Smartly sustainable

or

sustainably smart?

A study on the constitutive elements of the Smart Sustainable City

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Smartly sustainable or sustainably smart? – A study on the constitutive elements of the Smart Sustainable City

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Executive summary

The increasing world population and the changes in the world's climate have been found to threaten the future development of human life on Earth if nothing is done to mitigate their negative influence. A debate has been ignited about the role of cities in this regard as both the causes of the problems and as potential solutions to solve them. Over the years, many concepts, ideas and initiatives have come to the fore, and recently, a new concept called Smart Sustainable City (abbreviated as SSC) has been proposed to guide the future development of urban areas.

The Smart Sustainable City finds its origin in the combination of two earlier concepts, called Smart City and Sustainable City. Although proponents point at the possibility to combine the best of two worlds and develop cities according to this comprehensive framework, relatively little is known about how Smart City and Sustainable City relate to each other, outside the discussion surrounding SSC. This knowledge gap could lead to a development of a Smart Sustainable City theory that does not sufficiently take into account the mistakes and shortcomings of its predecessors, with suboptimal urban development results as a consequence in case the SSC theory is to be applied in the future. The problem formulation was therefore chosen as follows:

The unclarity about the relationship between Smart city and Sustainable city in the context of Smart Sustainable City increases the likelihood of failing Smart Sustainable City development efforts in the future.

Following from the problem formulation, the main research question sought to solve the problem by taking the relationship between Smart City and Sustainable City as the unit of analysis as its starting point. By then aiming for a detailed characterization of this relationship from both theoretical and practical angles and estimating its impact on the future of SSC, the goal is to increase the chances of a successful SSC theory development:

To what extent can the theoretical and practical relationship between Smart City and Sustainable City be more exhaustively characterized to increase the likelihood of a successful development of the SSC theory?

The reasoning behind the problem formulation and research question is that a better theory will lead to better urban planning results, with the 'perfect' future city as an elusive, but worthwhile goal to strive after. This view of the matter is in line with a positivistic, technocentric view of urban planning, which approaches the world (and in extension, cities) as a composition of multiple different systems (traffic, housing, energy, etc.) that interact with each other and for their individual optimal

performance are dependent on the performance of the other systems. This approach to city planning is advocated by a number of authors who also advocate for the SSC and was therefore adopted as a guideline for the research.

To give a characterization of the Smart City-Sustainable City link, however, a rather interpretivist epistemological approach was necessary. Given the relative infancy of the SSC research field and following the suggestions of Yin (1984), this qualitative way of studying the matter was preferred over a strictly technical characterization. Thus, two entities as understood through a positivistic ontology were analyzed using an interpretivist epistemology, with the goal of qualitatively clarifying the contribution of Smart City and Sustainable City to the SSC as a set of interacting concepts. The characterization resulted in both commonalities and differences between the two and furthermore showed there to be a dichotomy between what technically can be done to development Smart City or Sustainable City and what socially is aimed or wished for. Although the technical narrative, aiming at optimization of a city's functioning, currently has the upper hand, it was found that socially constructed knowledge regarding urban development should come to have a greater role in the development of a Smart Sustainable City theory.

Methodology

To answer the main research question, three subordinate research questions were formulated. Following the main research question, these questions were framed after the theoretical and practical angles. These two angles were chosen, because firstly, together they give a comprehensive picture of the Smart City-Sustainable City relationship and secondly, the practical results of implementing Smart City and Sustainable City principles cannot be fully understood and put into perspective without the knowing what the theoretical goals were that led to their implementation, in the first place. The first two questions are of a theoretical nature and assess the Smart City and the Sustainable City from the perspectives of

1. The way in which they are dominantly understood and defined in literature and interviews
2. The way in which they are described and epistemologically categorized
3. The function(s) they are understood to fulfill
4. The way in which they affect the economy and vice versa
5. The way in which they affect the political debate and vice versa
6. The way in which they affect the society and vice versa

The third question examined four existing urban development projects using the same six perspectives as given above, such that the findings could be compared to the theoretical part of the

project. As data sources, literature and interviews with professionals in the field were deemed to be the most viable ones, given the time, travel and research restrictions under which the project had to be conducted. The analysis of the collected data took place through discourse analysis, content analysis and thematic analysis.

Analysis results

The analysis resulted in several insights about Smart City, Sustainable City and how they relate to each other, as well as to the Smart Sustainable City. The most important finding is that instead of the technocentric understanding of cities in which systems are to be optimized through engineering and management, the political and societal influence on how a city develops appears to be more profound than expected.

Secondly, the role of Smart City in the SSC is likely to play an important role, because of the great amount of attention and research funding it is already receiving and its dominant feature of Information and Communication Technologies (ICT) that is widely regarded as a promising tool to achieve future developmental goals.

Thirdly, both Smart City and Sustainable City appear to contradictions regarding their goals in comparison to how they are supposed to reach these goals: their economic foundation is one that is connected to the currently prevailing paradigm of continuous growth under capitalist, neo-liberal economic principles. Yet, sustainable development, as a professed goal of both concepts, is likely unachievable while also aiming for continuous economic growth.

Fourthly, the Smart City and Sustainable City both have commonalities and differences that make keeping them strictly apart or seeing them as one and the same thing a difficult undertaking. In analogy to the first finding, it seems that a certain margin of free interpretation is necessary and effective to propel the academic and political discussion forward. This in turn goes against the original goal of the project for clarification and contributing to the work towards the ‘final’ goal of a ‘perfect’ future city.

