for grading.
The document length is 12 144 words from the introduction to the end of summary.

Jörgen Martin ……
Date: .....

Student code: 152788HAGM
Student e-mail address: jrgn.martin@gmail.com

Supervisor: Piret Tõnurist, PhD:
The paper conforms to requirements in force

…….....
Date: .....

Chairman of the Defence Committee:
Permitted to the defence

…….....
Date: .....

ABSTRACT

The aim of the thesis is to gain a better understanding of the governance factors that influence city`s success in becoming smart and having successful smart city projects. The main focus of the paper lies on the empirical research to better understand the city administration`s impact on the smart city ecosystem – specifically, how the city creates the former. For that, the thesis asks the following question: which factors are essential in different smart city governance models for effective smart city solutions? Deriving from the analysis of Vienna Smart City, Amsterdam Smart City and Helsinki Smart City, the thesis identifies the most emphasised innovation dimensions in different governance models and finds that the factors essential for effective smart city solutions differ from each other and depend on the approach the governments take. The data is gathered from academic articles published in scientific journals, academic reports, government reports and strategies and non-scientific articles published on online sources.

Keywords: smart city; governance factors; governance models; Vienna; Amsterdam; Helsinki

TABLE OF CONTENTS

INTRODUCTION

During its peak between 1200 and 1400 AD, the Italian city republic Siena attracted Europe's best scholars, thinkers, business elite and aristocrats. In the Siena City Hall (The Palazzo Pubblico), one can find a room referred to as the „Hall of Good Government," decorated by one of Siena`s greatest painters Magister Ambrogio Lorenzetti. In this dominating fresco around the room it emphasizes us the happy life of the city of Siena where people are well-fed, houses pleasantly ordered and new buildings arise, there are cafes and bars and people have enough money to purchase what they wish. (Drechsler 2001).

Nearly 700 years later we, by and large, still desire the same things, that our (city) government be good and smart, the businesses flourish, houses and infrastructure be constantly renewed and most of all, the people in the city would feel happy. However, governments are facing more and more complex issues and challenges on how to offer the services on a quality that the citizens need and assume. As the technology is revolutionising in a rapid speed it is creating new economic, social and environmental challenges to public sector. It is crucial for the public sector to catch up with the trends, apply new innovations and technological solutions to city governance in order to implement policy measures that respond to the socio-economic needs. For the past decade, there has been an ongoing debate and experimentation on how to turn cities smarter. Quoting Van den Bergh and Viaene (2016): "smart cities are currently the talk of the town in local governmental institutions and associations of cities."

Today, more than half of the global population lives in cities or suburban areas and by year 2050 it is expected that 66 percent of the world population will be living in city areas ("World`s population increasingly," 2014). This obviously creates enormous challenges and demands a new way of governing and managing the services and city ecosystem. Implementing smart solutions to city systems can be a way here to tackle these arising challenges. However, as said, this demands a new way of governing as traditional procedures such as „low bid" process[1] does not usually work

[1] A procurement where the winner of the public contract is chosen in a price-based decision process.

for smart city projects. Yet, it remains unclear how to best implement and lead smart city projects and specifically what should be the government`s role in that.

While there are many conceptual differences in defining a smart city, in general, it is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses (European Commission homepage 2016). This is the way the European Commission (EC) has defined the smart city and the concept actually goes beyond that entailing, for example, a more interactive and responsive city administration, safer public spaces, data monitoring, upgraded water supply etc. (*Ibid.*).

According to Giffinger *et al.* (2007) there are six characteristics of smart city: (smart) economy, people, governance, mobility, environment and living. As new initiatives and projects are developed, different actors need to work together and new ways of collaboration are created (Nijman 2014). Nijman (*Ibid.*) states that it is the interconnectedness of different characteristics, initiatives and projects, including actors and technologies involved what makes a city smart. The same is also brought out by Batty *et al.* (2012): cities can only be smart if the intelligence functions are integrated and synthesise the data for the purpose of improving quality of life in the city.

As there are conceptual differences in defining a smart city, there have also been different approaches to the design of its governance models and overall government involvement in smart city projects. For example, in 2014 the City of Madrid announced its cooperation with IBM for environmental services management project which would help to improve the delivery and efficiency of city services and provide citizens new tools to interact and communicate with the city council. Through this public private partnership, the city government is taking a leading role in a smart city approach where it offers the necessary infrastructure, management and control systems and integrates the actions and data while the information flow and data itself is produced by citizens, cameras and smart sensors. (IBM homepage 2014; Bouskela *et al.* 2016). On the contrary to Madrid, the City of Pittsburgh has rather taken a hands-off approach where Google Inc. is providing its funding to Carnegie Mellon University to turn its campus and the surrounding city into a living lab and test new technology of IoT (Internet of Things) (Pittsburgh Business Times 2015). A different example can be found in the City of Eindhoven, which in 2016 introduced 15-year smart city project called “Roadmap Urban Lighting Eindhoven 2030” where the city takes the role of “lead-user” through which the city is made available for innovations developed by others (den Ouden and Valkenburg 2012).

Therefore, smart city projects can be initiated and governed in a variety of ways. For example, projects can be governed by organizations that comprise networks such as Google Inc. and Carnegie Mellon University in the City of Pittsburgh (self-governance model) or by networks in which local governments act as highly centralized lead organizations and as such, manage the development of the smart city such as the City of Eindhoven (bureaucratic model) (Bolivar 2015).

According to EC (2016), there are three key types of governance models to smart cities solutions:

1. Strong cross-departmental smart city governance;
2. Sectoral leadership with strong supportive smart city coordination mechanisms;
3. Open governance model (platform model).

Nonetheless, little research has been done which examines more specifically the role governments take in implementing smart city systems. When different factors need to work together in creating a smart city, it leaves us with the question already raised by Bolivar (2015) – what are the drivers for governance models in smart cities? Why are some cities more successful in developing new initiatives while others fail?

This is crucial to understand as smart cities rely on the approach where local governments do not act in isolation, but in collaboration with the stakeholders and therefore, governments would have to adopt new rules of engagement within the community and transform their models accordingly (Van den Bergh and Viane 2016). According to Hafedh *et al.* (2012) the success of smart city initiatives depends largely on managerial factors, but only a few studies in the academic literature address issues related to managerial and organizational factors. In addition, strategies to execute and manage smart city projects vary among cities (Michelucci *et al.* 2016).

Consequently, this research aims to gain a better understanding of the governance factors from a city administration`s point of view that influence city`s success in becoming smart and having successful smart city projects. The main focus of this paper lies on the empirical research to better understand the city administration`s impact on the smart city ecosystem – specifically, how the city creates the former. The thesis hereby addresses the theoretical gap of why certain governance models in smart cities are selected and why they are effective in context (and not in others). The thesis uses Nam and Pardo's (2011) extended framework of smart city governance and management for analysis, but as an added value specifically looks at factors related to the success of smart initiatives. The framework is applied to analyse empirical findings and experiences of selected smart cities in order to identify the important drivers for managing a smart city, initiating

successful projects and understanding the approaches governments can take. This leads to the following research question:

Which factors are essential in different smart city governance models for effective smart city solutions?

This thesis contributes to the smart city research by creating an understanding around how smart city ecosystems act and what is the specific role of city government in the former. Therefore, the results are useful for any actor or stakeholder involved in smart city projects and initiatives. In particular, as this thesis focuses on the governance factors from city administration`s point of view, it is relevant to all civil servants involved with the development of the smart city concept.

The thesis begins by reviewing academic research done on smart city governance and management by outlining relevant frameworks and studies and identifying the gaps in literature from a governance perspective. After presenting the theoretical framework, methodology of the work is explained. An exploratory case study design was chosen because the aim of the current research is not to give final and conclusive solutions, but rather to help us better understand the (governance) factors that are related to the success of smart city initiatives. As every city has their own strategy to execute and manage smart city projects, an exploratory research here is an effective way to lay the groundwork on smart city governance factors that can hopefully lead to future studies on that subject.

Next, empirical research objects, City of Vienna, City of Amsterdam and City of Helsinki are described in more detail. These cases were selected because they exemplify diverging smart city governance models and especially the role of government involvement in smart city projects. Based on analysis of selected smart city governance structures, the important governance factors from the city administration`s point of view are examined, which are later discussed and commented on in the discussion section. Finally, conclusions are drawn, recommendations of conducted research given and limitations of the study stated.

1. THEORETICAL FRAMEWORK

1.1. Defining Smart City

Although the term „smart city“ itself is not new anymore, there is no clear definition on how to define smart city. The main reason for this is because every city that considers itself smart is being defined by different goals, inputs and challenges the city faces. As Hayat (2016) states, the term „smart city“ is therefore ambiguous in a sense that the precise content, feature and nature of smart cities varies from country to country, depending upon geographical condition, ecosystems, resources available and challenges faced. In the context of this paper, for more narrow definition, European Commission`s definiton will be used where smart city is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses (European Commission homepage 2016).

According to Cocchia (2014) there are two main aspects why it is difficult to give one certain definition on “smart city” term. To begin, the adjective “smart” depends on the meaning we give to this word, therefore “smart city” can also refer to intelligent city, digital city, wired city etc. Secondly, the label “smart city” is not always used accordingly as there are many cities that refer to themselves as a smart city, but actually only some characteristics can be identified as smart. (*Ibid.*). Hence, the term “smart city” can also, for example, be identified as: “intelligent city” where cities are territories with high capability for learning and innovation (Komninos 2006); „information city“ where digital environments are collecting official and unofficial information from local communities and delivering it to the public via web portals (Anthopoulus et al 2010); „knowledge city“ that aims at a knowledge-based development, by encouraging the continuous creation, sharing, evaluation, renewal and update of knowledge (Ergazakis *et al.* 2004).

