

Side-effects of the

SMART CITY

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Summary

Side-effects of the smart city

The purpose of this study was to establish what the known side-effects are for the smart innovations in Eindhoven, Manchester and Stavanger, three European smart cities, and to determine how the City Councils and technology companies involved/interested in the implementation of these smart innovations responded to these side-effects.

To make any statements about the side-effects in each city, a qualitative inquiry has been carried out, for which three respondents in each city have been interviewed and several documents have been studied (varying from videos, evaluation reports, brochures and advisory reports). On the basis of this information, a table of the Smart Innovations in each city has been made up and side-effects to these have been noted.

A major conclusion to this study was that there seems to be a unilateral view among the actors: there is a tendency to assume that there are no side-effects, that there are only positive side-effects, or that they are unquantifiable. This means side-effects were mostly ignored or avoided. Even though the representatives could name no concrete side-effects initially, some side-effects in Eindhoven and Stavanger could be derived from the interviews (usually referred to as issues, rather than side-effects). For example, some citizens had no access to the Smart-tool which was created to adjust energy and water usage to the life-style of inhabitants of Eindhoven, as they lacked the technological knowledge and equipment. As this had great impact on the effectiveness of the smart innovation, the active partners in Eindhoven remedied this side-effect.

Another important finding is that evaluation or feedback on the side-effects turned out to be a requisite in responding to these. The actors responsible for the implementation of the smart innovations have to be notified of any side-effects, or have to actively look for any wider impacts of their smart-innovations, before they can deal adequately with them.

Table of contents

1. Introduction.....	1
1.1 Research problem	1
1.2 Research objective and question	2
1.3 Scientific and societal relevance	2
2. Theoretical Framework	3
2.1 Domains of smart technology	3
2.2 The role of key actors	4
2.3 Effects of Smart City initiatives.....	5
2.4 Reactions and influential factors in implementing Smart initiatives	7
2.5 Conceptual Model	9
3. Methodology	11
3.1 Research strategy	11
3.2 Case selection	12
3.3 Research design.....	13
4. Results per city	16
4.1 Eindhoven.....	16
4.2 Manchester	19
4.3 Stavanger.....	22
4.4 Cross-case analysis	24
5. Conclusions.....	25
5.1 Conclusions.....	26
5.2 Comparison to the hypothesis	29
5.3 Discussion	30
References.....	32
Appendix.....	35
Appendix A – Interview Guide.....	35
Appendix B – Code book Atlas.ti	38

Smart side effects in the Smart City

The inclusion of side effects in urban policy.

1. Introduction

1.1 Research problem

Today, more than 50% of the world population resides in the urban environment. This population, in combination with the ominous global issues like climate change, impel cities to develop in unprecedented ways. To achieve urban comfort, safety on the streets, reduction of emissions and a greener environment, an increased number of City Councils have joined forces with technology companies, employing a term which stands for both their objective and strategy: The Smart City (Shelton, 2014).

Smart city policies rely on quantitative and computational data-collection from sensors, social platforms, and cards like credit- and transport cards. This data is used to comprehend and reconfigure socio-spatial action, in order to update or create services/goods which are cheaper, quicker, more sustainable and/or more profitable. Examples of existing developments are weather adaptive lighting, surveillance cameras and waste-management sensors to maximize efficiency for sanitation workers (Shrestha, 2016). City councils often highlight the potential of smart development to attract businesses, receive funds from the European Union, and as a way to promote their cities (Shelton, 2014).

However, in developing and allocating these smart services and goods, unintended side effects may arise for certain citizens. City Councils and technology companies have to take a few factors into consideration before rolling out a certain smart technology. An example of one of these factors could be ROI, return on investment, which indicates the profit that these actors gain from a Smart development. This factor often pushes City Councils and technology companies to favour high income neighbourhoods and densely populated urban areas (Grubestic, 2017). On the long term, an extreme result of this could be urban segregation, as economic gaps between citizens might be broadened (Hollands, 2014). On a more local scale, smart services and goods can have bad consequences as well. Vehicles which were redirected off busy motorways by a GPS, might end up in initially quiet neighbourhoods; frustrating for residents living there, but a benefit for the GPS-users.

To minimise undesired effects of Smart technology, it is of importance that the vital actors in smart city developments (City Councils and technology companies) predict the side effects which could occur and take these into consideration when they implement a Smart development. This way, more citizens may be able to benefit from a specific smart technology. But what are the possible unintended side-effects, and how do City Councils and technology companies take the side effects of smart city developments into consideration?

1.2 Research objective and question

The aim of this research is to establish what the known side-effects are for the smart innovations in three European cities (as described in 3.3), and to determine whether the City Councils and technology companies interested in the implementation of these Smart Innovation took these into consideration. In this research the rational decision-making behind Smart City developments by these actors will be tracked, and other important factors for these actors will be noted (e.g. efficiency, partnership and economic value). After conducting the research, an attempt will be made to make statements about the occurrence of any side-effects in each of the three cities, and the reasons why these two main actors decided to either utilise, remedy or ignore these.

The central question in this research will be:

→ *What are the known side-effects of smart city-like products and services in three European cities, and in which way did the City councils and technology companies that are implementing smart city-like products react to the side effects of these products and services?*

1.3 Scientific and societal relevance

Conducting this research is relevant at a scientific and a societal level.

The literature around Smart Cities is vast; a lot is written about technological inequality as a result of Smart innovation, in the sense that it is a persisting problem and it often arises from already existing socio-economic differences in Smart cities (Hollands, 2014; Shelton, 2014). This, however, is just one complex and large-scaled possible effect of Smart innovation, for which the focus on return on investment is constantly named as a malefactor. On a smaller scale, little is written about the outcomes of Smart goods and services, and other factors that play a role in deciding how to react to these. This research will contribute to this lack of knowledge in the sense that it will give insight in outcomes and effects of local Smart development. Furthermore, with this research a light will be shed on the actors responsible for implementing Smart developments, rather than pointing out all the shortcomings of Smart Cities in general which is often done in the literature (Cartier, 2005; Datta, 2015; Watson, 2015; Mullins, 2017). One extreme example of this is by Hollands (2014), who argues that smart goods/services are usually just a product of a corporate utopian vision, or cinematic false dawns (Hollands, 2014). In this research critical questions will be posed to the 'source of the problem'. Are they even aware of the fact that not everyone benefits from the same technology, and are they willing to strike the side effects an undesired technology can bring? By drawing conclusions on the basis of these questions, this research will contribute to the knowledge gap found in the literature as described above.

This research is also relevant at a societal level. By asking the question whether City Councils and technology companies considered possible negative side effects, awareness for this issue may be created among these key actors, both in the researched cities and other cities implementing Smart services and goods. As a result, the need to address this issue in their decision-making may grow. By showing possible side-effects and the factors that play a role in the decision-making around these, City Councils and technology companies can improve effectiveness of a smart technology and prevent any undesired side-effects of technologies in the future.

2. Theoretical Framework

This chapter consists of several underlying theories and concepts which are relevant for this research. In section 2.1, the domains of smart technology will be named to present the subdivisions in Smart City innovations. In section 2.2, the role of actors implementing Smart City services and goods will be touched upon. This paragraph will be followed up by the effects these actors wish to achieve with Smart Innovation, and the side-effects which could occur (2.3). Finally, the factors that play a role in dealing with these side-effects will be named in section 2.4.

2.1 Domains of smart technology

Smart city initiatives can be classified into several different domains. Washburn et. al. (2010) distinguish the following physical domains:

- City administration, via which the smart government stays informed about its city's condition and components.
- Education, which has to be improved in access, quality and costs.
- Healthcare, which has to stay available, provide rapidly and needs to diagnose accurately.
- Public safety; it has to be guaranteed at all times, making real-time information and quick communication vital to act quick to emergencies and threats.
- Real estate; via smart initiatives the operating costs shrink, while the values and occupancy rates increase.
- Transportation; a good transportation network is essential for a functioning economy. Public transportation, and reduction of traffic congestion is vital to achieve this (Grubestic, 2017).
- Utilities; services like energy and water have to be used more sustainably.

A more general and wider approach to the domains of smart city initiatives comes from Giffinger (2007), who defines the following six:

- Economy (competitiveness)
- People (social and human capital)
- Governance (participation, transparency, and the functioning of administration • Mobility (transportation and ICT)
- Environment (natural resources, environmental protection, and sustainable resource management)
- Living (quality of life, cultural facilities, health and safety)

On the European scale, the latter have been used as a city ranking system for Smart Cities. However, IBM's ranking system only holds three domains (Dirk & Keeling, 2009):

- Operating systems (the administrative side which enables city to offer public services)
- User systems (health, education, public safety and business)
- Infrastructure systems (not just transport, but also water, communication and energy)

2.2 The role of key actors

Achieving innovation in each of these domains is dominated by three main actors, according to the Triple-Helix system of Innovation. This Helix-system is built upon the three institutional spheres, being government, industry, and knowledge institutions (Leydesdorff & Etzkowitz, 1998). These actors are connected by organisations such as contract offices and industrial liaison (Leydesdorff & Etzkowitz, 1998). Each of these actors have their own role in the Smart City.

Firstly, the role of City governments is further explained by NAM (2014). According to him, governments have two responsibilities within Smart Cities: “Using technology to integrate the information systems of different service delivery agencies to enable better services for citizens (internal view), and tailoring services to the needs of individual citizens (external view)” (NAM, 2014).

Secondly, Washburn (2010) has created three tiers to depict the involvement Chief Information Officers have in smart city initiative. These tasks can be generalised for the actor ‘industry’, as it shows the in-depth tasks of industries in Smart City development.

Figure 5 The Role Of CIOs In Planning, Implementing, And Delivering The Smart City Vision

	Plan	Implement	Deliver
Tier 1: CIO of a city	• Be versed on smart city developments and best practices. • Develop a comprehensive smart city vision, road map, and regulatory framework with key IT, political, and corporate stakeholders. • Assess how “smart” your city’s critical infrastructure and services are today. • Prioritize smart projects. • Develop new business models and funding options. • Identify skills gaps to city administration projects.	• Allocate funding to purchase and implement smart technologies for city administration projects. • Modernize legacy infrastructure and networks. • Assist in distributing funding to broader smart city initiatives. • Hire staff, develop staff, and align internal process to implement and deliver on city administration projects. • Partner with industry stakeholders, system and technology integrators. • Measure progress. • Develop metrics and SLAs.	• Roll out smart city administration services. • Assist in the rollout of broader smart city rollouts. • Educate citizens and stakeholders on smart city benefits and how to take advantage of them. • Continue to develop business models to fund and monetize smart city initiatives. • Measure progress, value delivered, and SLAs of city administration and broader smart city services.
Tier 2: CIO of a critical city infrastructure or service	• Be versed on smart city developments in your city and industry best practices. • Collaborate with city IT, political leaders, and industry peers to develop a smart vision, road map, and regulatory framework. • Assess how “smart” your organization is today. • Design your organization’s “smart” technology and system road map. • Prioritize smart projects. • Develop new business models and funding options. • Identify skills gaps.	• Allocate funding to purchase and implement smart technologies. • Modernize legacy infrastructure and networks. • Hire staff, develop staff, and align internal processes to implement and deliver smart technology projects. • Work with city planners, technology partners, and system integrators to deploy solutions. • Measure progress. • Develop metrics and SLAs.	• Roll out smart city services in your respective domain. • Educate customers, citizens, and other stakeholders on smart city benefits and how to take advantage of them. • Continue to develop business models to fund and monetize smart city initiatives. • Measure progress, value delivered, and SLAs of smart services.
Tier 3: CIO of a “consumer” of critical city infrastructure or services	• Be versed on smart city developments in your city. • Understand what smart city initiatives mean to your organization. • Develop a technology plan to take advantage of smart city initiatives. • Understand financial incentives available for smart city investments.	• Invest in technologies that take advantage of smart city services. • Align people, processes, and incentives to take advantage of smart city investments. • Develop metrics and SLAs to measure the value of smart city investments.	• Take advantage of smart city services in your organization. • Educate your organization on smart city benefits and how to take advantage of them. • Measure the value delivered from smart city investments.