Discussion

When putting all findings into perspective, it thus seems that the popular approach to urban planning as a matter of engineering and optimizing systems may have technical value, but does not coincide with reality, in which the socially constructed meaning of Smart City and Sustainable City has a bigger influence on their being than what ICT and sustainability principles can offer.

Content

Preface

A Master's thesis marks a turning point in a student's academic career. Most likely, it is his last hurdle before leaving the safe environment of university and venture into territories he thus far only knew from books. No safety net, no rubber bullets. "Welcome to the real world", they will say, grinning, while he gets back up with an iron taste in his mouth.

And indeed, this thesis is the most extensive and elaborate project, I have worked on so far. As part of the study program Sustainable Cities at Aalborg University in Copenhagen (Denmark), this document is the result of research carried out for the program's fourth semester and constitutes the last step towards obtaining the degree of Master of Science. It was conducted independently over the course of about four months and incorporates much of what I have learned over the past two years.

In this thesis, I got the chance to combine my two greatest academic interests: contributing to making cities cleaner, more sustainable places to live, while doing so through cutting-edge, innovative ideas and technologies. Over the course of the project, I learned how much more complex urban planning is than I already thought it was, that a city in the real world is a fragile balance between the visions of people and technical limitations. I also increased my academic research skills, took new steps in learning how to structure my thinking, analysis and writing, and pushed my limits by choosing an abstract topic that goes to the core of urban development.

I certainly could not have done this on my own, and therefore I would like to express my gratitude to some people who assisted, supported and/or endured me in my quest for new knowledge. First of all, I would like to thank my supervisor Lars Engberg, who has been of paramount importance in the process of finding a research topic, focus my research and writing down my findings. Always when I found myself tangled up in research papers and had stared myself blind on details, he pulled me out and, in the end, always found a way to boil everything down to what really mattered. It was through the counselling of Lars that I obtained some of the most important insights of this report.

Furthermore, I would like to thank Mrs. Mortensen and Mr. Braunstein of Frederiksberg Municipality for their willingness to participate in interviews and give me an impression of the daily reality of urban planning and the challenges they face in their work.

Lastly, I want to thank my friends and family for putting up with me during times that I frantically worked to turn my thesis into something I could be proud of. They kept me with both feet on the ground and made sure that my perfectionism would not get the best of me.

Towards the end of the work, I was remembered of the words of Ecclesiastes: “But beyond these, my son, be warned: there is no end to the making of many books, and much study wearies the body.” After five years spent behind the walls of universities, I now start to understand what he meant by this. Nevertheless, I hope for this thesis to be the starting point of something extraordinary and of doing my part in taking care of our planet.

Copenhagen, 8 June 2018

Mark Westerhuis

1. Introduction

This introductory chapter will set the stage for the report of the thesis project "Smartly sustainable or sustainably smart?", which was carried out during the spring of 2018 as part of the study program Sustainable Cities at Aalborg University in Copenhagen. In the following, a literature review will be presented outlining the context in which this project was carried out. Using the knowledge from this review, the research problem and accompanying research questions will be derived. The last part will consist of a definition of the scope of the project, including the project justification, position and audience, delimitation, assumptions and limitations.

1.1 Literature review

With the 21st century well underway, humanity is finding itself at a crossroads. The past decades have seen an unprecedented growth in economy, quality of life and knowledge. However, the global community has come to realize that these developments have also resulted in a deterioration of the Earth's climate and depletion of resources. Currently, the ecological footprint of humanity exceeds the carrying capacity of the Earth, putting the livelihoods of future generations at risk (Rockström et al., 2009). The unfolding consequences of this situation are felt worldwide. However, because effects of interventions can oftentimes only be evaluated after decades, decisions taken today will be decisive for the state of the planet in many years.

1.1.1 Climate Change

The deterioration of the Earth's climate as brought about by human activity is one form of what is called 'climate change' and has gained significant importance on the agendas of policy makers, notably since environmental problems were recognized as a global concern during the UN Stockholm Conference in 1972 (Höjer & Wangel, 2015). Climate change is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as a change of climate over extended periods of time (mostly decades or longer) that is attributable to human activities, natural variability (e.g. volcanic eruptions) or a combination of the two (IPCC, 2015).

The change in climate happening today is almost universally recognized as attributable to human activity with the consequence that on a global scale, the temperature of the Earth's atmosphere is rising: in its most recent Fifth Assessment report (2014), the International Panel on Climate Change (IPCC) concludes that the likelihood of human actions to be the cause for the observed warming of the global climate system is "extremely likely" (p.47) and pointed at factors like population size, economic activity and energy use to be decisive for the amount of released greenhouse gases, which

lie at the core of the rising atmospheric temperature. This has significant consequences on a myriad of ecological subsystems, including a rise in the water levels of seas and oceans, the acidification of natural water bodies and an increase in the frequency of extreme weather events, such as hurricanes, heat waves and droughts (IPCC, 2015).