Hollands (2008) in his article “Will the real smart city please stand up?” focused on unwrapping the smart city label in academic literature as he drew attention to four main key elements which stood out. First, the utilization of network infrastructures to improve economic and political efficiency and enable social, cultural and urban development. Secondly, emphasis on business-led

urban development where it is seen that cities are being increasingly shaped by big businesses and corporations. Thirdly, the importance of humanist view (social learning, education and social capital) in developing smart city. Finally, Hollands emphasized social and environmental sustainability referring to "green" implications of urban growth and development. It should be noted however, that although there are different characteristics of each city, the recurring element is the holistic nature of smart city initiatives which are technology infused or driven and can tackle the issues related to mobility, economy, energy, environment, e-government etc. (Van den Bergh and Viane 2016).

Zubizaretta *et al.* (2015) emphasize that in this sense for the city to be smart it needs to center its values around communication and active involvement and participation of various communities. It is vital to understand the relationships and phenomena that take place in the city and without active role of citizens, real smart cities cannot exist (*Ibid.*). The same is also brought out by Hollands (2008) that even when a city involves range of things standard to be labeled as smart such as information technology, business innovation, (smart) governance and communities and sustainability, we must take into account consensus and balance in the relationship between these factors.

All these characteristics are also reflected in other definitions what have been given in academic literature: Giffinger *et al.* (2007) define smart city as a city well performing built on the „smart" combination of endowments and activities of self-decisive, independent and aware citizens; Caragliu *et al.* (2011) state that a city is smart when investments in human and social capital and traditional (transport) and modern (ICT) infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance; Dameri (2013) views smart city as a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects; Batty *et al.* (2012) say that a city can only be smart if there are intelligence functions that are able to integrate and synthesise data to some purpose, ways of improving the efficiency, equity, sustainability and quality of life in the city.

1.2. Success Factors of Smart City Concept

As briefly noted in the previous chapter, in order to rate the success of smart city, we need to look smart cities from a holistic point of view. Anttiroiko *et al.* (2013) mark here that an integrative and holistic approach is most important in order for smart initiatives to become a reality. Although the smart city strategies should aim at affecting change in the city life and existence (UN 2015) and foremost create smart solutions to make inidividual services better, the success of smart city lies in creating a service platform to integrate governance with services (Anttiroiko *et al.* 2013). Dodgson and Gann (2011) make an important note here to the value in understanding cities holistically: when technological systems are overlaid by the organizational and political systems and with their conflicts and lengthy processes, the tensions between sunk investments in old technologies and new demands, in all its complexity it blocks the innovation happening. However, seeing cities holistically, with new data and understanding, it can help make decisions that drive innovation.

To explain more in detail, technology and digital infrastructure used for the city should be able to sustain and provide open access to secure public data. As citizens are placed in the core of the smart city's performance and operation, it should enable them to access and use the information whenever they need it (UN 2015). However, to use and access the data to create succesful smart projects, the city government must first support this kind of decision-making to enable service providers to use the full range of data – principles such as connectivity, sharing of data, back office operations, service delivery systems, operation of the city governance and sharing management information should be advocated (*Ibid.*).

Chourabi *et al.* (2012) in their paper „Understanding Smart Cities: An Integrative Framework" present a framework on internal and external factors that affect design, implementation and use of smart cities initiatives. They listed eight fields that have an strong impact on smart cities envision and design initiatives. These are: management and organization; technology; governance; policy; people and communities; economy; infrastructure; natural environment. The authors argue that at different times and in different contexts some elements are more influential than others as they divide previously listed factors into two categories – outer and inner factors. The outer factors (governance, people and communities) are rather more influenced ones and the inner factors (technology, management and policy) more influential ones. Therefore, in case of technology, it can be considered as a meta-factor in smart city initiatives as many smart city initiatives depend

largely on using technology and so, technology consequently also influences all ohter success factors. (Chourabi *et al.* 2012).

Lombardi *et al.* (2012) in their attempt to model the smart city performance present a framework based on a triple helix model in which they proposed another unifying factor to the model. The triple helix model often used to analyse knowledge-based innovation systems links together three main agencies in the process of knowledge creation and capitalization: universities, industry and government. Lombardi *et al.* (2012) propose here civil society as the fourth helice. Altogether, the interplay between four helicies (universities, industry, government and civil society) and main dimensions of a smart city (smart economy, smart mobility, smart environment, smart people, smart living and smart governance), determines the success of a city in becoming smart and developing smart initiatives (*Ibid.*).

Kogan (2014) compared in her master`s degree thesis „Exploratory research on success factors and challenges of Smart City projects“ 13 smart cities to map success factors that will influence the outcome of a smart city project. According to her conducted research, the most important variable that determines the success of a Smart City project is the level of citizen engagement while governace, infrastructure and ICT come as two other major factors. Kogan adds that the level of ICT development can be seen here only as an enabler to make design, production and delivery of services more efficient, therefore empowering citizens for greater involvement in everyday life (*Ibid.*).

In addition, according to Angelidou (2014), one of the factors that influences the success of a smart city and is a major differentiating characteristic, is the level the strategies are implemented on. For example, are strategies focused on a more local level or rather on a city or regional level. Angelidou (*Ibid*.) notes here that the focus on a more local level has clear advantages as innovation and knowledge has geographical locus and their advancement is therefore more effective in making cities smart. However, it is important to pay attention to that although low-level policies can provide better understanding of city`s challenges and offer more specific smart city solutions and services to citizens, regional planning can have a stronger and more positive impact on harmonizing and coordinating top-level with low-level policies (Walters 2011 referenced in Angelidou 2014). Therefore, the city must consider the balance between the political and moral decision-making in developing smart city. To produce morally balanced and socially aware smart city strategies, it is vital to engage stakeholders as they can offer better insights to the needs of the

city, increase public acceptance and leverage human capital and collective intelligence (Angelidou 2014).

To conclude this chapter, there are four kinds of changes that have to be affected by smart city strategy that are core to succesful outcome of smart city and its projects (UN 2015). First, there has to be a clear and adequate technological change as ICT is the enabler of smart services. Secondly, industrial change as smart city has to implement new ways of bringing together networks of technology developers and standardize smart applications. Thirdly, social change to create change in behaviour, values, demands, end-users etc. Lastly, there has to be a change in city government`s policies to integrate governance with services. This change in policies can include for example adjusting regulations, economic instruments, governance and agreements. And as the aim of the (smart) city should be to provide more efficient, safer and happier life for its citizens, it is vital that the outcomes and performance of the city can be tracked through transparent processes. (UN 2015).

1.3. City Government`s Role and Approach to Developing Smart Initiatives

Johnston and Hansen (2011) have defined governance as the interaction of processes, information, rules, structures, and norms that guide behavior toward stated objectives that impact collections of people. These objectives include more efficient allocation of resources, coordination of different participants (citizens, stakeholders, public bodies etc), establishment of clear processes and the resolution of conflicts (*Ibid.*). So, what does smart city governance look like? Due to plurality of approaches, it is important to emphasize that, as of yet, there is no central perspective on the role of government. The governance models are contextual, practice-led and dynamic in nature: every city is taking its own approach in the development of smart city and initiates smart projects accordingly with their unique strategies.

Moreover, what Coletta *et al.* (2017) claim in their case study about „Smart Dublin“ is that the creation of a smart city can also be articulated, i.e already existing initiatives are converged into coordinated, strategic and branded narrative of a smart city, the development of a smart city, therefore, remaining always somewhat accidental. For example, as was the case with Dublin: every local authority developed their own smart solutions and initiatives focusing on the delivery of services within their areas, not having city-wide governance body that would coordinate the operations taken. In addition, city officials did not really consider themselves to be smart until

2015 when local authorities took the decision to create a smart city unit that would form a new vision for „Smart Dublin“. (Coletta *et al.* 2017). Thus, by its nature, the smart city is an interdisciplinary concept with a broad range of interpretations and depends largely on the viewpoint of who uses it (Soe 2018).

Nevertheless, there are several authors that have called for more systemic approach towards smart city governance. Anthopoulos (2017; 216) has identified four different approaches on city`s role in developing smart initiatives. First, the city government can be the „owner“ of the smart city and therefore, lead the smart projects (in this case, usually a municipality or a state-owned-enterprise plans and manages the smart city). In the second approach the city partners with several stakeholders, so, coalition is formed to initiate projects and manage the smart city. City government can also be in a manager role only, to standardize and supervise projects that are implemented by several stakeholders. In an approach like this, the city is responsible for the overall smart city monitoring and performance, while the stakeholders act as individual project owners. The fourth opportunity for the city is to assign the development of the smart city completely to a private developer. This is mainly a case only in developing entire new districts or city from scratch, where one vendor implements and manages the smart city project. (Anthopoulos 2017; 216).