Figure 1: The role of CIOs in Planning, Implementing and Delivering the Smart City Vision. Source: Washburn (2010).

Finally, knowledge institutions play a role in Smart innovation as well. Universities are mainly responsible for generating innovation and patents supporting smart projects. This means the triple helix of innovation connects knowledge institutions' patents, industry investment and local governance as a driver for Smart innovation, with knowledge as key (Dameri, 2016).

By getting involved with Smart innovation in a city, the city governments, technology companies and knowledge institutions as described on the basis of the Triple Helix, envisage certain effects that Smart services/goods have on the city. These, together with the unintended side effects which may also occur, will be discussed in the following section.

2.3 Effects of Smart City initiatives

City Governments and IT-companies are likely to invest in Smart City services and goods to contribute to social stability, economic prosperity, quality of life, networks & infrastructure, contentment for citizens, and encouragement from corporations to invest their resources and share their expertise in cities (Yeh, 2017). In a study by Beaudry and Green (2002), a positive correlation has been found between investment in IT and national GDP, given that "technology expedites the production of goods and services, eventually facilitating economic growth and improving perceived standard of living (Comin and Hobijn, 2008)". These concepts have been summarised by Dumay (2013) into the model below, in which he connects a capital vision (value creation) with a smart city vision (collective aims like sustainability and quality of life. This brings forth five envisioned aims for smart innovation.

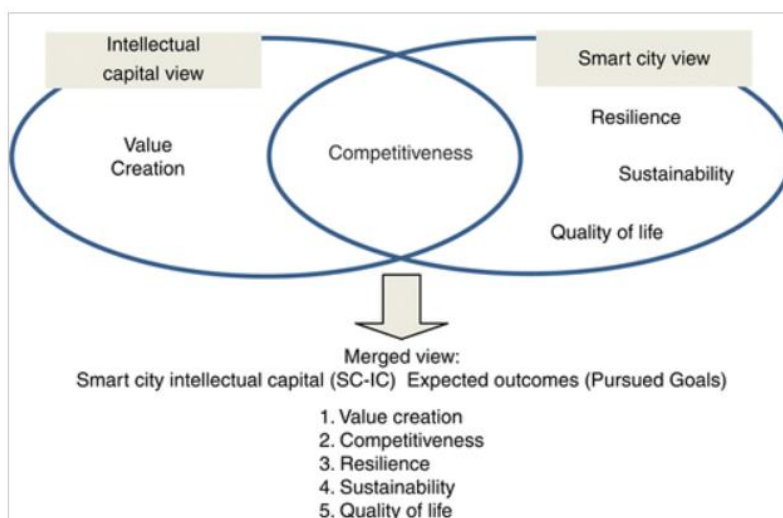


Figure 2: Merge between the typical expected outcomes in the intellectual capital and smart city views. Source: Dumay (2013).

Apart from these goals as an effect of smart innovation, side-effects may arise, either beneficial or disadvantageous for the main institutions and/or citizens who use and are effected smart-like services and products.

Kitchkin names a few internal unintended side-effects as a result of implementing smart services and products, given that the actors seem to hold on to an illusion that complex issues can be disassembled into neatly defined technical problems, and that these can be solved easily through smart-technology (Schechtner, 2017):

1. City systems and people are reduced to relatively simple components and agents, while there are so many metaphysical aspects to them (ideology, values, culture).
2. Urban issues get addressed in an instrumental and practical way, instead of a wider normative framework. "Developers might state that a technology can make a system more sustainable, without saying what "being sustainable" means beyond instrumental targets."
3. City Councils and IT-companies won't acknowledge that some complex issues can be best solved through other ways than simply introducing a new technology (political/social intervention, public policy).
4. Solutions are often, what Kitchkin calls, "sticking plaster solutions". Smart cities might attempt to optimize flow or re-route vehicles through smart initiatives, but the deeply rooted structural problems like the raising number of vehicles on the road are left unaddressed. Instead, Kitchkin said, a solution could be provided that encourages more cycling and walking (Schechtner, 2017).

These effects are based on the managerial side of the Smart City. Smart innovation, however, could have external effects for citizens as well. One of these external effects has been studied by Nancey Green (2012), who found that the smart-growth techniques used in 14 American cities to contain urban sprawl, links to the loss of industrial-zoned land. These techniques go at the expense of the economic base of cities, and reduce supply of job creating area (Green, 2012). Physical side-effects like these are the most visible side-effects, though more discrete cultural side-effects may arise as well.

With smart innovations such as investments in broadband and digital networks, communication is made digital and more computer-mediated communication (also known as CMC) is encouraged. Interaction is made possible, regardless of geographical, racial, religious and lingual boundaries. Moreover, communication is anonymised, and this may undermine the regulatory function of social norms and increase anti-social behaviour in cities. Subsequently, computer-mediated communication is associated with loss of cultural identity and depersonalisation (Postmes, 1998).

Finally, there is concern over possible socio-economic side effects. Technology companies and city governments often favour particular areas for the implementation of smart-services and products, preferably by business model. A study by Grubestic (2004) showed that there are significant differences in the availability of broadband services in America, and competition between urban and rural area is high. A few reasons for this are given:

Firstly, lacks in technological requirements slow down the smart developments in certain areas. Grubestic named the difficulties with infrastructure development (in the form of the high cost of network upgrades to diffuse advanced services) as an example.

Secondly, rural or sub-urban areas have a market demand disadvantage which makes it harder to attract investing businesses (Grubestic, 2004). These socio-economical differences may happen on a local scale as well. Resources and capital are scarce, so actors implementing smart innovation have to make choices in where to roll out new services. This may increase socio-economic differences

between neighbourhoods. An example was given by Shelton, concerning the Smart innovation zones in the south of Philadelphia: “....*The latter is a new place for public and private investment to flow, far removed both socially and spatially from the poorer neighbourhoods that the city’s smart city project was meant to help*” (Shelton, 2014).

The latter side-effects are disadvantageous under almost all circumstances, though unintended side-effects could be beneficial as well. Smart-Cities are often the centre of higher education. By rolling out a smart innovation, the city will offer more utility. With that innovation, the implementing actors may have primarily envisaged to raise the quality of life within that area, but as a result they may also attract new students. On one hand, this is often a brain drain for another area, on the other, it contributes to the city’s overall turnover (Winters, 2011).

The side-effects above have been summarised in the following table:

Internal-side effects	External side-effects
Managerial	Cultural
	Physical
	Socio-economical
	Demographical

Figure 3 Internal and external side-effects. Source: personal collection.

The actors responsible for the implementation of the Smart services/goods may want to enhance or tackle effects and side-effects. The following section contains the reaction that the organisations may have to these (side)effects, and the underlying factors for this reaction.

2.4 Reactions and influential factors in implementing Smart initiatives

According to Nancy L. Stein (1992), a certain emotion/reaction to events by persons and organisations is determined by the goal attainment of the corresponding project. The following emotions according to the goal-attainment are named in the article: “*Happiness for goal attainment or maintenance, sadness for failure to attain or maintain goals, anger when agents cause these same losses, and fear when such failures have not as yet occurred but have a high probability of occurrence*” (Stein, 1992).

Possible plans of actions for each of these reactions are shown in figure 4 (Stein, 1992):

Response/emotion	Action taken as a result
Happiness – Satisfaction	Maintenance (attempting to keep things the way they are)
Sadness - Dissatisfaction	Goal reinstatement
Anger	Revenge (approaching the agents that cause goal loss or blockage and fighting/fixing it)
Fear	Avoidance (ignoring events or persons that threaten goal attainment or maintenance)

Figure 4 Responses and actions taken as a result. Amended from: Stein (1992).

The infilling of these actions are different per situation, and it is of importance to recognise that one response does not always lead to one of these actions. (Stein, 1992).

In the table below rational factors are depicted which play a role in the decision-making process per view (internal and external) around Smart Cities for Smart Governments (City Councils on a local scale). These factors determine to what extent the goal of the Smart City service/good has been attained. The infilling of these factors may differ for every Smart project.

	Management (internal view)	Service delivery (external view)
Efficiency	• How does the smart government initiative improve <i>internal managerial efficiency</i> (the ratio of outputs generated to resources invested) in terms of workloads, activities, and processes inside a public organization?	• How does the smart government initiative improve <i>service-oriented efficiency</i> (the ratio of outputs generated to resources invested) in producing and delivering public services to citizens?
Effectiveness	• How does the smart government initiative improve <i>internal managerial effectiveness</i> (the quality of internal management in government organizations)?	• How does the smart government initiative improve <i>service-oriented effectiveness</i> (the quality of services delivered to citizens by enhanced communications and interactions with them)?
Transparency	• How does the smart government initiative improve <i>internal managerial transparency</i> (transparency in various processes through information sharing and integration across government organizations)?	• How does the smart government initiative improve <i>external transparency</i> (accessibility of information and decision processes related to service provision and delivery)?
Collaboration	• How does the smart government initiative improve <i>internal collaboration</i> between agencies or departments inside government?	• How does the smart government initiative improve <i>external collaboration</i> between government and non-governmental parties?

Figure 5: The metrics for assessing a smart government initiative. Source: Nam (2014).

Moreover, investment in IT in Smart Cities increases capital stock and may improve labour productivity. These factors combined, is defined by OECD (2008) as MFP (multifactor productivity). Other factors of IT-based investments in the smart cities are network/external goals, like the reduction of transaction costs and speeding up innovation (which also benefits MFP). These factors play a big role for the decision-making on the “what, where and how” of Smart Development within a city (OECD, 2008).

2.5 Conceptual Model

Based on the concepts as described above, a conceptual model has been developed (figure). In this model, the **main actors provide services and goods on the basis of a certain envisaged goal**. These services and goods will be noted in the following table after the analysis of the documents and interviews, based on the divisions in smart innovations according to Washburn et. al (2010).

	Eindhoven	Manchester	Stavanger
City administration			
Education			
Healthcare			
Public Safety			
Real estate			
Transport			
Utilities			

Figure 6: Services and goods implemented by each of the cities. Source: personal collection.