1.1.2 Population growth

At the same time, however, the agreed plans to contain the negative influence of mankind on the Earth's ecosystems is being complicated by a steady rise in the global human population. With a current amount of 7.1 billion, this number is projected to rise to 8.6 billion by the year 2030 and to 9.8 billion by 2050 (UN DESA 2017, see also Figure 1). Although future population growth is heavily dependent on fertility rates, it can be said with confidence that most of this growth will take place in Africa and Asia, with the former being responsible for the lion's share (1.3 billion) of the total growth of 2.2 billion people (UN DESA, 2017).

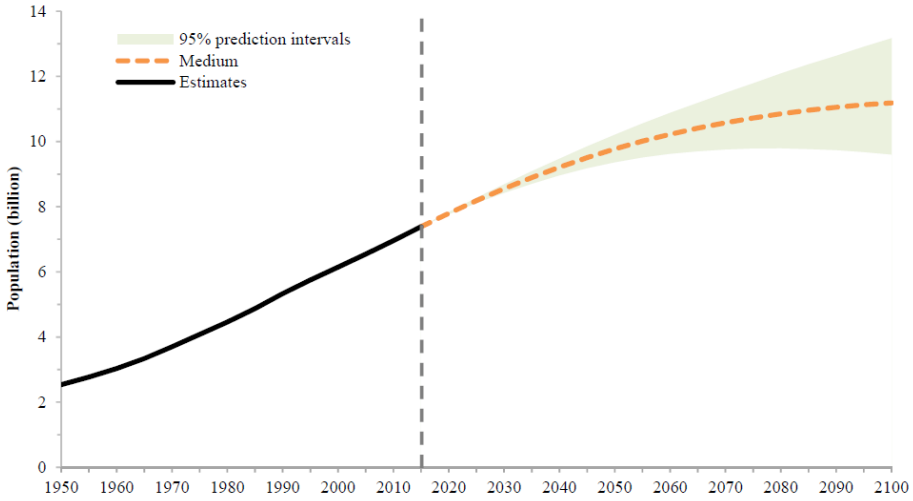

Figure 1: Development global population until 2100 (Source: UN DESA, 2017*, p.2)*

Because a bigger world population needs more resources to survive and thrive, whereas the current situation is one in which resources are either depleted or are being mismanaged, the global community has denoted population growth as one of the biggest obstacles to successfully limiting the most important negative effects of human intervention on the global climate (IPCC, 2015).

1.1.3 Sustainable Development

The general movement behind the push to limiting these effects and change the way humans use and influence the Earth's carrying capability is aimed at 'sustainable development'. The term 'sustainability' was first coined in the 1960s, around the time when the first reports of worrying

climate change began to surface. The call for sustainability ran counter to the conventional way of economic and human development, which thus far had only focused on growth in a financial and material sense, without notable consideration for the impacts on the environment. In general, sustainability is often understood as a balance between three dimensions: economy, society and environment (Bibri, 2018). In policy making, this balance has been formulated in terms of the 'triple bottom line', implying that the practical results of policy and development should be judged by 'what comes out under the bottom line' of each of these dimensions (UN WCED, 1987).

It eventually took until the release of Our Common Future in 1987, a report by a United Nations committee headed by Gro Harlem Brundtland – hence the colloquial name Brundtland Report –, that 'sustainability' and 'sustainable development' were fully recognized as necessary and desirable (UN WCED, 1987). Whereas the principles of sustainability were first cast into the Millennium Development Goals of the United Nations (running from 2000 to 2015) and, after having only been realized to partial extents, were then reframed into the Sustainable Development Goals in 2015 (Freeman, 2017).

Although easily to be confused with each other, 'sustainability' by itself is rather related to a "desired state or trajectory of development." (Höjer & Wangel, 2015, p.338). 'Sustainable development' on the other hand is to be understood as the operationalization of sustainability (Bibri & Krogstie, 2017). The definition of sustainable development as formulated by the Brundtland committee has been widely used until this day, and states that "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (UN WCED, 1987) Nevertheless, this definition has received widespread critique regarding its (oxymoronic) meaning (Jacobs, 1999; Redclift, 2005). For instance, it is said to be not certain what should be understood as 'needs', whether the needs of future generations can already be defined today, and who are understood to be included in 'future generations' (Redclift, 2005).

1.1.4 Role of cities

Around the same time the Brundtland definition of sustainable development was conceived, another trend in global human development became visible that is today understood to have a profound impact on the future ability of mankind to make sustainable development possible. Not only does the global population grow, but it also urbanizes at increasingly faster and bigger rates compared to the past decades.

In 2008, a milestone was reached when for the first time in history, more people lived in urban areas than did in rural ones (UN DESA 2015, see also Figure 2). As of 2014, the ratio between urban and

rural population was 54% in favor of urbanized areas (UN DESA, 2015) and this number is projected to rise to around 70% by the year 2050 (UN Habitat, 2015).