Meijer and Bolivar (2015) have also put forward a more layered approach to smart city governance: government of a smart city; smart decision-making; smart administration and smart urban collaboration. In this conceptualization, government, as the first category, is given the role of making the right policy choices and implementing these in an effective and efficient manner. Smart governance can also lie in the approvement of strategies or in promotion of smart initiatives. Smart decision-making emphasizes the need to restructure decision-making as more information becomes available for different parties involved in smart projects and there is need to involve different actors and the public. Therefore, governments need to take a new approach to decision-making processes and to implementation of these decisions. The third level is about creating smart administration to interconnect and integrate information, processes, institutions and physical infrastructure. Hence, from the government level it demands changing government organizations internally and deal with the new requirements of differentiated policies. This principle is also closely linked with smart urban collaboration which is about establishing strategic cooperations between the various actors in the city (Meijer and Bolivar 2015). Meijer and Bolivar (*Ibid.*) highlight this conceptualization at the highest level of transformation since it also involves the transformation of external organizations. A crucial point here to note is that for organizational

changes, top-management support and commitment is essential to succeed in innovation, establishing strategies, identifying and encouraging leaders and developing the right set of goals (Nam and Pardo 2011). In this sense, considering basic good governance practices, governance of smart cities does not really differ from other cities (UN 2015).

At city level the practice shows that some cities are following suit and consolidating agendas. For instance, in Brussels an „umbrella" brand Digital.brussels was established in February 2017 to consolidate and coordinate various digital plans in the city (Brussels Smart City 2017). In order to oversee smart city actions and various political initiatives, respective Coordination Committee was formed which will meet twice a year with the aim of drawing up a plan of actions with budgets to specify the projects and collaborations that are being considered. Moreover, the Smart City Manager position was created to put forward concrete proposals and prepare the smart city policy in practice. (Brussels Smart City 2017). Another example to be drawn here is Hamburg where several smart initiatives were already previously established such as smartPORT, smartROAD, Smart Home, Capital of Knowledge etc. but in 2016 Digital City Strategy was initiated by the Senate of Hamburg to bundle the processes in these diverse areas, coordinate them, harness synergies and also to monitor the ongoing processes (Hamburg SmartCity 2015).

Yet, again due to the bottom up development and richness of local context, different models of governance in cities have emerged. Some authros, e.g. Anttiroiko (2012), Van den Begh and Viaene (2016), Dameri and Benevolo (2016), Johnson (2008) describe these through the following factors: promoting collective interests, connected governance, techno-orientation, empowerment and collaboration, platform governance, creativity.

According to Anttiroiko (2012) this new perspective and change of governing a city which involves actors from various social, business and ICT areas, emphasises the purpose of promoting collective interests and building up connected governance where public agencies share and integrate information using common standards. On the other hand, the growing involvement of corporate firms and their role in envisioning, planning and executing smart cities, often leads to lobbying the government and rather achieving the corporate-driven smart city vision than the overall objective of city-level efficiency (Kummitha 2018). Anttiroiko (2012) further notes that this redesign in collaboration has given rise to a new methodologically and technologically oriented idea of platform governance, where government shares power among different inter-dependent actors to solve complex problems that often cross organisational boundaries e.g financial, security and environmental issues. This can be seen in the peer-to-peer trends emerging

in urban context worldwide. To conclude, as business and development processes must be co-constructed, governance will have to balance control with empowerment and teamwork and collaboration will have to take more open forms (Van den Bergh and Viane 2016).

Dameri and Benevolo (2016) stress that until now smart cities have been developed as bottom-up projects, bringing together public bodies, enterprises, citizens and non-profit organizations, but in order to build a long-term smart strategy capable of producing returns, governments need to build up a comprehensive smart city framework. It must be noted here that governance also requires different mechanisms, instruments and processes to be in place such as laws, rules, territorial policies, subsidiaries, citizen participation etc. that will enable the city to build up platform governance and finally involve network of actors in community leadership (*Ibid.*).

According to Johnson (2008), even when all economically important institutional and technological changes are initiated and developed in the city, it does not mean the city is also creative. What Johnson means here with being creative is that in order for the city to be innovative there has to be, what he says: „ …a combination of specific factors at specific times for urban innovation to be strong," (Johnson 2008, 148). Often cities fail to match technological changes with institutional arrangements and supply side factors with demand side factors thus slowing economic growth of the city and hampering its innovation (Johnson 2008).

In sum, the practice and the model point to these important factors as part of the government's role: leadership, strong core values, multi-stakeholder partnerships with industry, academia and residents, support to research and development, constant evaluation of smart city processes (UN 2015).

The first crucial factor is leadership – as there are always high risks of failure when implementing new technologies and changing policy, the leaders should strongly support the concept of technology and transformation to smart city (UN 2015). This is important as executive support facilitates citywide and organizational commitment to the initiatives (Alawadhi *et al.* 2012), but also empowers and builds trust among citizens (UN 2015).

Secondly, importance of core values such as ethics and good governance, is highlighted. These include integrity, professionalism, respect for diversity, accountability, creativity, citizen orientation, commitment to ongoing development and technological awareness. (*Ibid.*).

Thirdly, building up multi-stakeholder partnerships with industry, academia and residents as smart city development depends highly on participation and co-production. Moreover, this is important in order to tackle issues that are cross-organizational and require citizen involvement such as urban development, information exchange, crowdsourcing of smart applications, designing and implementing new initiatives and addressing environmental problems. (UN 2015). Alawadhi *et al.* (2012) distinguish here two approaches to organizational forms that lead smart city initiatives. In the first type one particular public body takes the lead to initiate projects and links together all related internal and external organizations and stakeholders. Another type is identified as collaborative structure where no particular agency has strong authority in decision-making and project management. (*Ibid.*).

In addition to listed factors, it is vital that governments support research and development and seek more innovative ways to make city smarter. Besides, cities should also monitor and implement evaluation processes to continuously assess the progress of the smart city development (UN 2015).

On the whole, the literature is not very extensive in looking at the role of government or governance in general in the emerging literature. Nevertheless, drawing here on Johnson`s (2008) explanation, successful innovation in cities requires packages of policies. Although ICT is the enabler of smart solutions, the problems are not necessarily resolved by technical innovations alone. According to Johnson (*Ibid.*), often both the problem and the solution are more institutional than technical.

1.3.1. Framework of Smart City Innovation

Several different approaches and governance factors have been previously brought out in defining smart city governance. Moreover, it is emphasized in several cases above that smart city needs to be considered holistically where ICT is not used merely for new technologically-oriented initiatives, but also for turning governments and governance more efficient and transparent. Therefore, to innovate city`s services, change needs to happen as well in government layers. This ICT-triggered change in the government can happen through four layers proposed by Gong & Jannsen (referenced in Soe 2018): organisational, structural, managerial and procedural.

Janowski (2015) claims that this kind of government digitization can be achieved through four complex phases what he calls a Digital Goverrnment Evolution Model: Digitization (technology in government), Transformation (electronic government), Engagement (electronic governance)

and Contextualization (policy-driven electronic governance). In the context of smart city we also have to consider the characteristics of the phases as the creation of smart city depends largely on the aims the government sets: a) whether the digitization will transform the internal working structures of government, or it just adds to current processes; b) whether the technology is used just as an internal tool for government or it as well affects the relationship with citizens, businesses and other stakeholders; and c) whether the transformation depends on a particular context (e.g of a country, location or sector) or is context-independent (Janowski 2015). Janowski elaborates that as government organizations are under pressure from different sets of social, economic, political, ecological and other factors in the phase of evolution, they are at insistence to adopt the latest technologies as a response (*Ibid.*). However, he makes an important point here that while such innovations provide just short-term response to existing pressures, they can become a prevailing practice within government organizations and part of a bigger institutionalization process that will also lead to government innovation. Equally, as part of turning cities smart or governments digital, the innovations initiated need to be applied, reapplied and improved constantly over time for them to finally be mainstreamed. (*Ibid.*).

Table 1 presents us the multidimensional framework of smart city innovation with an emphasis on technology, organization, policy and context dimensions to understand how the city shapes the technological, organizational and policy aspects of that city and to define city government`s managerial factors related to the success of smart city initiatives (Nam and Pardo 2011). However, as pointed out in the theoretical framework by other several researcheres (Hollands 2008; Zubizaretta *et al.* 2015; Giffinger *et al.* 2007; Anttiroiko *et al.* 2013; UN 2015; Chourabi *et al.* 2012; Lombardi *et al.* 2012; Kogan 2014), one of the most important variables that determiners the successful outcome of the smart city project, is citizen engagement. Therefore, to consider the framework of smart city innovation holistically, Table 1 presented by Nam and Pardo is completed by „Citizen Engagement“ dimension.

According to Nam and Pardo (2011), smart city innovation is comprised of technology, management and policy innovations as the table presented places equal value to the importance of technology, organization, policy and context dimensions. Where Nam and Pardo (*Ibid.*) consider „level of interactions“ as innovation under the „context“, the completed table puts separate emphasise on citizen interaction and/or engagement as smart city innovation calls for more systemic approach towards smart city governance.

To make a city smart, technologies should be readily integrated across systems and organizations (Nam and Pardo 2011), but that also on citizen engagement level, meaning that integrated technologies should add to the value of turning cities holistically smart and engaging all social levels. This is cruical, because as Dodgson and Gann (2011) state, when technological systems are overlaid by the organizational and political systems and with their conflicts and lenghty processes, it blocks the innovation happening.