These smart services and goods may lead to **side-effects**, which can be divided in five groups based on the examples found in the literature: Managerial, cultural, physical, socio-economical, and demographical.

The reaction to these side-effects depends on their **impact on the goal attainment of the smart innovation**. The concept of goal attainment has been added because it plays a vital role in the reaction of actors to the side-effects (Stein, 1992). The reactions of actors will differ, based on the impact of the side-effect on the goal. If the side-effect threatens the goal, it will likely to lead to anger, fear, and/or dissatisfaction. If it contributes to the goal, satisfaction will be a logical response (as shown in figure 7). The four internal factors as described by NAM (2014) are useful tools in determining to what extent the side-effect threatens or contributes to the goal. These are efficiency, effectiveness, transparency and collaboration. A side-effect might undermine the effectiveness of a smart innovation, which may stand in the way of attaining the envisaged goal.

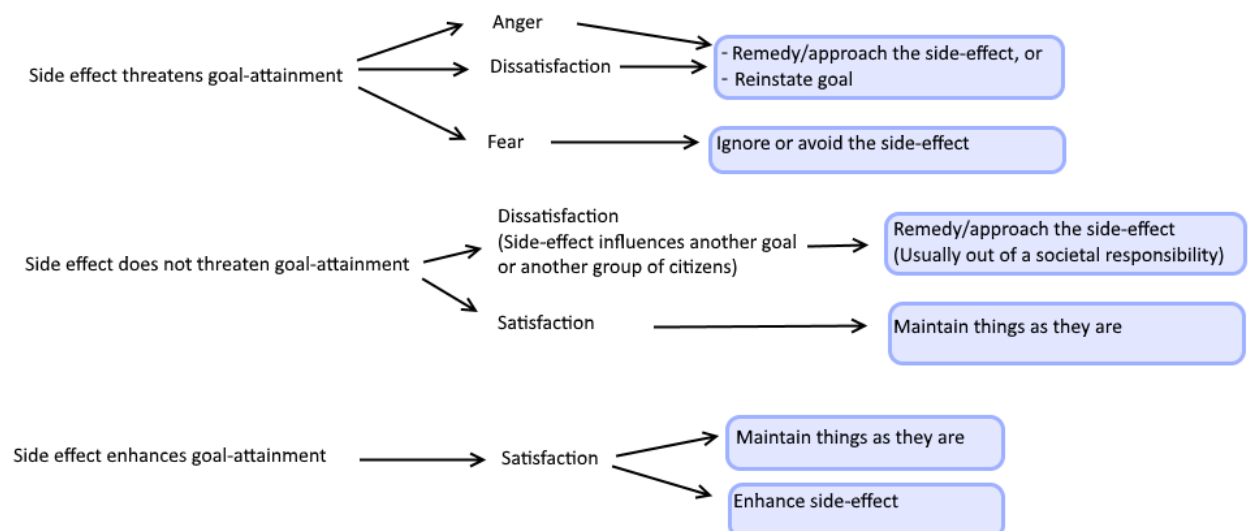


Figure 7 Responses to side-effects. Amended from: Stein (1992).

Based on the reaction of the actors, **measures** will be taken in the form of maintenance (keeping things the way they are), goal reinstatement (lowering the standards), revenge (approaching and solving the side-effect) or avoidance of the side-effect. It must be noted that not every side-effect is visible, so before actors can take react to side-effects and take any measures in the first place, some form of reflection or feedback on the side-effect must occur.

An scenario on the basis of this model could be the following:

A city government wishes for more sustainability while maintaining the quality of life by implementing a smart heating system in apartments. A partner technology company develops a mobile app which enables the inhabitants to fill in their work-times, so the heating system turns on/off on the basis of their work schedules. However, a group of inhabitants cannot access this app, as they lack the technological equipment (Ipad or any other modern mobile device), a socio-economical side-effect. The actors, provided that they receive word about this side effect, are dissatisfied by this effect, as it threatens the effectiveness of the heating system and therefore the goal. Measures are taken: the actors set-up a help desk for these people to remedy this side-effect.

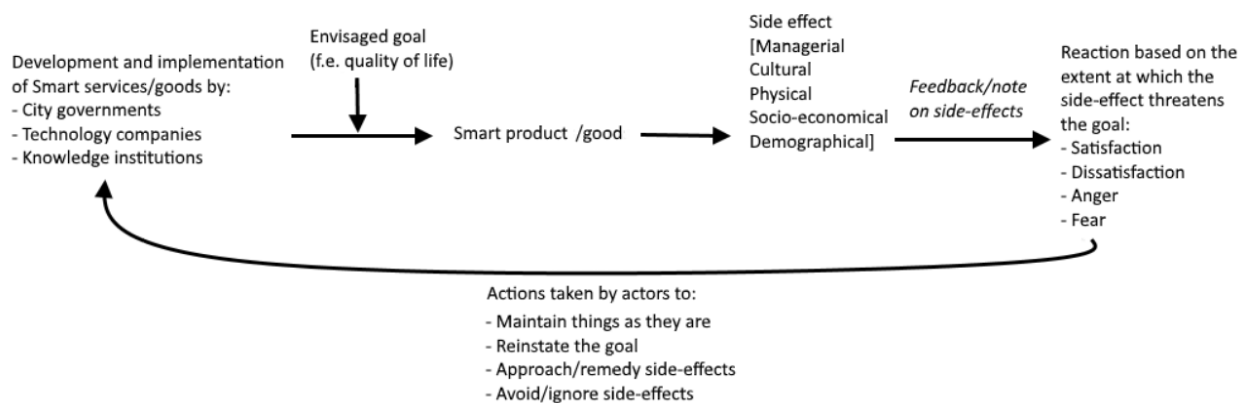


Figure 8 Conceptual model on the basis of the literature review. Source: personal collection.

An expected outcome on the basis of this conceptual model is that city governments, technology companies and knowledge institutions will often ignore side-effects for the following two reasons:

1. It is not efficient to deal with any side-effects; the costs are too high and the contribution to the achievement of the goal of the smart product is neglectable.
2. The side-effects are not always visible or quantifiable.

3. Methodology

A few possible side-effects have been given in Chapter 2, though further in-depth analysis is needed to be able to answer the main question:

What are the known side-effects of smart city-like products and services in three European cities, and in which way did the City councils and technology companies that are implementing smart city-like products react to the side effects of these products and services?

In order to distinguish the side-effects and analyse how city governments and technology companies respond to these, a clear and comprehensible methodological approach is needed. Throughout this procedure core values like validity and reliability should be embedded. In this chapter, an outline of the chosen research strategy and research procedures will be given, followed by arguments for choosing these.

3.1 Research strategy

Five options for qualitative research strategies can be distinguished according to Creswell (2013):

- narrative research,
- phenomenological research,
- grounded theory,
- ethnographic research, and
- case study.

Within this research case study will be used as the approach to inquiry, in which conclusions will be developed in an inductive manner. With this strategy the researcher explores (multiple) bounded systems -the case(s)-. To do this the researcher makes use of detailed data from multiple sources, which could be written sources like documents and reports, but also audio-visual material, observations or interviews. The researcher will combine these sources of information to a description of the case and the concepts and themes which are connected to it (Creswell, 2006). This method is chosen as the research consists of clearly identifiable cases and asks for an in-depth understanding of these.

There are three types of case studies:

- instrumental (one central issue or concern, illustrated on the basis of one case),
- collective/multi (one central issue or concern, illustrated on the basis of multiple cases), and
- intrinsic (the focus lies on the case itself, as it is a unique situation).

The type chosen for this research is collective/multi case study, in which the issues will be the side effects of Smart Developments, and in which the case consists of the decision-making on Smart City developments in the European cities as described in section 3.3. These developments will be studied on the basis of information from the key actors representing City Councils (civil servants), technology companies and knowledge institutions on these smart developments. These actors have been chosen on the basis of the Triple Helix theory as described in section 2.2 of the Theoretical frame. A collective case study will give a more elaborate image of European Smart Cities, as multiple cities are studied (Creswell, 2006).

A case study with a qualitative nature is appropriate in this research for the following reasons:

1. To answer the central question a deeper understanding of the factors which are taken into account in the decision-making process of the key actors is needed. This understanding has to be derived from an exploration of the behaviour of the respondents from City Councils and technology companies. This means the processes and relations of a small amount of actors have to be researched in detail, for which qualitative analysis is an appropriate method (Mayring, 2015).
2. The research has an exploratory nature and is open for new and/or unexpected concepts. The research question as stated in chapter 1.2 has an open ended nature. Quantitative research would be inappropriate in such a research, as it is more static, focused on measuring existing factors, and testing existing theory rather than developing a theory (Vennix, 2011).

3.2 Case selection

The research will be carried out in the cities Eindhoven (Netherlands), Manchester (United Kingdom) and Stavanger (Norway). These cities are currently part of a three point Smart city project called Triangulum, and serve as experiment cities for various innovative projects concerning mobility, energy and ICT. The main objective of Triangulum is to test Smart city developments so that, if they work, they can be disseminated and replicated by other cities. Seeing as these three cities hold a high number of Smart developments, and have the status “European Smart-pioneers”, they are likely to make a good representation of the European cities that are most involved with Smart City innovation (Viitanen, 2013; Blocken, 2016 ; Haarstad, 2016). The Triangulum partnership exists of City Councils and closely involved companies. As the Triangulum cities are constantly implementing new Smart-developments, they are likely to come across issues with the side-effects of these technologies.

On the basis of the information above, the actors in each city (each case) will be the following:

Eindhoven – The recent¹ Smart developments by KPN, gemeente Eindhoven and TU Eindhoven

Manchester – The recent Smart developments by the Manchester City Council, Jacobs and the Manchester Metropolitan University

Stavanger – The recent Smart developments by Greater Stavanger, Stavanger Kommune and Lyse

¹Recent meaning developed in the last 5 years. Reason for choosing this time-span is the focus on the modern smart-city approach as a multi-disciplinary ground, including urban planning, computer science, regional studies and political sciences (Ricciardi, F. and Za, S, 2014).