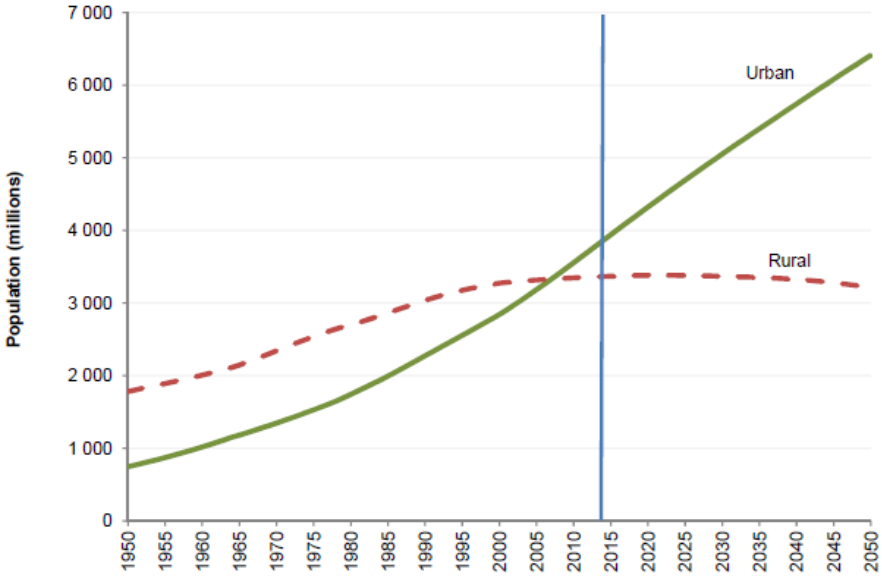

Figure 2: Development global urban and rural population until 2050 (source: UN DESA, 2015, p.7*)*

With this increase in urbanites, cities have also strengthened their position as economic powerhouses. Indeed, roughly 80% of the global GDP is produced in cities (Grubler & Fisk, 2013) and as much as one billion people living or moving to cities are projected to raise their living standards to that of what is considered the middle-class by 2025, thereby stimulating the world economy with US$20 trillion a year in consumption (Dobbs et al., 2012).

Whereas Europe and North-America today are already very urbanized, Asia and Africa are catching up, with urbanization rates being forecasted to grow from 40% and 48% to 56% and 64%, respectively (UN DESA, 2015). Most of this growth will take place in medium-sized cities with 1 million inhabitants or less (UN DESA, 2015). Effectively, these numbers represent an increase in the global urban population by more than two thirds (equivalent to 2.5 billion people) by 2050, with 90% of this increase taking place in Africa and Asia (UN DESA, 2015). With this enormous growth, the land area covered by cities is thus expected to nearly triple, when comparing numbers from the year 2000 to those expected for 2030 (UN DESA, 2015). Containing urban development is therefore of great importance as already in the year 2012, around 863 million people, accounting for almost one third of all urban dwellers in the developing regions of the world, lived in slums or other forms of informal settlements, lacking access to even the simplest services like water and sanitation (UN DESA, 2015). A worsening of this situation can significantly complicate the desire for sustainable development in general.

Jedwab et al. (2017) mention the 'urban pull' and 'rural push' to be significant contributors to the increasing migration of rural populations to urban centers: 'urban pull' is caused by a country experiencing e.g. an industrial revolution, which includes increasing wages and the attraction of workers from the countryside. 'Rural push' may be caused by poverty or natural disasters. Apart from industrialization, Hofmann and Wan (2013) also point at economic growth and education as primary drivers for urbanization.

The growth of cities can thus both be seen as a problem and a solution to sustainable development (Hodson & Marvin, 2017). On the one hand, cities are already responsible for 60% to 80% of global energy use and for 70% of resource consumption, with these numbers set to only increase in parallel to increasing numbers of residents (Elgazzar & El-Gazzar, 2017; UN Habitat, 2015). Moreover, the location of many big cities close to seas, oceans and estuaries makes them vulnerable to the already mentioned sea level rise and occurrence of natural disasters (de Sherbinin, Schiller, & Pulsipher, 2007).

It is therefore not a farfetched idea to take on the challenges of lowering the global resource use and population rise through strategies that aim at leading urban development in the right direction. In 1992, the United Nations Conference on Environment and Development in Rio de Janeiro (Brazil) resulted in the publication of the Agenda 21, a non-binding action plan that cities and communities around the world were encouraged to use in their efforts for sustainable development (Höjer & Wangel, 2015). Indeed, in their capacity as centers of innovation and development (Mitchell & Villa, 2010), cities are places that have a significant influence on socio-economic and environmental development (John, Keeler, Wiek, & Lang, 2015). Consequently, over the years many different terms, concepts and initiatives have been proposed with the goal of supporting the development of the urban realm (De Jong, Joss, Schraven, Zhan, & Weijnen, 2015).

1.1.5 Smart City

One of the most influential ones of these development concepts is the Smart City. It is characterized by its reliance on Information and Communication Technologies (ICT) as a tool to be used in various sectors of urban management, including energy, traffic, water management and healthcare (Albino, Berardi, & Dangelico, 2015; Nasrawi, Adams, & El-Zaart, 2016). Because of the enabling role of ICT, the roots of Smart City extend back into the 1960s, a time in which the advent of digital technology became a transformative force for the way society functions, and equally so for urban planning as a profession and research field (Albino et al., 2015; Angelidou, 2015; Höjer & Wangel, 2015). The use of computers made it possible to design and manage urban development in a more efficient and informed way than hitherto possible (Klosterman, 2015).