Janowski (2015) has pointed out that in the context of smart city we also have to consider the characteristics of the phases as the creation of smart city depends largely on the aims the government sets. In addition, as mentioned previously, governance models are often contextual and practice-led and therefore, every city takes its own approach in the development of smart city and initiates the smart projects accordingly. Presented framework gives the ability to look at the smart initiatives started and to apply this framework to identify the approach and the role the governments of the selected subjects take in implementing smart initiatives and therefore, recognize the drivers to better understand which governance factors are essential in different governance models of smart city. The framework proposed, will be therefore used to analyse the subjects of this thesis.

Table 1. The Framework of Smart City Innovation. Completed with „Citizen Engagement" dimension

Dimension	Innovation	Risk	Way to Success
Technology (to serve as a tool for innovation)	▪ Leveraging transformational potentials of advanced ICTs	▪ Lack of knowledge ▪ Incompatibility ▪ Too much hope ▪ Security	▪ System interoperability ▪ Integration of systems and infrastructures
Organization (to manage innovation)	▪ Enhancing efficient, effective management (front-office and back-office) ▪ Improving interoperability within or across organizational boundaries	▪ Organizational conflict ▪ Resistance to change ▪ Misalignment between goals and projects	▪ Enterprise interoperability and business modeling ▪ Cross-organizational management and managerial interoperability ▪ Leadership
Policy (to create an enabling environment)	▪ Redesigning relationships between government and actors ▪ Policy experiment	▪ Inconsideration of multiple stakeholders ▪ Political pressure ▪ Conflict with other policies	▪ Policy integration ▪ Marketing ▪ Governance ▪ Collaboration ▪ Partnership
Context	▪ Physical dimension ▪ Environment ▪ Level of interactions	-	▪ Consideration of context
Citizen Engagement	▪ Promoting collective interests ▪ Engaging on all social levels	▪ Tensions between organizational and political processes ▪ Lengthy processes	▪ Use and access of public data ▪ Transparent processes

Source: Nam and Pardo (2011, 187); „Citizen Engagement" factors referenced in Anttiroiko 2012; Nam and Pardo 2011; Dodgson and Gann 2011; UN 2015.

The framework presented in the context of smart city innovation to analyze the role governments take in implementing smart initiatives is useful because, as explained by Nam and Pardo (2011) and previously by Janowski (2015), technological innovation depends largely on effective management and on the other hand, technological innovation also requires organizational and policy innovation. Additionaly, as more information becomes available for different parties involved in smart projects, there is a need to involve different actors and the public (Meijer and Bolivar 2015) and therefore to analyze the role governments take in engaging public and its citizens.

The framework is defined through five dimensions:

1) Technology innovation as a mechanism to upgrade technological tools to improve services and create conditions where the tools can be better used;

2) Organization innovation as a mechanism to create managerial and organizational capabilities;

3) Policy innovation as a mechanism to address institutional issues and create conditions enabling for a smart city;

4) Unique context as characteristics of the city – how each city shapes its technological, organizational and policy aspects. (Nam and Pardo 2011);

5) Citizen engagement as smart decision-making to involve different actors and public (Meijer and Bolivar 2015).

2. METHODOLOGY

For this thesis, exploratory case study is used as a research method. This case study design was chosen as the aim of the current research is not to give final and conclusive answers, but rather to help us better understand the (governance) factors that are related to the success of smart city initiatives. In a study where little research has been done before, as is the case of this thesis when examining the role governments take in implementing smart city systems, exploratory case study design is often applied (Streb 2012). Exploratory case study design is as a preliminary step of an overall causal exploring of a relatively new field in which the research questions have not been clearly identified and the data required for a hypothetical formulation has not yet been obtained (*Ibid.*). As a preliminary step, this paper aims to improve the groundwork on smart city governance factors that will hopefully lead to future studies on that subject.

This thesis focuses on three European cities: Vienna in Austria, Amsterdam in the Netherlands and Helsinki in Finland. Although these cities are selected as research cases, the units of observation in this paper are smart city initiatives deployed and related governance factors. These cities were selected considering the following criteria:

- The city has a proven record of successful smart city projects.
- There is a smart city strategy in place.[2]
- The selected cases have to represent different governance models proposed by the European Commission (2016).
- There is enough data available to conduct the study.

The aim of this research is to gain a better understanding of the governance factors from a city administration`s point of view that influence city`s success in becoming smart and having successful smart city projects. Consequently, to have diverse perspective on the governance factors in exploratory cases, different cities mentioned under different EC smart city classifications were

[2] It is certainly possible that smart cities are governed without smart city strategies being in place. However, this makes data collection very difficult for the purpose of this study. Nevertheless, this aspect should be recognised as a limiting factor in selecting the cases.

chosen. The selected cities will be compared based on the framework of smart city innovation (Table 1).

Streb (2012) makes the case that since the aim of exploratory case study is the exploration of the unknown, it benefits most from cases that make the characteristic investigation field issues easily apparent. Theoretical framework is thus based on a synthesis of existing research on the smart city, (city) governance and innovation management. Empirical data in the thesis derives from qualitative analysis (document analysis). The data was gathered through academic articles published in scientific journals, academic reports, government reports and strategies, non-scientific articles published on online sources. Consequently, the thesis has a major limitation: it looks at self-preceived and reported governance factors, but does not analyse the governance factors in practice. This is also the reason why to look at more established smart cities with existing strategies, because they have had time for feedback to understand which factors are influential in their context.

The empirical part of the research presented in this paper begins with collecting data from selected smart city strategies and looking into what has been done in real life cases. Taking into account theoretical framework of the available literature, the characteristics of smart city governance were translated into five dimensions based on the Smart City Innovation framework propsed by Nam and Pardo (2011) and completed with “Citizen Engagement” dimension as smart city innovation calls for more systemic approach towards smart city governance.

3. CITY AS A FORMER

3.1. Smart City Wien

The first smart city strategy studied was Smart City Wien, which defines the development of a city by assigning and interlinking the priorities of energy, mobility, buildings and infrastructure (City of Vienna 2016). Three main ambitions have stated in the framework: radical resource preservation to reduce CO2 emissions; development and productive use of innovation and new technologies; high and socially balanced quality of life (*Ibid.*). Therefore, the strategy lays out purposes for the city in the long run (framework`s time horizon extends to 2050) and gives stakeholders and all participants additional assistance and an ambition to thrive for. The fundamental development of the city lies in the holistic approach, which includes mechanisms of action and coordination in politics and administration as well as a wider scope of action to citizens (*Ibid.*).

City of Vienna is the capital of Austria with a population of about 1.8 million inhabitants, making it also the biggest city in Austria (Wikipedia 2018a). Internationally, Vienna is known for its high quality of life and acknowledged as a city with strong cultural heritage and business environment (*Ibid.*). For example, according to The Global Liveability Index 2018, The Economist Intelligence Unit (2018) named Vienna as the most liveable city in the world. Also, one of the four headquarters of the United Nations and the OPEC Secretariat are located in Vienna (Wikipedia 2018a). Since 2001, the city centre was designated an UNESCO World Heritage Site and in July 2017 it was moved to the list of World Heritage in Danger (*Ibid.*).

The Smart City Wien Initiative was launched in 2011 while the development of the strategy begun in 2013. The Initiative states its key goal for 2050: „ ...to offer optimum quality of life, combined with highest possible resource preservation, for all citizens.“ (City of Vienna 2016). Therefore, the strategy directs itself at all target groups of the city: citizens, enterprises, non-profit institutions, the public sector, and in addition, states the aim to position itself also as a responsible and innovative metropolis in Europe (*Ibid.*). It must be emphasised here the integrated approach the initiative aims, where modern technologies are not seen as universal solutions for all urban challenges, but much rather, the focus is on people and their everyday lives (Smart City Wien

2017). This means, technical solutions are to provide support and make a contribution, but they are no substitute for detailed consideration and integration of social aspects, potentials and innovations. Taken this into consideration, the key factor for governing all initiatives in the framework, is social inclusion. (*Ibid.*).

This way, the strategy describes the key goals and principal approaches and lays out guidelines for other specialised strategies of the city to further define concrete plans in named areas. Here the framework strategy poses a twofold challenge: "…how can the goals be gradually rendered more and more ambitious despite the demanding practical and financial frame conditions? And, secondly: how can policy and change processes be designed in an even more cross-cutting, multi-sectoral manner?" (City of Vienna 2016).

The Smart City Wien approach has two primary levels of implementation, where it on the one hand concerns the political level and on the other hand the operative level. In addition to cooperation within administration, such as with Vienna Public Utilities and Vienna University of Technology in the context of a curriculum, this also means tighter cooperation processes with the Federal Provinces of Lower Austria and Burgenland, for example regarding mobility and regional development issues. Also, to follow the aim of resource preservation and CO2 reduction, Vienna advocates the frame conditions of the Federal Republic and the EU as this can not be achieved without corresponding strategies. But, as emphasised in the framework, the most essential task of the strategy does lie in the additional assistance it can provide for other specialised strategies underway in Vienna. (*Ibid.*).

Vienna is characterised by a strong administration and high social responsibility (*Ibid*). The political strategy of Vienna is to keep under its control the infrastructure required to deliver basic services as many public systems and utilities are covered by enterprises and companies of the City of Vienna, for example Vienna Fund for Housing Construction and Urban Renewal, Vienna Water, the hospital sector and Vienna Public Utilities. Moreover, Vienna has put in place several awareness-creating measures under private law to stimulate awareness among the public, e.g. the use of renewable energy sources in buildings, car pools or pilot projects to demonstrate the positive attitude of the city towards new developments and innovations. (City of Vienna 2016). Moreover, an analysis of the implementation of Vienna Smart City strategy by Fernandez-Anez *et al.* (2018) found that the public sector unquestionably takes the central role in the strategy. Public companies, municipal government departments and national companies make up the biggest stakeholder group in the Vienna Smart City ecosystem (*Ibid.*).