3.3 Research design

To thoroughly analyse the cases named in the previous section, a comprehensive research design is needed. The cases above will be dealt with on the basis of the following steps, as defined by Creswell (2006):

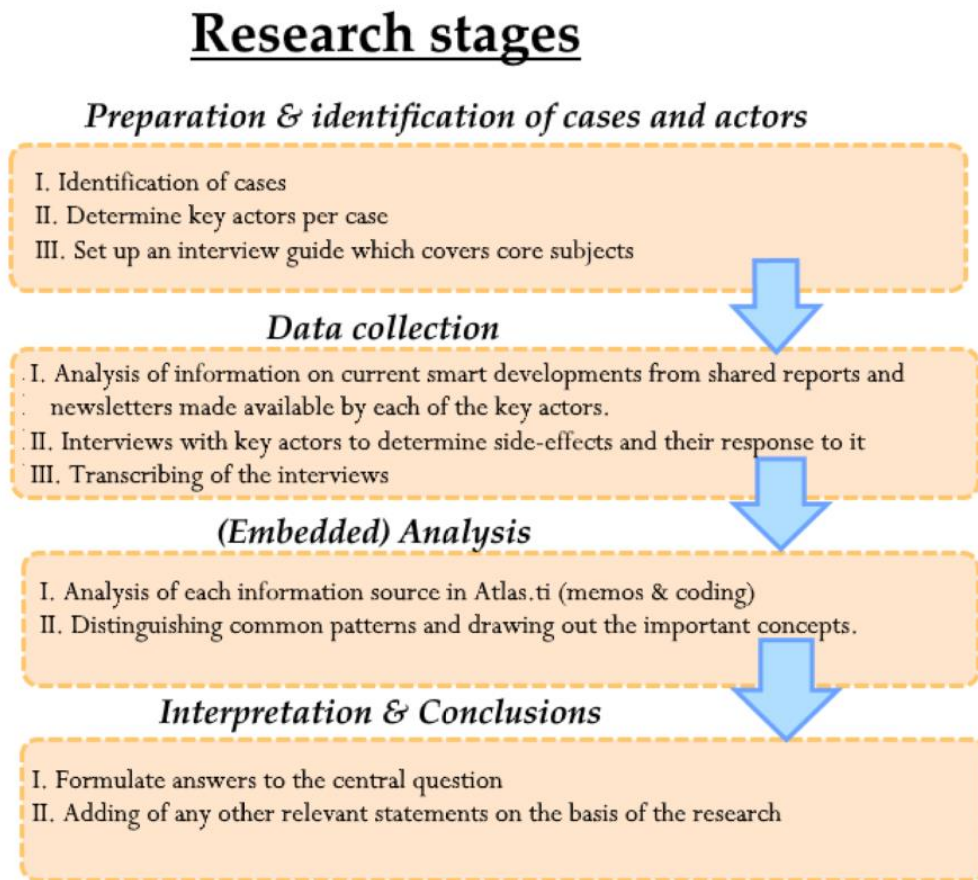


Figure 9: Research stages. Amended from: Creswell (2006).

Identification of cases

This was done on the basis of the three European pioneer cities of the Triangulum project.

Data collection

The data collection will be done by means of both document research and semi-structured interviews. Documentation is an important asset for this research, as there is a lot of information available on specific smart city technology cases. The documentation analysis is chosen to provide information on the side effects of each of the chosen developments, and to find information about current inclusion of side-effects by City Councils and technology companies. To back this information with first-hand and personal information semi-interviews will be conducted with representatives of City Councils and technology companies, during which there will be space for the interviewees to propose additions or demonstrate their field of expertise more carefully. The interviews will consist of a critical inquiry on the rational decision-making of the interviewees on certain smart developments. On the basis of the documents, three interviews will be done; one in each of the cities as described above. Interviews will be recorded and transcribed. The interview guide can be found in Appendix A. Details about the respondents and used documents are listed in figure 10.

	Interviews	Audio-visual material	Reports	Brochures
<i>Eindhoven</i>	Hans van Amelsvoort (Communication advisor) – Municipality of Eindhoven 15-05-2018	Triangulum Video - Triangulum activities in Eindhoven (2017)	SmartWayz evaluation report (2017)	Invitation to Eckart Lichtroute opening (2017)
				Newsletter Eckart Lichtroute (2017)
<i>Manchester</i>	Dino Visco – Jacobs Transport 5-5-2018	Triangulum video – Manchester Smart City mobility (2017)	Communication on Smart City Evaluation and reporting in UK cities (2016)	An Energy solution for Smarter Buildings (2018)
			Common Monitoring and Impact Assessment Framework V2.0 (2017)	
<i>Stavanger</i>	May Endresen (Opportunity manager & international relations) – Greater Stavanger 22-05-2018	Triangulum Video – Have a look at what they do in Stavanger (2017)		
		Triangulum video – Triangulum Project Presentation (2017)		

Figure 10: Information sources analysed in Atlas.TI. Source: personal collection.

Analysis of this data

As this research focuses on one certain aspect of the case (side-effects), the analysis will be embedded (on the basis of three types of coding). Firstly, a detailed description of the case and themes that play a role in this case will be given (within-case analysis) on the basis of the collected data. As this research consists of three cities, a cross-case analysis will be executed as well, which will compare the data collected in the three cities. The analysis will be in English, though some interviews may be carried out in Dutch. Atlas.ti will be a tool for the analysis of the data. Intermediate memos will be written to keep track of findings. Open coding will be used to describe and note down all themes. Axial coding will follow, to distinguish important factors and themes. Finally, selective coding will connect the themes together into common patterns. From this a basis of concepts and ideas can be created to be able to answer the main question.

Atlas.ti has been chosen as an analytical tool for coding, as it supports analysis of different data-formats (transcripts, audio, video and images), and allows to open these different types of data at once. The ability to record memos during the analysis is an advantage as well, as it allows immediate documenting of decisions in the research process. Atlas.ti connects documents in such a way that the list of codes of one transcript can be easily transferred to another transcript, which will speed up analysis actions. It is easy to navigate through codes and concepts. Finally, Atlas.ti fits an inductive research approach, as multiple themes and patterns can be bundled into one network and/or concept (Konopasek, 2008).

Interpretation

In the interpretative phase, conclusions will be drawn on the basis of the analysis of the data, and answers will be given to the central question.

4. Results per city

The following chapter will cover the results of the interviews and the documentation research. Each section will start with a description on the Smart innovations in each of the cities, followed by an in-depth analysis on the decision-making around these in which the conceptual model will be reflected on each theme.

4.1 Eindhoven

History and the smart developments

Eindhoven distinguishes itself from other cities with the historical technological and electric industries. It is for this reason Eindhoven is still known for its inventions and innovation, developments in lighting and transport in particular. A few examples of these were named by H. van Amelsvoort, representative of the municipality of Eindhoven and Triangulum (personal communication, 15th of May, 2018). Eindhoven currently has a number of electrical bike stations, movement-sensor based lamp posts to save energy on lighting, and charging points for cars to encourage sustainable use of transportation. This Green City paradigm within Eindhoven is also demonstrated in the smart heating in several offices, among which the Town Hall, which is based on individual working times. Moreover, power in these offices is provided by means of Direct Current (DC), rather than alternating current (AC).

Eindhoven's latest innovation is the light-route, situated in Ekkartvaartsbroek. Special lamp posts have been put on a path of about five kilometres around a pond. The path used to be dark and unsafe at night, and has been upgraded into a walking path, with adapting lights depending on one's speed. With a special lighting programme joggers can now enter how many kilometres per hour they are planning on running, and the lighting will move along with the individual (H. van Amelsvoort, personal communication, 15th of May, 2018).

Eindhoven is currently working on two big projects. The municipality of Eindhoven, and partners TU Eindhoven, KPN, Woningbedrijf, and Volkerwessels are developing lamp posts which have their own IP-adress in Strijp S (Mobility S). With this technology, lighting and other facilities like parking will be adaptable, depending on the real-time situation. Another current development is done by KPN and Volkerwessels. A tool has been developed for apartments in Strijp S up for renovation, which allows (future) inhabitants to digitally walk through one's apartment in 3D. With this tool, inhabitants can enter certain details like the preferred room temperature in each room, and the expected water usage over that week. Depending on the inhabitant's situation, KPN and Volkerwessels then determine which add-ons (such as double-sided glass, and solar panels) would be most efficient for the specific inhabitants, and for themselves. Finally, the partners have developed a smart sewage system which rinses out soil that has been previously polluted by the heavy industries (H. van Amelsvoort, personal communication, 15th of May, 2018).

Role of organisations and desired effects

According to H. van Amelsvoort (personal communication, 15th of May, 2018), Eindhoven is part of Triangulum, a partnership of Eindhoven, Stavanger and Manchester, set up to receive funds from the European Union and to collectively work on certain smart-innovations. The primary goal of Triangulum is to promote the Smart City to bring sustainability, knowledge and prosperity to European cities. Within Triangulum, the consortium as named above was created. The technical University of Eindhoven is one of the inventors of Smart services and products, together with KPN.

Municipality Eindhoven stays involved in these inventions, and implements these with Volkerwessels and KPN. Together, they attempt to achieve a few goals/envisaged effects. H. van Amelsvoort named a few desired effects for the municipality of Eindhoven for the smart innovations above: guaranteeing the quality of life in Eindhoven, achieving more social cohesion, and attracting people to the neighbourhoods that are being upgraded with smart services and goods (personal communication, 15th of May, 2018).

Side-effects and decision-making

At the start of the Lichtroute project, the municipality in Eindhoven invited citizens to information nights, in which they could share their own opinion. This became clear from a brochure which they distributed among citizens who lived nearby (Gemeente Eindhoven, 2017). Early in the process, the municipality was focused on transparency of the process and getting promotion for the innovation, possibly to enhance the use of the smart innovation. H. van Amelsvoort from the municipality of Eindhoven was unable to name any concrete and visible side-effects to this innovation or any other recently implemented smart good/service, reasoning that it was still too early to judge on that and that he did not know how to measure them in the first place:

"I don't know if we could measure that, and how we could measure that. Maybe we should ask the housing corporation whether they got more applications, oh I would like a residence in Ekkartsvaartbroek, it is a possibility" (H. van Amelsvoort, personal communication, 15th of May, 2018).

Even though H. van Amelsvoort could not mention any concrete side-effects, some physical side effects could be derived from the interview. By developing the light-route in Ekkartsvaartbroek, a local supermarket had to move and rebuild, as its back-side was too close to the pond to roll out the light-route. Furthermore, the lamp posts they initially designed turned out to be harmful for bats. These lamp-posts were changed immediately in such a way that they shine directly onto the path, rather than onto the water.

Furthermore, with the 3D tool a socio-economic side-effect arose as well. The 3D tool implemented by KPN and Volkerwessels was not accessible for everyone, as it was technically sophisticated and only accessible on laptop, computer or iPad. To enhance the effectiveness of the smart innovation, the 3D tool was personally explained to the inhabitants of the apartments by KPN employees, to make the tool as effective as possible.

Another interesting case arose during the designing of two wind turbines on the roofs of flats. Early detected side-effects like the shade casted by the blades, together with calculations which proved the planned smart innovation to be inefficient and ineffective, resulted in a full cancellation of the project. This means the municipality and partners did *anticipate* on these side-effects.

It must be noted that any side-effects as described above were not recognised as side-effects by H. van Amelsvoort, but more as issues or problems in the process of implementing smart innovation.

Eindhoven Analysis

The description above of the Eindhoven case gives rise to the following observations, relevant to answer the central question:

1. There is a tendency to assume there are no side-effects, or that they are unquantifiable.

A possible explanation for this could be that Smart innovations are often automatically seen as a perfect solution. In this case the innovation which H. van Amelsvoort highlighted the most, the Lichtroute, was only approached in a positive way. This comes back in the brochures and videos about the innovations in Eindhoven which automatically assume that it only has positive effects. The structure of each of those sources is clear. A citizen asks a question or poses his/her opinion, followed by a standard fragment that the municipality and the partners implemented exactly what he/she asked for (Totté, 2017; Triangulum project, 2017). There seems to be no room for a critical approach to what the smart innovation can and cannot bring. This is in line with the critique of Hollands (2014) as discussed before in the introduction and the scientific relevance sections, who argues that Smart City innovations are often based on a corporate utopian vision or cinematic false dawns (Hollands, 2014).