It however was not until the 1990s and the popularity of a movement called Smart Growth, when the adoption of digital technology in urban planning took a flight and Smart City became popular among scholars and policy-makers (Höjer & Wangel, 2015). Smart Growth professed action to be undertaken against traffic congestion, air pollution, loss of open space and so forth (Yang, 2009). Effectively, and according to Cervero (2001, p.29), Smart Growth is "mainly about better coordinating and integrating transportation and land development", thereby discouraging urban sprawl. As part of the wider framework of New Urbanism, smart growth envisages a profound change in the way cities should function and develop (Albino et al. 2015). Part of the popularity of Smart City in this wider context is its holistic approach to address the issues discussed by Smart Growth, combining elements of social, sustainable and economic development. This enthusiasm has extended into the 21st century, with as many as 143 initiatives ongoing or completed in cities around the world in 2013 (Lee, Hancock, & Hu, 2014). An important driver for the worldwide adoption of Smart City was the publication of the "Horizon 2020" development plan of the European Union (European Commission, 2010), which set out a European development strategy and thereby provided considerable funding into Smart City as a key component of European urban development until the year 2020 (Manville et al., 2014; Sanseverino, 2017).

Nevertheless, and perhaps exactly because of its widespread applicability, Smart City remains a difficult term to explain. As there to this day is no single, comprehensive definition (Gil-Garcia, Pardo, & Nam, 2015), several scholars over the years have provided multiple ways of understanding Smart City by using varying classification schemes (Angelidou, 2014; Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014). Ahvenniemi (2017) identifies two tracks: one in which there is an emphasis on a technology centered approach with ICT at the heart of Smart City (Bibri & Krogstie, 2017; Harrison, C. and Donnelly, 2011; Washburn & Sindhu, 2010), while the other track takes citizens and their position in the urban system as a starting point (Hollands, 2008; Nam & Pardo, 2011; Neirotti et al., 2014). One of the most widely referenced authors is Giffinger (2007), who initially identified four components of a Smart City in which 'smartness' is implemented: industry, education, participation and technical infrastructure. This list was later expanded to six components (Giffinger and Gudrun 2010), including smart economy, smart mobility, smart environment, smart people, smart living and smart governance.

What makes understanding Smart City even more complicated is its close relationship to other concepts. Albino (2015) gives a detailed account on the commonalities and differences between Smart City and such concepts as Digital City, Intelligent City, Virtual City, Ubiquitous City and Knowledge City. What makes Smart City different from these other concepts is its relatively elaborate attention to a holistic development of the city, which not so much treats ICT as a goal in itself (as e.g.

Digital City and Intelligent City do) but uses ICT as a tool to create a higher quality of life for citizens and improve environmental sustainability, along with economic opportunity (Albino et al., 2015; Maltese, Mariotti, & Boscacci, 2016).

With the discourse surrounding the Smart City having been around for the past 20 years, some have identified patterns and point out a shift that is happening: from a first phase of communication or "evangelism", the discussion is now moving to a second phase, in which the obstacles become rather political, economic and legal, instead of only technical (Saujot and Erard 2015, p.21). To some, this morphing of the discussion from a fundamental one to an organizational one was only a matter of time, as most of the technology implemented in Smart Cities is said to have already existed before but was hitherto never used in conjunction with each other on a scale as big as seen today (Höjer & Wangel, 2015).

The scale at which ICT is used in the Smart City reinforces its importance. Indeed, despite ICT being a means to an end, which could lead to the impression that it enjoys less attention than in Virtual City or Knowledge City, ICT remains a defining feature of Smart City, and it is said to play an important, enabling role for its realization (Manville et al., 2014; Nam & Pardo, 2011). El-Gazzar (2017) identifies the Internet of Things (IoT) and the data that is generated by the IoT (Big Data) as the core components of the ICT that is driving the Smart City movement.

The main driving force behind the adoption of ICT are corporate actors (McFarlane & Söderström, 2017; Söderström, Paasche, & Klauser, 2014). They specialize in offering products for more informed decision making, with diverse goals such as achieving energy efficiency or decreasing traffic congestion and air pollution, among other things (Höjer & Wangel, 2015). This leads some to question to which extent there is a supply push from the side of firms, who have a strong financial interest in selling their products, or a demand pull from the side of society, who are to be the end users of the Smart City solutions (Angelidou, 2015).

It is exactly the role of businesses in cooperation with governments and their focus on technical 'solutions' to urban 'problems' that has generated substantive critique over the past years. Albino (2015), for example, points at the negligence of social and environmental aspects of urban life in favor of economic development. Kitchin (2015) argues that because of this focus on the economic performance of a city, the current framing and use of ICT does little to truly improve other aspects of the urban realm. Although software and hardware in theory do provide benefits for efficiency, connectivity and real-time management of urban infrastructure, this view does not depend on the inclusion of the public, nor does it give them any meaningful role in it.

Furthermore, Hollands (2008), as one of the most referenced critics of Smart City, points out the intentions of cities using the term Smart City as a badge to promote themselves as innovative and attractive to external investors. This way, Smart City becomes nothing more than a label, lacking any deeper meaning than whatever meaning it is given, as is also explained by Chourabi (2012, p.2290), stating that "some are recognizing the use of smart city as an urban labeling phenomenon, noting that the label smart city is a concept and is used in ways that are not always consistent."

1.1.6 Sustainable City

When it comes to addressing the development challenges of cities, there is another concept that has been hotly debated over the years and in relation to Smart City pays more attention to environmental and social sustainability: Sustainable City. What is today understood as the Sustainable City traces its roots to the recognition of the human influence on the Earth's climate in the late 20th century and the birth of the 'sustainability' and 'sustainable development' movements. It was through the adoption of the Brundtland definition of sustainable development and the (Local) Agenda 21 that some of the first references to the term Sustainable City were made (Freeman, 2017; Koh, Gunawansa, & Bhullar, 2010).