Smart City Wien framework further elaborates steps needed to be taken to implement the initiative and develop a supportive organisational model for interdepartmental strategy. Five main actions have been brought out to support this:

1. Coordination and cooperation, establishment of lighthouse projects;
2. Strengthening the participation possibilities of citizens and experts;
3. Human resource development, training and recruitment;
4. Information and brand management for Smart City Wien;
5. Alliances, lobbying and consultation processes. (City of Vienna 2016).

To conclude, Smart City Wien was identified by the EC as with strong cross-departmental smart city governance (European Commission 2016). The Smart City Wien Initiative has taken a holistic approach, where the city targets itself to all groups of the city, this includes citizens, enterprises, stakeholders, public sector etc. The strategy is positioned as an additional assistance and guide for the other specialised strategies of the city. However, this also means developing a strong supportive organisational model, both on the political and operative level. (City of Vienna 2016).

3.2. Amsterdam Smart City

The City of Amsterdam has an ambition to be the largest smart city innovation platform by creating the ecosystem, connecting communities, sharing expertise and accelerating new projects (Amsterdam Smart City homepage 2014a). Amsterdam Smart City (ASC) is organised around six themes, (Digital City, Energy; Mobility; Circular City; Governance and Education; Citizens and Living) which aim to bring together different organizations and offer assistance to initiate new projects (*Ibid.*). The city aims to create new partnerships and new types of approaches to its citizens while the idea behind that is that only the most effective initiatives will be implemented on a large scale at the end of the test period (Amsterdam Smart City 2011).

Amsterdam is the capital of the Netherlands with a population of about 850 000 inhabitants, making it also the most populous city of the country. Amsterdam can be considered as one of the top financial centres in Europe as many leading technology companies have their European headquarters in Amsterdam such as Netflix, Cisco, Tesla and Uber, in addition several other world-known companies such as Nike, Adidas, IKEA and also big Dutch companies such as Philips, ING

and TomTom. (Wikipedia 2018b; AmsterdamTips homepage 2018). The city is also widely known for its historic and cultural sites and as one of the most multicultural cities (Wikipedia 2018b).

ASC was set up with the aim of showing how it is possible to reduce energy consumption now and save in the future. For that, ASC – partnership between the people, businesses, knowledge institutions and local authorities – was set up. The project was first initiated in June 2009 by the Amsterdam Innovation Motor and grid manager Liander in collaboration with the Amsterdam Municipality and research institute TNO. (Amsterdam Smart City 2011). In defining smart city, ASC emphasises its integrated and open approach, where it is not solely focused on technology, but creates a smart city through a collaborative ecosystem (Amsterdam Smart City homepage 2014b) where every actor has a bi-directional relationship with the organization as the exchange of information goes from one actor to another through the intermediary ASC platform (Putra and van der Knaap 2018). ASC describes itself through four main characteristics:

1. Focus on public-private collaboration within the community (municipalities, knowledge institutions, corporates, start-ups and citizens);
2. Central role for citizens, where solutions and choices made should fit their needs and wishes;
3. Encouraging openness and transparency, meaning open data and transparent goals and ambitions should be available and acknowledged to all parties and at the same time requiring the same from partners;
4. Putting effort to and defining problems within the public – private – people partnerhip sphere, not focusing only on solutions. (Amsterdam Smart City homepage 2014b).

ASC is organised around six themes, (Digital City, Energy; Mobility; Circular City; Governance and Education; Citizens and Living) and operates on four main pillars:

1. Cooperation at every possible level as long as it is aimed towards the end user.
2. Driven by smart technology and the need to bring behavioural change.
3. Knowledge exchange, where all the knowledge and experience must be shared with Amsterdam Smart City.
4. Only economically viable initiatives will be rolled out on a large scale. (Amsterdam Smart City 2011).

ASC acts here as a testbed or an accelerator of climate and energy programmes, which brings together partners and creates opportunities for smart initiatives to be tested. At the end of the test

period, the most effective initiatives will be chosen and implemented on a large scale. (Amsterdam Smart City 2011). One of the crucial factors to this kind of approach, is the political backing of the city and its association with major private partners to mobilise funds and initiate the implementation of projects (FMDV 2014). For example, the first phase of the project (2009-2011), with a budget of 4 million euros, was financed 20% by public funds from the municipality, 40% by the private partners and 40% by European funds (*Ibid.*).

Lastly, ASC is organised around its 11 public-private programme partners, which is lead by a supervising steering committee, with one director of each program partner (Amsterdam Smart City homepage 2014b). Depending on the smart city theme, different interested public and private parties are further involved in projects. This all is guided by the Chief Technology Office of the Municipality whos director also acts as a chairman of the ASC Steering Committee (*Ibid.*). However, a study by Putra and van der Knaap (2018) revealed that not all municipality departments are involved in the ASC innovation system and therefore, not all smart city projects directly linked with the agendas of the municipalities as Chief Technology Office can legitimate the smart city projects that have been succesfully tested.

3.3. Helsinki Smart City

In the City of Helsinki, a network of Living Labs under Forum Virium Helsinki has been providing test and experimentation environment to co-create (the municipality, private sector, other public sector organisations and Helsinki residents) innovative smart city services in the Helsinki Metropolitan Area (GSMA 2012). Its projects span to six key areas: smart city, wellbeing, new forms of media, innovative public procurement, innovation communities and growth services (Helsinki-Uusimaa Regional Council 2015).

Helsinki is the capital of Finland and the most populous municipality of the country with a population of nearly 650 000. The city is the country`s most important center for politics, education, finance, culture and research. (Wikipedia 2018c). Helsinki can also be considered as a city with very high standards of living, as it ranked 16th according to The Global Liveability Index 2018 (The Economist Intelligence Unit 2018). The Greater Helsinki metropolitan area (including the cities of Espoo, Vantaa and Kauniainen) generate approximately one third of Finland`s GDP and over 80 of the 100 largest Finnish companies have their heaquarters located in the Greater Helsinki area (Wikipedia 2018c).

The aim of the Helsinki Smart Region initiative is to double the regional impact of research and innovation and to be a forerunner in the use of innovative products and services. The focus areas in this initiative are urban cleantech, health and wellness, digitalising industry and citizen city. (Helsinki Smart homepage 2018). However, it is important to note here that the Helsinki Smart Region initiative is run by the Helsinki-Uusimaa Regional Council and in developing smart city initiatives, its programme „Research and Innovation Strategy for Smart Specialisation" functions here as a framework for the region to achieve its goals (Helsinki-Uusimaa Regional Council 2015). The goal of the Helsinki-Uusimaa Region's Smart Specialisation strategy is to promote sustainable growth via value creation of research and innovation activities and projects through the cooperation of different actors, stakeholdes, universities and municipalities (Helsinki-Uusimaa Regional Council 2015).

In order to achieve this, following actions have been presented:

1. To actively promote regional cooperation with the goal of creating breakthroughs on an international level.
2. Combine and utilize the know-how and expertise in the region as a common basis for innovation.
3. To bring together various actors on the cooperation platforms and in combining expertise, technology and key resources, to solve common challenges.
4. To increase the productiveness, predictability and use of long-term approaches in research and innovation activities
5. To improve networking.
6. Focusing on collaboration on thematic priorities that seek solutions for the everyday and business challenges of actors in the Helsinki-Uusimaa Region. (Helsinki-Uusimaa Regional Council 2015).

The whole process is guided by the Regional Cooperation Committee, which also initiates and organises necessary actions once the Board of Helsinki-Uusimaa Regional Council has confirmed the RIS3 strategy. The RIS3 strategy acts in accordance with the Europe 2020 strategy and therefore, also lies in the policies and financial instruments supporting them. (*Ibid.*).

Regardless, on a more regional level, it is essential to take into account the goals set by the RIS3 strategy and by the concrete smart actions initiated in the City of Helsinki. Here, Helsinki has focused on the use of mobile technology, engaging with citizens and opening up the data of public

sector to all interested parties (GSMA 2012). Already in 2005, the City of Helsinki and several ICT companies such as Elisa, Nokia, TeliaSonera, Tieto and YLE founded Forum Virium Helsinki to develop new digital services that are based on the real needs of the users in collaboration with private companies, the city, other public sector organisations and the residents of Helsinki. Its projects compass six key areas: smart city, wellbeing, new forms of media, innovative public procurement, innovation communities and growth services. Since 2007, a network of living labs has been providing test environments where different actors can collaborate to create smart city services in the Helsinki Metropolitan Area. (GSMA 2012).

For example, Forum Virium Helsinki lead the project to develop Software Development Kit (SDK) for the urban digital environment. Within the project, Helsinki has opened up its data systems and offered support for private developers interested in developing city services. The EU-funded CitySDK project, now evolved into the Connected Smart Cities Network, has enhanced collaboration in several European cities by opening up and harmonizing APIs (Application Program Interface). For instance, city services developed in Helsinki are also in use in Amsterdam and Rome. As of today, over 1000 data sets created with public funds have been given free, open access. (Forum Virium Helsinki n.d.).