2. Possible problems and wider impacts of the innovations might not be observed or stated in reports as side-effects. H. van Amelsvoort could not state any side-effects, though he could name some problems associated with the smart innovation.

3. It is a possibility that there is a missing concept in the theoretical frame/conceptual model, which concerns the prediction of side-effects in advance. It is currently assumed that side-effects are dealt with after the actors are notified of any side-effects associated with their implemented smart services/goods, though prediction of side-effects might impact the way at which an innovation is implemented in the first place. Side-effects were considered at a much earlier stage of the decision-making with the wind turbines. The full project got cancelled upon seeing the many problems and side-effects which wind-turbines could bring.

4. The lamp-posts at the Lichtroute which were harmful for bats were changed, likely to prevent costs in the future (efficiency), and out of fear for any dissatisfaction and protests from the organisation which brought it up (H. van Amelsvoort did not name the organisation). Furthermore, H. van Amelsvoort considered the lack of technological knowledge with the 3D tool as solved, though it cannot be assumed that everyone is capable of making use of the 3D tool, either due to a lack of technological equipment or technical knowledge.

5. There might be side-effects/problems which remain unnamed by the partners or unstated in the documents. The partners active in Eindhoven might ignore these side-effects/avoid speaking about these out of fear for high-cost fixes or dissatisfaction among the citizens. Another reason might be that an evaluation on the smart innovations and/or feedback on the side-effects is missing. During the investigation of the documents associated with Eindhoven in particular, no evaluations were found, though an operationalisation of the important goals/innovations which have to be evaluated has been set up by SmartWayz (SmartWayz, 2016).

4.2 Manchester

History and the smart developments

Manchester has been involved with Smart Innovation on the highways ever since the 1990's. A follow-up effect was clear back then, as Manchester used the Dutch model as an example for their own speed limits on the basis of data from traffic flows and use of hard shoulder on the M25 (a ring road of London). From there new sources of data-collection were introduced, an example being number plate recognition, from which one could work out journey times (D. Visco – Jacobs, personal communication, 5th of May 2018).

From there things started moving at a quick pace, according to an interview with D. Visco (personal communication, 5th of May 2018):

“Most cars have got Bluetooth built into them that’s turned on, and again you will pick up that Bluetooth signature across two points and you can work out the sort of data. And all that is now heading towards, probably what’s coming is the start of taking information from the vehicles and providing information back to the vehicles.”

In the interview with D. Visco, a lot of examples were named for this data interaction between the vehicle and the organisations collecting the data (like Highways England).

*“But also, if every vehicle going through has it’s fog lights on, it’s probably foggy....
.... you can pass that data upstream to vehicles to say there is fog ahead. And provide the information to warn them, and display that in their vehicle. And other things, if you provide it to vehicles you don’t need all the up ahead signs, but just provide it into the vehicles, and ultimately there’s this autonomy going into the vehicles. They will slow down, rather than just telling there’s a problem, the vehicle can slow down in advance of it.”*

More uses for the data were named, like improving air quality with the data from exhausts, determining where the surface of the road is bad on the basis of suspension moves so governments can prioritise those roads for fixes, and bringing information out to vehicles on where to park, using data on the amount of vehicles in each of the carparks (D. Visco – Jacobs, personal communication, 5th of May 2018).

Whereas the engineering company Jacobs, represented by D.Visco, focuses on transportation, Siemens is working on some innovations within the electricity grid. With a new project called ‘building management system’ (BMS), Siemens attempts to collect data from the grid off commercial buildings in the City Centre of Manchester. This is to determine energy flows, and send back a signal to the devices which tells them to turn up or down (O’Reilly, 2018). Other developments in the City Centre (mainly the Manchester Corridor) are from CityVerve, the Manchester Metropolitan University and the Manchester city Council. This is also the area which Triangulum subsidises under the name ‘horizon 2020 funding’. Transport developments cover the introduction of 100% electric Nissans, electric vans and electric bikes for the staff of the Metropolitan University and for local partner businesses. Other developments are smart parking, and data collection projects to determine road safety & how to improve it. Health is also a returning domain with investment in projects like ‘Community Wellness’ which enables real-time health-care information so patients can get medical attention quicker (Triangulum project, 2017; City Verve, 2017).

Role of organisations and desired effects

According to D. Visco (personal communication, 5th of May 2018), Jacobs' role in this is client based. Designing solutions and maintaining the highways were one of their central occupations, depending on the client's desires and needs.

With these efforts, Jacobs hopes to raise the autonomy of vehicles, in the sense that they can take initiative and react quicker to situations like fog. Better communication with vehicles is another desired effect, especially brought forward by the clients, as Jacobs was involved with a big broadband scheme in Scotland to improve mobile coverage. The financial aspect also plays an essential role:

"... So it will come down to how much benefit you will get compared to the cost, and obviously the areas with the highest populations are likelier to get the most spend on them. And the links between them, there's a lot of money going into linking cities up to allow easier movement, whether it will be from HS2 or from a highway point of view."

From the Manchester City Council website it became clear that the municipality of Manchester mainly wishes to "use new technologies and ways of working to understand and optimise city systems, to change how the city functions, and to improve how people live, work, play, move, learn and organise" (Manchester City Council, n.d.). The Manchester City council facilitates and selects new projects. The University of Manchester wishes to see similar effects, and has the roles to test new technology, and coordinate Eindhoven and Stavanger teams with a joint assessment of economic, environmental, and social impacts of smart city technologies (Siemens, 2017).

Side-effects and decision-making

In terms of side-effects, D. Visco has seen little evidence on them himself. The work they do is often client-based, and they focus on what they can do for the client (collaboration), rather than seeing the smaller side-effects that come out. Side-effects often get lost, according to D. Visco, in the scale of the work they do as well. With multimillion pound projects it would be hard to notice the side-effects, or to even establish that they come from that particular project (D. Visco, personal communication, 5th of May 2018). D. Visco did, however, show a critical approach to the possibility of side-effects, and stated some examples of the dangers which their smart innovations could have:

"I think there are certainly concerns around it. I haven't noticed anything yet but there are concerns over what you do and what the impact of it would be. (...) Looking at something like air quality. And there are areas where – across the country there are clean air zones being built. But there is actually a concern that they just push the problem onto somebody else who is outside the clean air zone."

"So you you push vehicles from roads that were previously congested but were perhaps built for it, you push them onto side streets."

"One of the things we were doing from a major highway point of view is things like ban mopeds. Some of them. They can only go 30 miles an hour, they can't be particularly smart. The risk is then that you push those kind of vehicles onto local roads and past schools. Places where you wouldn't want them either"

Concerning the City Centre, the investigation of the documents shows no evidence for side-effects to the innovations as described in the previous section. This might link to the following quote of the Manchester City Council, drawn from an advisory report by Caird (2017) on communication between British Smart Cities:

“Inappropriate evaluation could kill a good idea if conducted too early.” (Caird, 2017).

However, it must be recognised that there is an evaluation report available on the Triangulum innovations in each of the cities. The joint assessment (the product of the Manchester University as mentioned before) recognises there are side-effects in the following way:

“Resources concentrated on a specific area can have positive spill-over effects or negative shadow effects in other geographical areas, particularly given the prioritization of investment and tax incentives that often are attached to public policy initiatives to kickstart new enterprise” (Evans et. al, 2015).

Though a quick nuance is given, limiting side-effects to the transportation and energy domains:

“While the specific impacts of improvement to transportation and energy are largely geographically specific, integrative ICT systems attempt to reduce lopsided geographical impacts through the provision of distributed benefit” (Evans et. al, 2015).

The report continues with the following, though strikingly, no negative externalities have been taken into account in the further course of the report:

“Negative shadow effects may arise through distorting incentives for private investment, which are difficult to precisely quantify with or without geographical specificity. The researchers acknowledge the existence of such negative externalities and will consider all glaring and adverse effects in forthcoming deliverables” (Evans et. al, 2015).

Manchester analysis

The description above of the Manchester case gives rise to the following observations, relevant to answer the central question:

1. Technology companies might not be interested in the side-effects, as clients or facilitators of projects have the end responsibility on its impacts. Jacobs is often put in the position of executor, rather than the facilitator of the project. This might explain the fact that D. Visco could not name any concrete side-effects to their projects. Another reason for not being able to name any side-effects could be that there is no active problem-seeking in implementing a project. Problems or positive side-effects possibly are dealt with as soon as they arise, rather than an early detection of side-effects and *avoiding* them from the start.
2. The scale of the project might blur any side-effects, as it might no longer be clear that the particular side-effect can be attributed to the smart innovation. Though, it would be logical that large-scaled projects hold a budget for the analysis of side-effects.
3. City governments might be reluctant to evaluate negative effects, as the results might disappoint. This could be connected back to ‘fear’ in Stein’s theory (Stein, 1992). Fear often leads to the *avoiding* of side-effects, or in this case, *avoiding* the possibility that any side-effects may become visible.
4. The statement that side-effects are unquantifiable seems to be enough reason to ignore/neglect speaking about side-effects in scientific papers or as an important implementing main actor.

4.3 Stavanger

History, current and existing smart developments

Norway has been and still is exemplary in the oil & gas business, according to M. Endresen. Seeing as Norway is fully reliant on renewables, oil and gas can be exported to other countries (Greater Stavanger, personal communication, 15th of May 2018). M. Endresen does make clear that it is hard to get any businesses and companies to invest in other sectors than oil & gas, as oil & gas has a short-term revenue guarantee. However, there is one technology company which is involved with almost all smart technology in Stavanger: Lyse. Together with Greater Stavanger, University of Stavanger and the Stavanger municipality consortium they form the central actors in Stavanger. Existing smart services with Triangulum funding are all based on the energy and transport domains:

- An energy facility which heats up and cools down the city hall, city centre and swimming pool with waste water.
- “Smarte Hjem”, a smart home system which allows residents to control lights and heating by means of an app.
- Three battery powered buses to reduce Co2 emissions (Stavanger Kommune, 2017).

M. Endresen made clear that Triangulum was important at the time, though the smart innovation is now evolving independently of Triangulum. Lyse is currently organising contests for smart innovation ideas and working on solutions within the ENSEA (European North Sea Energy Alliance) project to optimise the energy systems in terms of balance, storage and infrastructure (Demo:Lyse, 2018). From a brochure created by the head of the Smart City consortium of Stavanger, it became clear that the municipality focuses on five domains (health & welfare, education & knowledge, climate & environment, urban art and governance & democracy). These domains are projects like smart parking solutions, smart air quality sensors, and a 3D tool for Urban planning projects (Crawford, 2018).