Nevertheless, as with Smart City, Sustainable City is a difficult term to define. Some explanations exist, which describe a Sustainable City as one which balances the interests in economic, environmental and socio-cultural aspects (Mega & Pedersen, 1998) or as one which "aims at attaining a set of sustainability principles." (Aina 2017, p.50) Still, as explicated by Bulkeley and Betsill (Bulkeley and Betsill 2005, p.42): "Despite [...] near universal recognition that sustainable cities [...] are a desirable policy goal, there is less certainty about what this might mean in practice."

There have also been several attempts at classifying the sectors belonging to the Sustainable City. UN Habitat (2016) refers to economic, environmental and societal development goals to be overarched by a governance system that includes a thorough inclusion of the public. The Sustainable City can then be operationalized through the so-called quadruple helix model as adopted by the Swedish government in their national Smart Sustainable City strategy, which sees civil society, academic actors, industry and government working together to realize common goals (Kordas, Lazarevic, & Linn, 2015).

A further similarity with Smart City is that Sustainable City experiences competition from similar terms and concepts, too. The most notable of these is the Eco-City. In their comparison of Sustainable City and Eco-City, Koh et al. (2010) describe the term Eco-City to be coined by Richard Register, who explained his idea of a city in which people would live in harmony with nature. Recent surveys have

indicated a substantial number of Eco-City initiatives to exist around the globe, with 170 initiatives being underway, of which more than 100 located in China (Caprotti, 2014).

Despite this relative success, however, the true Eco-City remains elusive. While Eco-City in comparison to Sustainable City seems to be rather aimed at developing new cities, whereas the latter is more related to retrofitting existing cities for sustainability (Koh et al. 2010), Chang (2017) finds Eco-City to include the activity of retrofitting, as well. He further points out how the term Eco-City is interpreted in different ways by different actors, turning it into just as much as a label with flexible meaning as Smart City.

Williams (2010) locates the greatest challenge of Sustainable City to currently be in its definition and how to apply it to cities. Telling it apart from the rivalling Eco-City is already hard enough, but this is further complicated by the findings of Hodson and Marvin (2017), who diagnose the Sustainable City narrative to have fallen apart in multiple different "logics" ('urban resilience', 'urban carbon regulation', 'smart urbanism', etc.), each with its own focus. Neither of these logics, however, have as a comprehensive and inclusive meaning and applicability as Sustainable City has.

1.1.7 Smart Sustainable City

Over time, a balance appeared to be reached between the 'tracks' of Smart City and Sustainable City. Since the beginning of the 2010s, however, some researchers have started to suggest that there could be benefits to combining Smart City and Sustainable City (Kramers, Höjer, Lövehagen, & Wangel, 2014; Nasrawi et al., 2016). Aptly called Smart Sustainable City (also abbreviated as SSC), this concept was to bring together the best of sustainable urban development – as represented by Sustainable City – with the ICT features of Smart City. Specifically, Höjer and Wangel (2015) identified five different developments contributing to the birth of SSC, namely (1) the globalization of environmental problems and sustainable development, (2) urbanization and urban growth, (3) sustainable urban development and sustainable cities, (4) the advent of ICT and (5) the application of ICT in cities through Smart Cities.

Like Smart City and Sustainable City, SSC is hard to define; it has no standardized terminologies as of yet (Ibrahim, El-Zaart, & Adams, 2018) and the available attempts of various authors, as bundled by Ibrahim (2015), appear to spend most attention to utilizing ICT for sustainable urban development (Bifulco, Tregua, Amitrano, & D'Auria, 2016; Manville et al., 2014). Höjer and Wangel (2015) are most concrete by defining the SSC through its individual components "smart", "sustainable" and "city", stating that the SSC is an aggregate concept that can only exist through the combination of all three components. Their definition of the SSC (p.342) counts among the most widely adopted ones

and is closely related to the Brundtland definition of sustainable development (1987): an SSC "is a city that meets the needs of its present inhabitants, without compromising the ability for other people or future generations to meet their needs; and thus, does not exceed local or planetary environmental limitations, and where this is supported by ICT." Why the Brundtland definition of sustainable development was chosen to have such a prominent role, however, is not clarified.

One other influential definition was put forth by the International Telecommunications Union's (ITU-T, 2014) Focus Group on Smart Sustainable Cities (FG-SSC). Through analyzing more than 100 definitions on Smart City and Sustainable City, the FG-SSC abstracted the most frequently appearing and influential terms to arrive at the conclusion that an SSC "is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects." (p.13)

So far, Bibri and Krogstie (2017, p.185) have provided the most comprehensive overview of Smart Sustainable City to date, outlining that ICT is the best available candidate for the sustainability challenges of this time, given its "proven track record" of outperforming other ideas of the past, including Compact City and Eco-City. The main goal of ICT in the context of SSC is to bring about sustainability, efficiency and a better quality of life for city residents, by connecting urban sectors and make urban development a more efficient process. Indeed, ICT is referred to as being essential to the Smart Sustainable City, as it holds the "key to a better world." (p.185) Conversely, however, Kitchin (2015) and Haarstad (2017) question this faith in the abilities of digital technologies, stressing that there is still a limited understanding of what it contributes to sustainable development.