In creating smart city services, end-users are seen as an valuable input to testing and developing new concepts and ideas. In the process, through the first stages of the development, input is drawn and collected from end-users and citizens to identify the needs, making them equal partners with public and private sectors and academia. Following, based on the input and data collected and analysed, private or public companies that develop products and services then collaborate with the municipalities and financiers to develop the final product. Finally, the steering committe appoints a working committee to set the operational direction of the project and design and test the services through trials during the last stages of the process. In addition, the strategy promotes the engagement of start-ups in smart city projects to support SMEs in developing international growth strategies, secure funding and promote their services. (GSMA 2012).

To conclude, Forum Virium Helsinki has two primary objectives: to identify and create better services and to open up new domestic and international markets for local companies. Its role varies from advisory services to full management of projects, defining strategy, initiating, coordinating and evaluating smart city projects throughout their life-cycle. In addition, by engaging users and providing support for start-ups and developers, it also helps to shape the smart city ecosystem. (GSMA 2012).

4. COMPARATIVE ANALYSIS OF SMART CITY GOVERNANCE FACTORS

Previous chapter took a closer look into what is the specific role of the city government in selected research objects in forming smart city and explained how smart city ecosystems act in these cities. But which of these factors are essential in different smart city governance models (strong cross-departmental smart city governance; sectoral leadership with strong supportive smart city co-ordination mechanisms; open governance model) for effective smart city solutions? In this chapter, Nam and Pardo`s extended framework of smart city governance and management (Table 1) will be applied to analyse empirical findings and experiences of selected cities in order to identify the important drivers for managing a smart city, initiating successful projects and understanding the approach governments can take in different governance models.

Even though all three previously named cities are widely acknowledged as smart, have gained popularity in economic world and are considered as the best places to live, their approach to smart city governance differs to some extent. The analysis by the European Commission (2016) of integrated Smart Cities and Communities solutions identified three emerging governance models:

1. Strong cross-departmental smart city governance;
2. Sectoral leadership with strong supportive smart city coordination mechanisms;
3. Open governance model (platform model).

Next, based on the description of research objects in the previous chapter, five main factors of smart city projects from the city government`s point of view are presented and compared in Table 2 – key goal; approach, role, implementation and target group.

Table 2. Comparison of main factors of smart city projects from the city government`s point of view

Factor	Wien	Amsterdam	Helsinki
Key goal	To offer optimum quality of life, combined with highest possible resource preservation, for all citizens.	To reduce energy consumption now and save in the futuure.	To be a forerunner in the use of innovative products and services.
Approach	Integrated, where technology is not an universal solution, but the focus is on people.	Integrated and open approach by creating collaborative ecosystem.	A network of living labs to provide test environments to create smart city services.
Role	As an additional assistance and guide for the other specialised strategies of the city.	As a testbed or an accelerator of climate and energy programmes with the political backing of the city.	Role varies from advisory services to full management of projects, defining strategy, initiating, coordinating and evaluating projects.
Implemen-tation	Cooperation within administration and tightening cooperation in processes.	Organised around 11 public-private programme partners who choose at the end of the test periood the most effective initiatives what will be implemented on a large scale.	Input to testing from end-users, private or public companies develop in collaboration with municipalities and financiers. Steering committe evaluates the project.
Target group	All target group of the city: citizens, enterprises, NPOs, public sector.	Citizens, businesses, knowledge institutions and local authorities.	Private companies, the city, other public sector and the residents.

Source: Analysis based on City of Vienna 2016; Smart City Wien 2017; Amsterdam Smart City 2011; GSMA 2012; Helsinki Smart homepage 2018; Amsterdam Smart City homepage 2014b.

As main factors have been described and compared, we are able to put this to Nam and Pardo`s framework (Table 1) and therefore, based on the researched objects, to analyse the factors that are essential in different smart city governance models for effective smart city solutions.

In the Smart City Wien strategy there is a clear emphasise on the additional assistance it aims to provide for other specialised strategies underway. In this sense, Vienna smart city acts as a group consisting of multiple agencies, where Smart City Wien strategy describes the key goals and principal approaches and lays out guidelines to other organizations involved. (City of Vienna

2016). So to manage organizational innovation, interoperability within and across organizational boundaries must be improved (Nam and Pardo 2011). This can be referred to as *whole-of-government* collaboration, where the (city) government defines the standards, infrastructure components, coordination mechanisms etc to facilitate the interaction between the government, services and partners (see additional resources referenced in Nam and Pardo 2011). However, the first monitoring of the Smart City Wien Initiative in 2017 showed that the actors are often unaware of the intended and actual inter-relationships between the objectives. As a result, the clear anchoring of tasks and responsibilities in implementing the strategy has not yet happened to a sufficient extent. (Smart City Wien: Monitoring Report 2017).

In addition, the strategy refers to several policy measures to link and coordinate policies across different actors e.g advocating the frame condition of Federal Republic and the EU, forming alliances and lobbying, brand management and creating measures under private law to stimulate awareness among the public. Thirdly, the Smart City Wien Initiative states that the focus is on people and their everyday lives and the key factor for governing all initiatives is social inclusion. (City of Vienna 2016). However, it is not explained more in detail on how will the citizens be included in forming smart city. In the initiative, social inclusion rather stands for solidarity, open society, mutual respect and acceptance (*Ibid.*).

Amsterdam Smart City is unique in a way it acts as a testbed or an accelerator to smart city initiatives, where projects go throw a funnel and in the end only the most effective initiatives will be chosen and implemented on a large scale (Amsterdam Smart City 2011). Therefore, there is clear emphasise on the policy dimension in redesigning relationships between government and actors and to some level experimenting with the policy, meaning that new ways of shaping and changing the city services is introduced (Nam and Pardo 2011). Secondly, Amsterdam Smart City framework states that central role has given to citizens, where solutions should at firsthand fit their needs and wishes and initiatives aimed towards the end user. (Amsterdam Smart City homepage 2014b; Amsterdam Smart City 2011). According to UN (2015), the way to succeed here, is to make public data accesable and usable to everyone and by establishing transparent processes, which has not, however, received too much attention at related smart city strategy. To conclude, much attention in public Amsterdam Smart City materials was payed to marketing and introducing the program in overall, while it was not brought out concrete steps e.g on how to support coordination mechanisms between actors or strengthening the participation.

In comparison, Helsinki Smart City on one hand is guided by the RIS3 strategy and on the other hand concrete smart projects are bought to action under guidance of Helsinki`s innovation unit Forum Virium. In order to create new smart services, Helsinki has opened up over 1000 data sets and given them free and open access. In addition, Helsinki has developed its own SDK for the urban digital environment. Therefore, the smart city innovation is led by the integration of systems and infrastructures and of use of public data. So, to put this to Nam and Pardo`s framework, there is clear priority to technology and citizen engagement dimension. In addition, there is some significance in the policy dimension as regional cooperation and collaboration in smart specialisation is improved and supported by the RIS3 strategy.

Table 3 summarizes the approaches governments take in different governance models according to Nam and Pardo`s (2011) extended framework of smart city governance and management. Table gives an overview of which dimensions are emphasised the most in different governance models – "3" standing for most emphasised, "2" for medium significance, "1" for some significance and "0" meaning that no particular input was discovered towards selected dimension.

Table 3. Importance of Smart City Innovation Dimensions in Different Governance Models

Dimension	**Vienna** (strong cross-departmental governance)	**Amsterdam** (sectoral leadership with strong supportive coordination mechanisms)	**Helsinki** (open governance model)
Technology (to serve as a tool for innovation)	0	0	3
Organization (to manage innovation)	3	0	0
Policy (to create an enabling environment)	2	3	1
Context (physical dimension, environment)	0	0	0
Citizen Engagement (promoting collective interests and engaging on all social levels)	1	1	2

Source: Author.

As an answer to the research question of this thesis, connecting the above analysed cases with dimensions, we are able to validate (self-preceived) the factors that are essential in different smart city governance models for effective smart city solutions and see, how in different governance models different dimensions are implemented. For this, Table 4 is presented. Thus, an important finding of this thesis relates to identifying, what are the levers through which governments can lead their smart city development.

Table 4. Essential factors for effective smart city solutions in different smart city governance models.

City	Essential factors for effective smart city solutions
Vienna (strong cross-departmental governance)	▪ Interoperability within and across organizational boundaries, implementation both on political and operative level. ▪ Cross-organizational management. ▪ Leadership in laying out guidelines and imposing frame conditions, including integrating policies. ▪ Social inclusion and creating policy measures to raise awareness of smart solutions / renewable energy sources.
Amsterdam (sectoral leadership with strong supportive coordination mechanisms)	▪ Leadership as being a strong partner and an example. ▪ Political backing of the city. ▪ Openness to policy experiment. ▪ Strong marketing to support the communication on all levels. ▪ Collaboration (especially financial) with private partners. ▪ Openness and transparency.
Helsinki (open governance model)	▪ Use and access of public data. ▪ Integration of systems and infrastructures. ▪ Steering and evaluating the projects and processes. ▪ Engaging all relevant actors – private companies, public sector, residents. ▪ Openness and transparency.

Source: Author.