Role of organisations and desired effects

There are a few returning actors in Stavanger in terms of Smart goods and services with each their own role and desired effects.

- Greater Stavanger, the organisation which often takes up the role of project manager and coordinator of Smart City projects within the city, is the establisher of meeting places between companies, the municipality and the people of Stavanger. They wish to achieve a healthy urban economy and prosperity for the citizens of Stavanger (M. Endresen, Greater Stavanger, personal communication, 15th of May 2018). M. Endresen mentioned that the most important factor to enable this was open data, so transparency.
- Stavanger Municipality is the facilitator of the Smart City projects within Stavanger. The Smart City consortium of Stavanger Municipality closely communicates with the inventing and realising/implementing actors, and has a few envisaged goals for Smart Innovation, among which a more sustainable community, more jobs, efficient public services, life quality, increase to capital and industry, promotion of Stavanger as the Smart hub, and reduction of greenhouse gas emissions (Crawford, 2018).
- Lyse is an inventing and implementing actor, which constantly assesses the potential for commercialisation of Smart goods and services to explore its market opportunities. Lyse wishes to bring out its expertise in several multi-purpose smart innovations, combining infrastructure, energy and telecommunication (Lyse, 2018).

Side-effects and decision-making

Upon telling M. Endresen about the interest in the side-effects of the smart innovations, a returning topic in the interview became the follow-up effect that the already implemented smart innovations brought about:

“But more interesting when it comes to Smart, are the spin-off effects” (M. Endresen, Greater Stavanger, personal communication, 15th of May 2018).

It was already stated in the Triangulum agreement that there were several follow-up cities in close contact with the lighthouse cities of Triangulum in case they would want to copy one of the smart goods or products. According to M. Endresen, Leipzig was very interested in the energy solutions in Stavanger. However, a spin-off side-effect arose, which seemed unintended yet desired on the basis of the interview. Seeing as Triangulum had clearly stated the goals and desired outputs in reports beforehand, there was little space to manoeuvre in as an organisation interested in Smart innovation. Thus, the companies, businesses and organisations that wished to invest in Stavanger wished to create their own conference and meeting platform, the Nordic Expo:

“The Nordic Expo is not only their exhibition and a conference, there is also a now a cluster of companies of which is a kick-off on Monday. So there is a cluster of Smart City companies, that has been established. So those are more the spin-off effects which I think is more important” (M. Endresen, Greater Stavanger, personal communication, 15th of May 2018).

As a result of the Nordic expo, M. Endresen gave the impression in the interview that Triangulum was no longer a necessity for smart innovation within the city

Further investigation of documents did not bring up any further reports, publications or mention of side-effects as a result of the smart innovations in Stavanger by Lyse or the municipality of Stavanger.

Analysis Stavanger

The description above of the Stavanger case gives rise to the following observations, relevant to answer the central question:

1.. What is striking, is that M. Endresen focused on an undesired, yet positive effect for the city. It is disputable that the foundation of a conference and meeting platform is a direct side-effect from the innovations of Triangulum, though the need for grew with the tight agreements from Triangulum. The introduction of smart services and goods, together with the expected output might have been a trigger for the establishment of it which would otherwise not have happened yet for some years. Actors implementing Smart Innovation may *avoid* speaking about any negative side-effects, possibly to *avoid* confrontation. The focus of the conversation was immediately put on this positive spin-off effect, which was ‘more important’, according to M. Endresen. Seeing as one of Greater Stavanger’s roles is to attract businesses to Stavanger, it might very well be that members of the organisation are mainly focused on promoting Stavanger, and putting the city in a advantageous business position, rather than being critical about any smart-innovations.

4.4 Cross-case analysis

In this section the results of the cross-case analysis will be discussed. Each of the cases were compared on their approach and response to side-effects to detect any common patterns.

There seems to be a different approach in each of the cities with implementing Smart services/goods which might explain some of the reactions to questions concerning side-effects.

- The actors in Eindhoven focus on the community and speak of a “Smart Society” rather than a Smart City. From the brochures, videos and the interview it became clear that Eindhoven is putting up great effort to receive the opinion of the citizens who use or are affected by smart goods or services, and to have an ear for their desires. One of the commonly used codes was “co-creation”. It is a possibility that this is the image the partners in Eindhoven wish to create of themselves, and that the documents associated with Eindhoven contain a unilateral view.
- Manchester is mostly occupied with the efficiency of the innovations and involving small local businesses to test the new services/goods.
- Stavanger has a very economic approach to Smart innovation. This is seen back in the efforts to create meeting places and set up communication between the main actors and businesses. A returning code in the interview was “city promotion”.

Whereas the representative of the municipality of Eindhoven did not see any side-effects yet, he did give enough evidence to support that they focused on an early inclusion and/or avoidance of possible side-effects. However, it was not done consciously to avoid side effects, but to avoid issues associated with the smart/service or good in the future. A focus was put on keeping the citizens happy and giving them the feeling that they contributed towards the Smart innovation. This might have been a strategy of the municipality of Eindhoven for citizens, as the feeling that they contributed to the innovation possibly reduces critique or notice of any negative effects associated with the innovation (H. van Amelsvoort, personal communication, 15th of May, 2018). In Manchester the process was slightly different. There seems to be a fear for the occurrence of side-effects, though it is not reflected in the way actors implement a smart innovation (D. Visco – Jacobs, personal communication, 5th of May 2018). There is also a reluctance to evaluate or reflect on the possibility that they might occur, possibly because they are aware issues may arise in the form of side-effects, given that the implementing factors did not take any steps to prevent these/include these in the decision-making (Caird, 2017). In Stavanger, the focus on promotion, having an open data base, and the provision of pull-factors for companies might explain the focus on positive side-effects. Marketing and selling innovations seems to be a priority in the city, so the underlining of any negative effects is disadvantageous (M. Endresen, Greater Stavanager, personal communication, 15th of May 2018; Demo:Lyse, 2018). In neither of the cities there seems to be a thorough evaluation on the side-effects of smart innovations, though there are impact assessments with themes like the total reduction of emissions.

Another striking result is that Stavanger seems a step ahead in the Smart innovations. Electric cars are seen as a normality in Stavanger, a given, while in Eindhoven and Manchester they are focusing on charging stations and promoting the electric cars as a concept of Smart Cities. This might be the reason why Triangulum seems to be important for Eindhoven and Manchester as a provider of subsidy, while Norway seems to be more independent.

5. Conclusions

Technology companies, knowledge institutions and city governments implement smart services/goods with a few envisioned effects in mind. Examples of these could be urban comfort, safer neighbourhoods, a greener environment and prosperity within the city. In implementing these smart services/goods, their potential is often highlighted to attract businesses, receive funds from the European Union and promote the particular cities. For this reason, the envisaged goals and effects are prioritised, though smart services/goods could have (positive/negative) side-effects as well.

Three pioneering cities have been researched, for each of which three comparable actors have been chosen. Interviews have been conducted together with documentation research to determine the side effects in each of these cities and the response to these by the main actors responsible for the implementation of the smart innovations.

In this chapter, the results of the literature review, together with the empirical results and the results from the documentation will be conjoined to answer the following main question:

→ *What are the known side-effects of smart city-like products and services in three European cities, and in which way did the City councils and technology companies that are implementing smart city-like products react to the side effects of these products and services?*

The conclusion will be divided in the following themes:

1. Existing and current developments
2. Side-effects associated with these developments
3. The reaction to these and the reason for this response

The answering of this questions will be followed by a reflection on the process and results, and recommendations which can be made on the basis of the research.

5.1 Conclusions

Existing and current developments

In the table below each of the smart services/goods have been noted for each city by the Smart City domains as described by Washburn (2010). Note that these are the innovations which became clear from the research, rather than a list of all innovations in the cities. Some innovations may be missing.

	Eindhoven	Manchester	Stavanger
City administration	Lamp-posts with own IP address	Data collection on the basis of: - Bluetooth signals - Lighting - Exhaust data - Vehicles in carparks - Potholes	
Education			Contests for new innovations
Healthcare	Lichtroute – jogging route	Community Wellness	
Public Safety	Lichtroute – smart lighting		
Real estate	-Smart lighting and heating offices. -3D tool		Smarte Hjem
Transport	-Mobility S -Smart charging stations -Smart parking on the basis of lamp-posts	-Introduction of 100% electric Nissans and vans - Smart parking	Three battery powered buses
Utilities	Smart sewage system	Building Management System	-Energy facility heating and cooling with waste water - ENSEA (European North Sea Energy Alliance)

Figure 11: The existing and current developments in each of the studied cities. Source: personal collection.

Each of these innovations have been investigated more closely to find any side-effects to them.

Known side effects

In Eindhoven no concrete side-effects were named or noted in any documents, though some could be derived from the interview with the municipality of Eindhoven. The **lichtroute** had the following physical side effects:

- A supermarket had to move and rebuild. This was because its back-side was too close to the pond to implement the lichtroute.
 - The lighting was harmful for bats. A nature organisation demanded that the lights would get adjusted to the animals. The organisation was not named.
- Finally, the **3D tool** had a socio-economic side-effect, as it was not accessible for every one due to its technical requirements and complexity.

In Manchester no concrete side-effects were named, or noted in any documents, though possible side-effects could be named by the representative of Jacobs. Rat-running between actors, roads and neighbourhoods is likely to occur as an unintended result of smart innovation. By banning out vehicles from clear air zones, more of those the vehicles might end up in other neighbourhoods. By attempting to detour vehicles off congested roads, side-streets might become congested instead.

In Stavanger no concrete side-effects could be found in the documents, though one unintended positive side-effect was highlighted by the representative of Greater Stavanger. This was the establishment of the Nordic Expo, as a result of the tight agreements and expected outputs of the Triangulum agreement. Businesses within Stavanger which became involved with Smart innovation as a result of Triangulum (like utility company Lyse), desired a more open approach and independency. Without the introduction of the Triangulum innovations and the corresponding partnerships, the Nordic Expo would not have been created.

An evaluation report from Triangulum which covered all three cities showed that the researchers would include the side-effects in their reflections on the smart innovations implemented in each of the cities, though no concrete side-effects were named in the report.

Striking here is the tendency to assume there are no side-effects, that there are only positive side-effects, or that they are there, but unquantifiable.