Despite research on the SSC still being in the beginning stages (Bibri & Krogstie, 2017), the efforts of the scientific community to put SSC on the map in recent years have resulted in interest from the corporate and political realm. Ibrahim (2015) observes companies like Cisco, IBM, Panasonic and Huawei to have released their take on the Smart Sustainable City through publications. In the same paper, countries like the USA, China and the UK are also mentioned as adopters of the SSC. In Sweden, too, the Smart Sustainable City has been noticed and adopted (Freeman, 2017). In 2015, the Swedish government published the Strategic innovation Program for Smart Sustainable Cities (Kordas et al., 2015), which outlines how the Smart Sustainable City may be shaped and implemented in Swedish cities.

To facilitate this interest and provide decision-makers with practical tools, the development of strategic frameworks to implement SSC has been picked up by several institutions and authors. The European Union describes the necessary steps towards the Smart Sustainable City to consist of six steps, including (1) the development of a holistic vision, (2) the agreement on a central plan for the activities, (3) the design of the necessary interventions, (4) the actual construction of the infrastructure, (5) the delivery of the infrastructure and services and (6) the operation of those (Ibrahim et al., 2015). Similar ideas were proposed by Clarke (2013) and the British Standards Institution (Ibrahim et al., 2015).

There is also development work being done in related areas, such as the elucidation on how to govern the implementation of SSC measures (Kramers, Wangel, & Höjer, 2016), how the planning process for SSC should best be shaped (Kramers, Hojer, & Wangel, 2014) and how a comprehensive transformative 'roadmap' to the SSC could look like (Ibrahim et al., 2018). Hara (2016) specifies how these processes could be steered by defining four layers of Key Performance Indicators, which are based on the Triple Bottom Line of sustainable development.

Despite all this progress and the infancy of SSC, however, there is already substantive critique towards it. The most often referenced one is related to the currently dominant vision of bringing about the Smart Sustainable City by adjusting Smart City (that is, ICT) initiatives towards a more profound integration of social and environmental sustainability aspects. As Aina (2017, p.50) puts it, "it is debatable whether a mere implementation of a smart city could lead to a sustainable city." Ringenson et al. (2017) express similar worries in their paper on the limits of the Smart Sustainable City by asking to what extent society should be willing to rely on ICT for a city's functioning, while at the same time eradicating all 'analogue' methods and infrastructure that would constitute a valuable backup, in case the ICT systems fail. Furthermore, from the widespread application of ICT for sustainability it does not necessarily follow that people as the end-users also become more sustainable. Rather, there could be rebound effects (Ringenson et al., 2017). One should also not forget about the energy use of ICT itself. As Kramers (2014) observes in the case of the city of Stockholm (Sweden), ICT also does not necessarily provide solutions for the entirety of a city's sectors: in Stockholm, only 50% to 60% of the city's total energy use could be made more efficient through ICT applications.

Also, when it comes to questions regarding what can be done, what a city has already done and what is necessary to be done, there is no agreement, yet. As Ibrahim (2015) stresses in his article on the development of a roadmap towards SSC, none of the studies reviewed for the research pay attention

to examining a city's readiness for change or wide-scale interventions. Effectively, there is a lack of theory for the transformation of cities, despite the frameworks already proposed.

Regarding other knowledge gaps, there appears to be unclarity about the extent to which sustainability can be assumed to be an integral part of Smart City. Despite the defining role of Smart and Sustainable City in SSC, Höjer and Wangel (2015) observe parallels between the two and recognize those who claim that to an extent, the sustainability goals inherent to Smart City make it possible to treat Smart City and Sustainable City – at least partially – as the same thing. Several other studies also highlight the potential of ICT in Smart City to contribute to sustainability (Bibri & Krogstie, 2017; Rivera, Eriksson, & Wangel, 2015), without even mentioning the idea of Smart Sustainable City (Colldahl, Frey, & Kelemen, 2013; Silva, Khan, & Han, 2018). Anthopoulos (2017) finds there to be connections between Smart City, sustainability and overall quality of life, too. On the other hand, Höjer and Wangel (2015) also present findings of other researchers finding considerable differences between Smart City and Sustainable City.

1.2 Problem analysis and research questions

1.2.1 Problem Analysis

As outlined in the literature review, cities find themselves in a position that enables them to take on the development challenges lying ahead for the global community. At the same time, they are and could continue to be the cause of those same challenges.

The Smart Sustainable City (SSC) is now being introduced as the latest proposal to steer urban development towards meeting future needs: housing an extra 2.5 billion people in cities, whilst altering resource use and energy generation such that they do not exceed the Earth's carrying capacity. SSC emanates from Smart City and Sustainable City: The Smart City – with its dominant feature of ICT – is said to facilitate informed decision-making, resource use efficiency and communication between stakeholders on a scale that makes taking on the future development challenges technically feasible. The Sustainable City on the other hand relates directly to the need for a reduced influence of mankind on the natural environment and recognizes the pivotal role of cities in this respect. The SSC is intended to unify these different approaches to urban development under one roof and facilitate the combination of the best of two worlds.

Despite this potential, there are however knowledge caveats that may hamper the future development of an SSC theory. The literature review mentions a lack of normative definitions of the SSC, measuring frameworks for SSC project results and knowledge on how its 'ancestors' Smart City and Sustainable City relate to each other before they can be combined into the SSC. Not addressing

these gaps may eventually lead to unclarity about the translation of theory into practical guidelines and tangible planning results.