As an added value, this thesis promised to look at factors related to the success of smart initiatives and aims to answer question, why some cities are more successful in developing new initiatives while others fail? All three research objects – Vienna, Amsterdam and Helsinki are acknowledged as successful (smart) cities, according to the CIM Index, ranking correspondingly 19th, 10th and 22nd (IESE 2018). Nijman (2014) states that it is the interconnectedness of different characteristics, initiatives and projects, including actors and technologies involved, what makes a city smart. Although, there is quite a different approach to developing a smart city, in all of these cases, there

is a similarity of pursuing smart projects holistically. Meaning, that regardless of the emphasise to specific dimensions, the issues tackled are dealt together with other departments, stakeholders and relevant parties. For example, Amsterdam Smart City engages private companies to fund initiatives, which firsthand must be aimed towards public solutions; Vienna has an extensive smart city framework to communicate and lead the ambitions together with other departments; Helsinki tackles its challenges as community projects, which are joined in by citizen activists and private companies.

As Anttiroiko *et al.* (2013) stated, the success of a smart city lies in creating a service platform to integrate governance with services. In this context, service platform does not necessarily have to refer to a technological platform or to a program interface, but rather stresses the importance of creating and having the framework with clear goals from the city government, on which all the involved parties can initiate smart projects. Such as the Smart City Wien framework, which acts as an umbrella strategy for a large number of other municipal programmes, which in turn are focused towards the main goals of the Smart City Wien initiative (Smart City Wien: Monitoring Report 2017). But not only, for example, the key lesson in Helsinki was that without the city council strategy and innovation platform, it is very hard to even start smart projects (R. Ritvos, personal communication, 31.05.2017). The same was also brought out by the CEO of Forum Virium Helsinki, Jarmo Eskelinen: “The city needs to be an enabler. The best way to enable is to open up processes, data and data systems as well as the city’s operating models,” (Forum Virium Helsinki n.d.). Therefore, as noted by Lombardi *et al.* (2012), the interplay between the organizations engaged and main dimensions of a city determine the success of a city in becoming smart and developing smart initiatives.

CONCLUSIONS

Smart City research has been a growing trend and more and more cities are implementing smart city strategies, but what are the right ways to govern a smart city? European Commission (2016) identified three emerging smart city governance models in their analysis of integrated smart cities and community solutions:

1. Strong cross-departmental smart city governance;
2. Sectoral leadership with strong supportive smart city coordination mechanisms;
3. Open governance model (platform model).

Nevertheless, governing smart city has often been contextual, practice-led and dynamic in nature, every city taking its own approach in the development and initiating projects accordingly with their unique strategies. This thesis aimed to gain a better understanding of the governance factors that influence city`s success in becoming smart and having successful smart city projects with a focus to administration`s impact on the smart city ecosystem – specifically, how the city creates the former.

> This led to the following research question: Which factors are essential in different smart city governance models for effective smart city solutions?

Thus, the thesis addressed the theoretical gap of why certain governance models in smart cities are selected and why they are effective in context (and not in others). Based on the analysis of different success factors connected to the implementation of smart cities, the extended framework of smart city innovations from Nam and Pardo (2011) was used to look at three different models of smart city governance.

Thus, the thesis focused on three European cities: Vienna in Austria, Amsterdam in the Netherlands and Helsinki in Finland, each city representing a different governance model. To answer the research question, smart city initiatives deployed and related governance factors were observed in selected cities and compared in the multidimensional framework of smart city innovation.

The thesis identified that in different governance models different innovation dimensions were emphasised, meaning that the levers through which governments lead their smart city development and the factors essential for effective smart city solutions differ from each other and depend on the approach the governments take. The thesis found that in Vienna (strong cross-departmental governance model), organization dimension is the most important while in Amsterdam (sectoral leadership with strong supportive coordination mechanisms), policy dimension was emphasised the most and in Helsinki (open governance model), technology dimension was the most extensive. As an added value, this thesis looked at the factors related to the success of smart initiatives and found that in all cases, the development of smart city was always considered and lead holistically and by engaging all other relevant parties. Given the central role of governments in developing smart city and the interconnectedness of different characteristics in smart city ecosystems, the findings of this thesis are important as they help to better understand: a) the essential factors for smart city development in different governance models; b) the levers through which different stakeholders are involved in the development; c) the role governments can take in smart city development; d) the implementation of „smartness“ in three successful smart cities.

However, the findings of this thesis are based only on studied objects and in the context of the topic do not allow for broad generalization about the factors that could be considered as absolutely necessary in different governance models for effective smart city solutions. Given the limited scope of this thesis, it remains unclear what is the specific role governments can and should take in implementing smart city systems and what are the drivers for effective governance models in smart cities. For more complete understanding of the studied topic, future research should involve more cities to evaluate and understand if there can be identified some central drivers in different governance models.

ABSTRACT IN ESTONIAN (EESTIKEELNE RESÜMEE)

Töö pealkiri: Targa linna valitsemise faktorite uuring: Viini, Amsterdami ja Helsingi võrdlus

Töö eesmärgiks on paremini mõista targa linna valitsemise faktoreid, mis mõjutavad linna edukust tarkade projektide elluviimisel. Töö peamine fookus on empiirilisel uurimusel, mõistmaks paremini linna administratsiooni mõju targa linna ökosüsteemile – eriti, kuidas linn targa linna süsteemi loob. Töö uurimisküsimuseks on: millised faktorid on olulised erinevates targa linna valitsemise mudelites, et edukalt targa linna lahendusi juhtida? Põhinedes Viini, Amsterdami ja Helsingi võrdlusele, tuvastab töö oluliseimad innovatsiooni-dimensioonid erinevates valitsemise mudelites. Uurimus leiab, et faktorid, mis on olulised tarkade projektide elluviimiseks, erinevad üksteisest sõltuvalt lähenemisest juhtimisele, mille valitsused võtavad. Andmed töös on kogutud akadeemilistest artiklitest avaldatud teaduslikes ajakirjades, akadeemilistes raportites, valitsuste raportites ja strateegiates ning mitte-teaduslikest artiklitest avaldatud Internetis.

Märksõnad: tark linn; valitsemise faktorid; valitsemise mudelid; Viin; Amsterdam; Helsingi

REFERENCES

Alawadhi, S. *et al.* (2012) „Building Understanding of Smart City Initiatives.“ In: Scholl H.J., Janssen M., Wimmer M.A., Moe C.E., Flak L.S. (eds) *Electronic Government*. EGOV 2012. Lecture Notes in Computer Science, vol 7443. Springer, Berlin, Heidelberg

Amsterdam Smart City homepage. (2014a). „About Amsterdam Smart City.“ Available: https://amsterdamsmartcity.com/p/about, 06.10.2018

Amsterdam Smart City homepage. (2014b). „Frequently Asked Questions.“ Available: https://amsterdamsmartcity.com/p/faq, 26.10.2018

Amsterdam Smart City. (2011). „Amsterdam Smart City.“ Available: https://issuu.com/amsterdamsmartcity/docs/smart_stories?layout=http%25253A%25252F%25252Fskin.issuu.com%25252Fv%25252Flight%25252Flayout.xml&showFlipBtn=true, 06.10.2018

AmsterdamTips homepage. (2018). „Multinational Companies in Netherlands.“ Available: http://www.amsterdamtips.com/tips/multinational-companies.php, 25.10.2018

Angelidou, M. (2014) „Smart city policies: A spatial approach.“ *Cities.* Vol. 41, pp 3-11

Anthopoulos, L. and Fitsilis, P. (2010). „From digital to ubiquitous cities: defining a common architecture for urban development.“ *IEEE 6th International conference on Intelligent Environments,* (pp. 301–306). IEEE Xplore.

Anthopoulos, L. G. (2017) „Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?“ Basel: Springer International Publishing

Anttiroiko, A., Valkama, P. and Bailey, S. J. (2014) „Smart cities in the new service economy: building platforms for smart services.“ *AI & Soc.* Vol. 29, pp 323-334

Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G. And Portugali, Y. (2012) „Smart cities of the future.“ *The European Physical Journal Special Topics.* Vol. 214, pp. 481-518

Bolivar, M. P. R. (2015) *Transforming City Governments for Succesful Smart Cities.* Switzerland: Springer.

Bouskela, M., Casseb, M., Bassi, S., De Luca, C. and Facchina, M. (2016) “The Road toward Smart Cities: Migrating from Traditional City Management to the Smart City.” *Inter-American Development Bank report.* Available: https://publications.iadb.org/bitstream/handle/11319/7743/The-Road-towards-Smart-Cities-Migrating-from-Traditional-City-Management-to-the-Smart-City.pdf, 04.10.2017

Brussels Smart City (2017). “Smart City Strategy.” Available: https://bric.brussels/en/files/brussels-smart-city-strategy, 16.04.2018

Caragliu, A., Del Bo, C. and Nijkamp, P. (2011). „Smart cities in Europe.“ *Journal of Urban Technology*, Vol. 18 No. 2, pp 65–82.

Chourabi, H. *et al.*, "Understanding Smart Cities: An Integrative Framework," *2012 45th Hawaii International Conference on System Sciences*, Maui, HI, 2012, pp. 2289-2297.

City of Vienna. (2016). „Smart City Wien: Framework Strategy.“ Available: https://smartcity.wien.gv.at/site/files/2016/12/SC_LF_Kern_ENG_2016_WEB_Einzel.pdf, 06.10.2018

Cocchia, A. (2014). „Smart and digital city: A systematic literature review“. In Smart city, pp. 13-43. Springer, Cham.