The reaction to these and the reason for this response

At the outset of the research, it was assumed that there were a number of clear side-effects which could be linked to smart innovations. However, none of the organisations could name any concrete side-effects to their implemented innovations. This became visible in both the interviews as well as the documents associated with the smart innovations in the cities. On the basis of the results, it was much easier to note any desired effects by the implementing actors, rather than the side-effects which might occur as a result of focusing on these envisaged goals. It seems to be a neglected subject in the first place. This asks for a reformulation of the main question. The question is not how organisations reacted to each of the side-effects, but why they could not name any concrete side-effects to their services/goods, or are let off by merely mentioning how ‘unquantifiable’ the effects are. The analysis of the three cases suggests that there may be a number of reasons for this:

- The approach to smart services/goods of the implementing actors might be too positive to detect any malfunctions. This issue has also been addressed by Hollands (2014), reasoning that Smart services/goods are often based on ‘a corporate utopian vision, or cinematic false dawns’ (Hollands, 2014). This might also explain the single positive side-effect that was named by the representative of Greater Stavanger.
- Municipalities might predict side-effects in advance to minimise costs and maximise efficiency, which is a reason why any side-effects have not been detected. This prediction happened with the wind turbines in Eindhoven, in which the full project got cancelled upon seeing the many problems and side-effects which wind-turbines could bring. No proof has been found to support this claim in any of the other smart innovations as shown in Figure 11.
- Thorough evaluation has not been carried out yet. A reflective report on Eindhoven’s innovations by Smartwayz consisted of an operationalisation and list of key themes, but the evaluation has not been carried out yet. In Triangulum’s report for each of the cities too, an evaluation on possible negative externalities was missing. This is despite the fact that the academics from each of the three cities wrote in the beginning of the report that those would be included in the evaluation. Evaluation is an important step in dealing with side-effects. It allows the identification of side-effects, so action can be taken upon getting notified on these effects.
- Citizens did not raise any issues associated with the Smart Innovation yet. In Eindhoven there might also be a reluctance to do this among some citizens, seeing as they were so closely involved with the implementation of a few innovations like the Lichtroute.
- There might be no side-effects at all, though this seems unlikely with the eye on the examples as described in the theoretical frame.
- Technology companies might not be interested in side-effects, as clients or facilitators of projects often have the responsibility on its impacts.
- City governments might be reluctant to evaluate on negative effects, as the results might disappoint. This could be connected back to ‘fear’ in Stein’s theory (Stein, 1992). Fear often leads to the *avoiding* of side-effects, or in this case, *avoiding* the possibility that any side-effects may become visible. The Manchester authorities clearly showed this approach by disapproving of an evaluation of the innovations as ‘Inappropriate evaluation could kill a good idea if conducted too early’.
- The statement that side-effects are unquantifiable seems enough reason to ignore/neglect side-effects in the further course of a scientific paper or a justification by an implementing actor.

5.2 Comparison to the hypothesis

Expected results on the basis of the conceptual model were the following:

1. It is not efficient to deal with any side-effects; the costs are too high and the contribution to the achievement of the goal of the smart product is too little.
2. The side-effects are not always visible or quantifiable.

On the basis of the results, both statements can be confirmed under circumstances.

Firstly, the representatives of the municipality of Eindhoven and Jacobs underlined the difficulty in identifying and measuring side-effects. It is a costly and time consuming process to thoroughly investigate any possible side-effects as a result of the smart innovation. The benefit of the smart innovation compared to the cost was an essential part of the decision-making concerning smart innovation according to the representative of Jacobs. However, it is disputable whether dealing with side-effects contributes to the goal/envisioned effect of the smart innovation. Seeing as side-effects are often not actively considered in the decision-making around smart innovations, it becomes an even harder task to determine whether dealing with them contributes to the envisioned goal or not.

Secondly, there was a pattern found in the answers to the question whether “the specific city government or technology company knows any side-effects related to the smart services/goods they have implemented or are implementing”. The researched city governments and technology companies could name no concrete side-effects, quickly followed by the second statement to justify this lack of knowledge. From the results it cannot be confirmed whether side-effects are truly not always visible or quantifiable, or whether it is merely an excuse to be able to avoid/ignore the side-effects.

In the next paragraph a reflection will be given on the validity, and the contribution to the literature of the research. Finally, recommendations will be given for follow-up studies and the practice of implementing smart innovations.

5.3 Discussion

Validity

Taking into mind that the positivist validity viewpoints (external/internal validity and reliability) do not entirely apply to qualitative research, the discussion will be based on: descriptive validity, interpretive validity, generalisability and evaluative validity (Maxwell, 1992).

Descriptive validity, credibility or the accurate reflection of what the participant has said can be guaranteed in this research. In the transcription any stresses on words or letters have been noted in order to maintain the verbal particularities as thoroughly as possible. The information has also been thoroughly named in the analysis, touching on multiple parts of the interviews. The documentation has also been read fully and has been coded to make sure no important details were left out. Methodological triangulation has been used to increase the credibility of the results; the research is based on multiple sources of information, among which interviews, brochures, reports, evaluations and videos.

Interpretive validity can also be guaranteed in this research. Literal words and concepts by the participants have been used in the research, and any words and concepts not understood by the researcher have been looked up and processed in the analysis. It must however be noted that interpretive validity cannot always be fully guaranteed. It is important to recognise that the results from the interviews are reliant on personal factors (age, gender), psychological factors (personal preferences) and -especially relevant in this research- the contextual factors (technology, discourse, and institutions in each of the cities) (McGowan and Sauter, 2005).

The factors named above also play a role in the generalisability of the research results. Firstly, very different actors have been interviewed in each case, which may have led to different results compared to a similar study focused on other types of organisations or actors. Secondly, only three interviews have been carried out. A more extensive sample might have led to different and more generalisable results. Thirdly, to answer the main question, three pioneering cities on a Smart City level have been chosen in Europe. Though this variation in cities/countries contributes to the generalisability of the research, the focus on one city in particular might have led to more detailed and integrated results for that particular area. With the eye on these three points, it is debatable whether this research really depicts the situation and patterns that can actually be found in each city/case, or whether the results merely reflect the interviewed respondents. However, despite the varying sample, repetitive themes have been found back in each city: the actors had trouble stating concrete side-effects.

Evaluative validity can be guaranteed in this research, as multiple reasons have been stated for the occurring of a certain phenomenon in the analysis and conclusion.

Contributions to the literature and recommendations

This research has contributed to the literature on Smart Cities in the sense that it gives new insights in the inclusion of side-effects by municipalities and technology companies implementing smart services/goods. However, unusual suspects or any other type of actor not associated with city governments or technology companies could have given new insights into the subjects. An example of a missed actor was social housing cooperation Volkerwessels in Eindhoven, which is no technology company, but is still closely involved in the smart innovations in the city. A recommendation for a follow-up study is to investigate the reaction to side-effects among any other involved actors than

city governments and technology companies. Moreover, the side-effects named in this research were based on consequences for citizens and animals, though side-effects could also belong in other domains, like environment. A suggestion for a follow-up study would be to distinguish any of these other side-effects.

Another recommendation can be made on the basis of the results, concerning the process of implementing smart services/goods. As side-effects do not seem to be thoroughly considered in the decision-making around smart innovations, a more critical approach towards smart innovations in the form of evaluations, and surveys among users to detect side-effects would be useful. This way, actors can respond adequately and timely to side-effects, whether these are desired or undesired, so these cannot threaten the effectiveness, efficiency or transparency of the smart innovation.

References

List of images and figures:

Figure 1: The role of CIOs in Planning, Implementing and Delivering the Smart City Vision. Source: Washburn (2010).....	4
Figure 2: Merge between the typical expected outcomes in the intellectual capital and smart city views. Source: Dumay (2013).	5
Figure 3 Internal and external side-effects. Source: personal collection.....	7
Figure 4 Responses and actions taken as a result. Amended from: Stein (1992).	7
Figure 5: The metrics for assessing a smart government initiative. Source: Nam (2014).....	8
Figure 6: Services and goods implemented by each of the cities. Source: personal collection.....	9
Figure 7 Responses to side-effects. Amended from: Stein (1992).	9
Figure 8 Conceptual model on the basis of the literature review. Source: personal collection.	10
Figure 9: Research stages. Amended from: Creswell (2006).	13
Figure 10: Information sources analysed in Atlas.TI. Source: personal collection.....	14
Figure 11: The existing and current developments in each of the studied cities. Source: personal collection.	26

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Appendix

Appendix A – Interview Guide

Interview guide Smart Cities

Eindhoven/Manchester/Nijmegen – April 2018
Sjane Marie van Urk – Radboud University

General

<i>Location:</i>	Determined by participant
<i>Respondents:</i>	Representatives of City Councils and ICT-companies
<i>Time:</i>	The interview will take approximately 45 minutes. This means 5 minutes can be spent for each question. At any point during the interview, the interviewee is allowed to take a break or to stop the interview completely, without having to name a reason. This will be respected by the interviewer.
<i>Essentials:</i>	The interview guide, equipment to record the interview, a note block, and writing utensils

Goal of the interview

The goal of the interview is to receive as much to information as possible on the particular smart city initiatives in Manchester/Eindhoven/Stavanger, and how decisions are made regarding these initiatives. E.g. : How does the organisation determine which neighbourhoods/citizens are served by the smart initiative?

Method

The interview is done face-to-face, over skype or over telephone. The interview is semi-structured, which means open questions will be asked to allow the respondent to speak freely. If any subjects come up which need further explaining, the interviewer may ask questions which are not stated in the interview guide, but instead focus on what the respondent brought up.

Informed consent

An informed consent covers the goal, the participation, and the security of the collected information/personal details. The respondent will be told about the importance of their contribution concerning the research, and how their information will be used and processed. The respondent will be asked whether they give permission to publish their names, and if not, the respondent will be asked how he/she wishes to be addressed (remaining anonymous included). Finally, the respondent will be asked if they agree to the recording of the interview. If not, the interview will not be recorded.

Course of the interview

<i>Introduction:</i>	Introduction of the interviewee, and details about the thesis. Details about the goal of the interview, the course of the interview and the expectations.
<i>Informed consent:</i>	Information about the data processing and the security of the respondents details/information. Presentation of the informed consent form and signing of it.
<i>Interview:</i>	Noting of the respondents details. Conducting of the interview on the basis of the questions below.
<i>Conclusions:</i>	Short summary of the chat and feedback. Time for any further explanations/additions. Word of thanks for the respondent.

Details respondent	
Name (fictitious)	
Date of birth	
Gender	M / F / Other
Organisation	
Function within organisation & duration	

Subject	Focused question
About the organisation	- Does your organisation mainly focus on the introduction of smart services, or is that merely a component? - In which domain (transport/energy/real estate) does your organisation specialise? - What is the role of your organisation within smart city innovation (inventor/facilitator/executor)? - When did your organisation first get engaged with Smart innovation? - Why did your organisation decide to get engaged with Smart innovation? - Could you name an existing smart innovation by your organisation?
Existing and current projects	- In which areas of the city is your organisation mainly active? → Could you name any characteristics of these areas that make Smart-investment appealing? - What projects is your organisation currently working on within these areas? - Is there a certain way of dealing with every smart innovation? – Like a plan of action/ steps you take? - Did you encounter any problems during the implementation of any of these projects?
Partnership & the role of other actors	- With whom do you work together to achieve smart innovation? - Is there usually a collective goal you work towards, or do some parties have other interests/visions?
Decision-making – Rolling out & Benefits for citizens → Specifically based on one Smart Innovation or domain	- Could you name the factors which played an important role in choosing where to roll out the smart innovation? - Which benefits do you wish to bring to your target audience with Smart-Innovation? - Which benefits does your organisation wish to gain from Smart-Innovation?
Side effects → Specifically based on one Smart Innovation or domain	- Did you take any measures prior to implementing the smart-technology to prevent unintended effects? - Did any unintended consequences for citizens arise after implementing the smart innovations? (e.g. more people visited the area). This can be positive or negative. - Did your organisation tackle or enhance these effects in any way? → How?

Informed consent form

Responsible persons for this research

Researcher: Sjane Marie van Urk

Supervisor & organisation: Karel Martens, Radboud University Nijmegen

If you have any questions, complaints, or other reasons to contact the researcher, please send a message to the following e-mail address: Sjane_urk@hotmail.com
Or call the following number: +316 14459496

To be signed by the respondent:

1. I hereby declare I have sufficient knowledge about the nature, method and goal of the research. I am aware that the information I will provide will be used in this research, and might be used in follow-up studies. I am aware the data will be processed confidentially, in line with privacy and legislation.

I agree with partaking in this research, given that I can withdraw from the interview at any time without having to give a reason.

Date: Signature:

2. I hereby give the researcher the right to record this interview by means of sound-recording equipment.

Signature:

3. I hereby declare I wish to stay anonymous, or wish to be addressed with the name below:

Anonymous: Yes / No

Name:

Signature:

Appendix B – Code book Atlas.ti

Code families

Code Groups
◇ (Un)desired effects + side-effects (22)
◇ City Promotion (16)
◇ Data: collection, provision, variables etc. (7)
◇ Factors in decision-making (14)
◇ Financial & Funds (8)
◇ Future (4)
◇ History in Smart (6)
◇ Involvement of citizens (6)
◇ Job & organisation details + the smart dev. by it (12)
◇ Policy (4)
◇ Private V public (8)
◇ The complexity of Smart Innovation - challenges & issues (18)

Codes (Open=Blue, Axial=Green, Selective=Red)

Name	Grounded	Density	Groups
◇ adaptation rather than brand new concepts	1	0	[Future]
◇ Advantages of Smart innovation	8	0	[(Un)desired effects + side-effects]
◇ Attracting businesses	2	0	[(Un)desired effects + side-effects]
◇ Attracting companies by providing open data	1	0	[(Un)desired effects + side-effects]
◇ Brainstorming about possibilities	1	0	[The complexity of Smart Innovation - challenges & issues]
◇ Businesses prefer stability and short term results	1	0	[Factors in decision-making] [Private V public]
◇ Challenges	1	0	[The complexity of Smart Innovation - challenges & issues]
◇ Citizen specific - very sophisticated	6	0	[The complexity of Smart Innovation - challenges & issues]
◇ Co-creation	6	0	[Involvement of citizens]
◇ Communication and networking	3	0	[City Promotion]
◇ Companies can't make enough business out of it	1	0	[City Promotion] [The complexity of Smart Innovation - challenges & issues]
◇ Complexity of Smart	4	0	[The complexity of Smart Innovation - challenges & issues]
◇ Considerations	13	0	[Factors in decision-making] [The complexity of Smart Innovation - challenges & issues]
◇ Creative sector	1	0	[City Promotion]
◇ Current smart developments	22	0	[Job & organisation details + the smart dev. by it]
◇ Daimler	1	0	[Job & organisation details + the smart dev. by it]
◇ Data as an innovation platform for businesses = investment in Stavang...	1	0	[City Promotion]
◇ Data security	1	0	[Data: collection, provision, variables etc.]
◇ Data sharing	6	0	[Data: collection, provision, variables etc.]
◇ Deliberate avoidance of side-effects	1	0	[(Un)desired effects + side-effects]
◇ Desired effect	5	0	[(Un)desired effects + side-effects]
◇ Details about data collection	5	0	[Data: collection, provision, variables etc.]
◇ Details about energy-winning	1	0	
◇ Details about the costs	1	0	[Factors in decision-making]
◇ Difference rural & urban	1	0	[Policy]
◇ Difficulty getting companies to invest in other sectors than energy bec...	1	0	[The complexity of Smart Innovation - challenges & issues]
◇ Discourse with decision-making	3	0	[Factors in decision-making]
◇ Division between private and public	3	0	[Private V public]
◇ Dropped Smart innovation	1	0	[(Un)desired effects + side-effects]
◇ Early stages of Smart	4	0	[History in Smart]
◇ Economic goal	1	0	[Factors in decision-making]
◇ Effects aren't visible yet	1	0	[(Un)desired effects + side-effects]
◇ Eindhoven history	6	0	[History in Smart]
◇ Enhancing collaboration between actors	1	0	[City Promotion] [Private V public]
◇ 'Er zijn redenen waarom ze het niet hebben door laten gaan' - no furth...	1	0	
◇ EU has to accept it	1	0	[The complexity of Smart Innovation - challenges & issues]
◇ Existing Smart Innovations	20	0	[Job & organisation details + the smart dev. by it]

● ◇ Experimenting	2	0
● ◇ Factor in decision making	12	0 [Factors in decision-making]
● ◇ Financial aspect	16	0 [Factors in decision-making]
● ◇ Follow up effect	8	0 [(Un)desired effects + side-effects]
● ◇ Future perspective	5	0 [Future]
● ◇ Getting the opinion of users	7	0 [Involvement of citizens]
● ◇ Goals to smart innovation and their indicators	1	0 [(Un)desired effects + side-effects]
● ◇ Hinting that Triangulum is no longer important for Stavanger	1	0
● ◇ Hinting that Triangulum is tight and not flexible - expected outputs clear	1	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ Horizon 2020 funding	1	0 [Financial & Funds]
● ◇ How data is collected	13	0 [Data: collection, provision, variables etc.]
● ◇ Identification with technology	1	0 [City Promotion]
● ◇ Imlying how good the smart innovation is by main actors	1	0 [City Promotion]
● ◇ Importance of businesses	2	0 [Financial & Funds]
● ◇ Importance of evaluation	1	0 [Factors in decision-making]
● ◇ Importance of schemes	4	0 [Factors in decision-making] [Financial & Funds]
● ◇ Investment in developed area	1	0 [Factors in decision-making]
● ◇ Involvement of knowledge institutions	1	0 [Job & organisation details + the smart dev. by it]
● ◇ Issue: some citizens cannot work with technique	2	0 [(Un)desired effects + side-effects] [Involvement of citizens]
● ◇ Issue: Time is short	1	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ Issues for Smart innovation	16	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ Knowledge about existence of side-effects	1	0 [(Un)desired effects + side-effects] [Factors in decision-making]
● ◇ Local policy	3	0 [Policy]
● ◇ Major changing factor in history	3	0 [History in Smart]
● ◇ Making very clear to people that it is a transparent process	2	0 [City Promotion] [Involvement of citizens]
● ◇ Malfactors in data	2	0 [Data: collection, provision, variables etc.]
● ◇ Manchester history	1	0 [History in Smart]
● ◇ More trusting of partners as a government	4	0 [Private V public]
● ◇ Multi-purpose of Smart	5	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ mutual dependence-user&implementer	4	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ NAM-themes come back	1	0 [Factors in decision-making]
● ◇ National policy	2	0 [Policy]
● ◇ Natural aspect	1	0
● ◇ Network of goals	1	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ No sign of negative side-effects, maybe due quantifiability	1	0 [(Un)desired effects + side-effects]
● ◇ Organisation details	5	0 [Job & organisation details + the smart dev. by it]
● ◇ Organisation work field	7	0 [Job & organisation details + the smart dev. by it]
● ◇ Partners	25	0 [Job & organisation details + the smart dev. by it]
● ◇ Peculiar investment from the funding	1	0 [Financial & Funds]
● ◇ Personal work field	1	0 [Job & organisation details + the smart dev. by it]
● ◇ Planned evaluation - not carried out yet	1	0 [Factors in decision-making]
● ◇ Predicted side effect and remedied - but not consciously	1	0 [(Un)desired effects + side-effects]
● ◇ Privacy legislation	2	0 [Policy]
● ◇ Private companies chase ROI	1	0 [Private V public]
● ◇ Private owners as 'doelgroep'	1	0 [Private V public]
● ◇ Progress in Smart development	1	0 [Future]
● ◇ Promise to consider side-effects	1	0 [(Un)desired effects + side-effects]
● ◇ Promotion of smart city by brussels	1	0 [City Promotion] [Financial & Funds]
● ◇ Promotion of sustainability	7	0 [Future]
● ◇ Promotion of the smart innovation	3	0 [City Promotion]
● ◇ Promotion project	1	0 [City Promotion]
● ◇ Providing data back	11	0 [Data: collection, provision, variables etc.]
● ◇ Publication by social media and conferences	1	0 [City Promotion]
● ◇ Quality of life guarantee	6	U [(Un)desired effects + side-effects]
● ◇ Questionable efficiency/effectiveness	1	0 [(Un)desired effects + side-effects] [Factors in decision-making]
● ◇ Renovation	1	0 [Job & organisation details + the smart dev. by it]
● ◇ Requirements for smart innovation	22	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ Role of organisation	19	0 [Job & organisation details + the smart dev. by it]
● ◇ Schemes & Subsidy	4	0 [Financial & Funds]
● ◇ Seen as a new concept in Eindhoven, while it is a normality in Norway...	1	0 [Job & organisation details + the smart dev. by it]
● ◇ Selective showing of opinions	1	0 [City Promotion] [Financial & Funds]
● ◇ Shared efficiency - citizen & implementer	1	0 [(Un)desired effects + side-effects] [Involvement of citizens]
● ◇ Side effect-	4	0 [(Un)desired effects + side-effects]
● ◇ Slow Municipality - Same with Manchester	1	0 [Private V public]
● ◇ Smart as a healthy solution	2	0
● ◇ Smart as health and safety concept	3	0 [City Promotion]
● ◇ Smart Society rather than Smart City	2	0 [Involvement of citizens]

● ◇ Smart tools	■	3	0
● ◇ Social cohesion		1	0 [(Un)desired effects + side-effects]
● ◇ Socially-desired answers		1	0 [City Promotion]
● ◇ Societal function	■	7	0 [Private V public]
● ◇ Special case - UK	■	3	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ Spin-off		1	0 [(Un)desired effects + side-effects]
● ◇ Stern influence of Brussels		1	0 [Financial & Funds]
● ◇ Success of attracting businesses to the city via Smart City promotion		1	0 [City Promotion]
● ◇ Sustainable solution	■	3	0
● ◇ Technical development	■	3	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ Technological background as a city		1	0 [History in Smart]
● ◇ Technological details	■	2	0 [History in Smart]
● ◇ Tool by KPN		1	0
● ◇ Transport as domain	■	5	0
● ◇ Triangulum	■	2	0 [Job & organisation details + the smart dev. by it]
● ◇ Uncertainty about Smart innovation	■	5	0 [The complexity of Smart Innovation - challenges & issues]
● ◇ Unpredicted side-effect and remedied	■	2	0 [(Un)desired effects + side-effects]
● ◇ Unquantifiable side-effects		1	0 [(Un)desired effects + side-effects]
● ◇ Using hydropower, yet heavily reliant on oil and gas business		1	0
● ◇ Variables in data	■	19	0 [Data: collection, provision, variables etc.]