Coe, A., Paquet, G. and Roy, J. (2001). „E-governance and smart communities: a social learning challenge.“ *Soc. Sci. Comput. Rev.* Vol. 19, No. 1, pp. 80-93

Coletta, C., Heaphy, L. and Kitchin, R. (2017). „From the accidental to articulated smart city: The creation and work of „Smart Dublin“.“ *The Programmable City Working Paper* 29.

Dameri, R. P. (2013). „Searching for smart city definition: a comprehensive proposal.“ *International Journal of Computers & Technology*, Vol. 11 No. 5

Dameri, R. P. and Benevolo, C. (2016) „Governing Smart Cities: An Empirical Analysis.“ *Social Science Computer Review.* Vol. 34, No. 6, pp 693-707

den Ouden, E. and Valkenburg, R. (2012) “Vison and roadmap urban lighting Eindhoven 2030: research results July 2012.” *Technische Universiteit Eindhoven.* Available: http://repository.tue.nl/f3651538-5c7e-416c-8f86-ebeda3079e65, 04.10.2017

Dodgson, M. and Gann, D. (2011) „Technological Innovation and Complex Systems in Cities.“ *Journal of Urban Technology*, Vol. 18 No. 3, pp 101-113

Drechsler, W. (2001) „Good and Bad Government: Ambrogio Lorenzetti`s Frescoes in the Siena Town Hall as Mission Statement for Public Administration Today.“ Discussion Papers, No. 20. *Local Government and Public Service Reform Initiative.*

Ergazakis, M., Metaxiotis, M., and Psarras, J. (2004). „Towards knowledge cities: conceptual analysis and success stories.“ *Journal of Knowledge Management*, Vol. 8 No. 5

European Commission (2016). „Analysing the potential for wide scale roll out of integrated Smart Cities and Communities solutions.“ Available: https://ec.europa.eu/energy/sites/ener/files/documents/d2_final_report_v3.0_no_annex_iv.pdf, 15.09.2018

European Commission homepage (2016) *Smart Cities.* Available: https://ec.europa.eu/digital-single-market/en/smart-cities, 05.04.2017

Fernandez-Anez, V., Fernández-Güell, J.M. and Giffinger, R. (2018). „Smart City implementation and discourses: An integrated conceptual model. The case of Vienna.“ *Cities*, Vol. 78, pp.4-16.

FMDV. (2014). “Resolutions Europe: Local Innovations to Finance Cities and Regions.” *Regional Publications: Context & Case Studies.* Available: http://base.citego.org/docs/local_innovations1.pdf, 26.10.2018

Forum Virium Helsinki. (n.d.). “Building an Open City.” Available: https://drive.google.com/file/d/0BxF0qlDY5bSQLXctd3AtMHJlS1U/view, 25.11.2018

Giffinger, R., Pichler-Milanovic, N., Fertner, C., Kramar, H., Kalasek, R. and Meijers, E. (2007) „Smart Cities: Ranking of European Medium-Sized Cities.“ Centre of Regional Science, Vienna University of Technology

GSMA. (2012). “Finland: Forum Virium Helsinki. A user-driven approach to developing smart city services, mobile apps and open data.” Available: https://www.gsma.com/iot/wp-content/uploads/2012/12/cl_forum_virium_12_12.pdf, 08.10.2018

Hafedh, C., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., Pardo, T. A. And Scholl, H. J. (2012). „Understanding Smart Cities: An Integrative Framework.“ *System Science (HICSS), 2012 45th Hawaii Internation Conference on System Sciences.*

Hamburg SmartCity (2015). “Hamburg SmartCity.” Available: http://hamburgsmartcity.com/wp-content/uploads/2015/11/Hamburg-SmartCity-Booklet-2016.pdf, 16.04.2018

Hayat, P. (2016) “Smart Cities: A Global Perspective.” *India Quarterly.* Vol. 72, No. 2, pp 177-191

Helsinki Smart homepage. (2018). “About.” Available: https://www.helsinkismart.fi/about/, 04.11.2018

Helsinki-Uusimaa Regional Council. (2015). „Smart Specialisation in the Helsinki-Uusimaa Region: Research and Innovation Strategy for Regional Development 2014-2020.“ Available: https://www.uudenmaanliitto.fi/files/16166/Smart_Specialisation_in_Helsinki-Uusimaa_Region_-_Research_and_Innovation_Strategy_for_Regional_Development_2014-2020_B_51_-_2015.pdf, 08.10.2018

Hollands, R. G. (2008) „Will the real smart city please stand up?“ *City.* Vol. 12, No. 3

IBM homepage. (2014) “City of Madrid Implements Large Smarter Cities Environmental Analytics Project.” Available: https://www-03.ibm.com/press/us/en/pressrelease/44328.wss, 04.10.2017

IESE. (2018). „IESE Cities in Motion Index.“ Available: https://media.iese.edu/research/pdfs/ST-0471-E.pdf, 02.12.2018

Janowski, T. (2015). “Digital government evolution: From transformation to contextualization.” *Government Information Quarterly.* Vol. 32, No. 3, pp 221-236

Johnson, B. (2008). „Cities, systems of innovation and economic development.“ *Innovation: Management, Policy & Practice*. Vol. 10 No. 2-3, pp 146-155

Johnston, E. and Hansen, D. (2011) „Design Lessons for Smart Governance Infrastructures.“ Chapter in *American Governance 3.0: Rebooting the Public Square?* An edited book by the National Academy of Public Administration. Ink, D., Balutis, A., & Buss, T

Kogan, N. (2014) „Exploratory research on success factors and challenges of Smart City Projects.“ Master Thesis: Kyung Hee University, Seoul, Korea.

Komninos, N. (2006). „The architecture of intelligent cities: integrating human, collective and artificial intelligence to enhance knowledge and innovation.“ *IEEE 2nd IET International Conference on Intelligent Environments.* pp 13–20. IEEE Xplore

Kummitha, R.K.R., (2018). „Entrepreneurial urbanism and technological panacea: Why Smart City planning needs to go beyond corporate visioning?“ *Technological Forecasting and Social Change*, Vol. 137, pp 330-339.

Lombardi, P., Giordano, S., Farouh, H. and Yousef, W. (2012) „Modelling the smart city performance.“ *Innovation: The European Journal of Social Science Research.* Vol. 25 No. 2, pp 137-149

Meijer, A. and Bolivar, M. P. R. (2015) „Governing the smart city: a review of the literature on smart urban governance.“ *International Review of Administrative Sciences*

Michelucci, F. V., De Marco, A. and Tanda, A. (2016) “Defining the Role of the Smart-City Manger: An Analysis of Responsibilities and Skills.” *Journal of Urban Technology,* Vol. 23, No. 3, pp 23-42

Nam, T. and Pardo, T. (2011) „Smart city as urban innovation: Focusing on management, policy, and context.“ *ACM International Conference Proceeding Series*. pp 185-194.

Nijman, H. (2014) „Dynamic Roles in Smart City Development. Blurring Boundaries in Smart City Pilot Projects.“ University of Twente. Available: http://essay.utwente.nl/66534/1/Nijman%2C%20Hanke%20-%20S0139513%20-%20MasterThesis.pdf, 19.06.2017

Pittsburgh Business Times (2015) „With Google funding, CMU turning campus, Pittsburgh into Internet of Things testbed.” Available: https://www.bizjournals.com/pittsburgh/blog/innovation/2015/07/with-google-funding-cmu-turning-campus-pittsburgh.html, 04.10.2017

Putra, Z.D.W. and van der Knaap, W.G. (2018). „Urban Innovation System and the Role of an Open Web-based Platform: The Case of Amsterdam Smart City.“ *Journal of Regional and City Planning*. Vol. 29, No. 3, pp. 234-249

Smart City Wien. (2017). “Monitoring Report 2017: Smart City Wien Framework Strategy.” Available: https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008520.pdf, 21.10.2018

Soe, R. (2018) „A Tale of Two Smart Cities. How Virtual Walls between Cities can Fall.” Doctoral Thesis: Tallinn University of Technology, Tallinn, Estonia

Streb, C. K. (2012) „Exploratory Case Study.” In: Encyclopedia of Case Study Research. Thousand Oaks: SAGE Publications, Inc.

Zubizaretta, I., Seravalli, A. and Arrizabalaga, S. (2016) “Smart City Concept: What It Is and What It Should Be.“ *Journal of Urban Planning and Development.* Vol. 142, No. 1

The Economist Intelligence Unit (2018). “The Global Liveability Index 2018: A free overview.” Available: http://www.eiu.com/public/thankyou_download.aspx?activity=download&campaignid=Liveability2018, 15.10.2018

UN (2015) „Smart Cities: Regional Perspectives.“ *The Government Summit Thought Leadership Series.* Available: https://www.worldgovernmentsummit.org/api/publications/document/d1d75ec4-e97c-6578-b2f8-ff0000a7ddb6, 04.03.2018

Van den Bergh, J. And Viaene, S. (2016) „Unveiling smart city implementation challenges: The case of Ghent.“ *Information Polity*. Vol 21, pp 5-19

Wikipedia. (2018a). “Vienna.” Available: https://en.wikipedia.org/wiki/Vienna, 15.10.2018

Wikipedia. (2018b). “Amsterdam.” Available: https://en.wikipedia.org/wiki/Amsterdam, 25.10.2018

Wikipedia. (2018c). “Helsinki.” Available: https://en.wikipedia.org/wiki/Helsinki, 31.10.2018

World`s population increasingly urban with more than half living in urban areas. (2014, July 10). Retrieved from http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html