Especially the knowledge caveat regarding the relationship between Smart City and Sustainable City is a subject that lies at the core of the SSC and informs the way it can be understood by both researchers and practitioners in urban development. Although Smart City and Sustainable City as individual concepts have been thoroughly discussed in literature and have been applied to projects around the world, their elusive definitions and unclear relationship raise questions as to how well they can inform the formation of any SSC theory, and even whether the SSC can actually be realized and constitute a viable alternative to already existing urban development concepts.

Uncertainty about the conceptual pillars on which SSC is founded could amplify into confusion at later stages of the SSC's development, both in theory and practice. Given the looming environmental, social and economic challenges ahead, however, the cost of letting Smart City, Sustainable City or Smart Sustainable City fail may be unacceptably high. Therefore, the problem threatening the development of the SSC is that the unclarity about the relationship between Smart City and Sustainable City, as utilized by the SSC proponents, leads to a risk of the Smart Sustainable City failing to materialize: projects not delivering what they are meant to, resource usage not lowered to sustainable levels, etc. In short, this problem can be summarized as follows:

The unclarity about the relationship between Smart city and Sustainable city in the context of Smart Sustainable City increases the likelihood of failing Smart Sustainable City development efforts in the future.

Following from this problem, it can be concluded that the objective should be to provide more clarity about the way in which Smart City and Sustainable City relate to each other, thus taking their mutual relationship as the unit of analysis. By solving the problem, both the academic and practitioner communities can benefit from knowing what the differences and/or commonalities are to refine their understanding of the concepts they are working with and succeed in developing an SSC theory. Mistakes made in the past by attempts to implement Smart City or Sustainable City principles may be avoided and the strengths of both can be highlighted as special points of interest for the SSC theory development.

The academic reader of this report will be provided with knowledge that can act as input for the further development of a theory that can describe the Smart Sustainable City and its application. For the practitioner, the report aims to give information about Smart City and Sustainable City as they are worked with already and how they relate to each other, which can be useful within and outside the

discussion surrounding the SSC. The deliberate attention that is given to placing the unit of analysis in the context of SSC may also act as education of the practitioner on the latest developments in the field of urban development.

1.2.2 Main research question

The main research question will delineate the area in which the solution to the research problem is to be found. Based on the problem statement in the previous section, the main research question will take its point of departure in the unit of analysis and be directed to finding the commonalities and/or differences between Smart City and Sustainable City, thereby enabling a characterization of their relationship. By doing so, the logic behind the question (as further explained in Chapter 2.1) is to contribute knowledge to a linear process of theory development that starts by defining the concepts to be worked with and ends with a fully-fledged SSC theory that can be used in practical urban planning projects. The question is formulated as follows:

To what extent can the theoretical and practical relationship between Smart City and Sustainable City be more exhaustively characterized to increase the likelihood of a successful development of the SSC theory?

The formulation of the research question was strategically chosen to facilitate a rather explorative approach to the subject, without asking whether Smart City and Sustainable City are either the same or two independent concepts. Doing so would force the researcher to eventually pick a side, which however may not correlate with the ambiguity of reality, in which there may be arguments for both sides. Neither was the question framed to concentrate on asking whether there are commonalities or differences, as this would result in a yes/no-question that does not result in useful results for new knowledge generation, other than the fact that there are (no) commonalities or differences.

Instead, by using the phrase 'to what extent', the relationship as an entity can be characterized from any angle; the researcher is free to arrive at both commonalities and differences and explore the subject as thoroughly as he can or wants to. By specifically asking for a 'more exhaustive' characterization of the relationship, the current situation is taken as a reference point, in which little is known about the Smart City-Sustainable City relationship, other than what was covered in this report's literature review.

Importantly, the main research question includes an "SSC theory" as a concretization of the phrase "Smart Sustainable City development efforts" used in the problem formulation. This SSC theory is envisioned to delimitate the SSC regarding i.a. its properties, implementation, distinctness and influence on the city's functioning, among other things.

The answer to the research question can contribute to the characterization of SSC as some have already attempted to do in earlier papers (Bibri & Krogstie, 2017; Höjer & Wangel, 2015). The answer to the research question may be multifaceted: in some respects, Smart City and Sustainable City might have common grounds that would increase the importance of defining in what way the Smart Sustainable City adds something new to the debate. On the other hand, Smart City and Sustainable City might (also) be distinct from each other or even be incompatible, which would complicate the development of the SSC. Hence, there is a spectrum of possible answers, and finding these answers are expected to drive the SSC discussion forward.

1.2.3 Subordinate research questions

To make the work for answering the main research question better manageable, a number of subordinate research questions were derived from the main one. Together, the answers to these questions make it possible to answer the main research question. In the following, they will be presented and justified in turn, with the specific methodology for working with them specified in Chapter 2.

The main question was chosen to be approached from two angles, namely theoretically and practically. This way, a comprehensive and detailed picture can be provided of all aspects in which Smart City and Sustainable City are related. For the sake of comprehensibility and differences in content, the work for the theoretical part of the research was decided to be split up into two questions. As to the practically oriented part of the research, there is one question.

Each question covers a different level of abstraction, such that together, they will provide a detailed view of the topic at hand. Furthermore, for ease of comprehension and understanding, the questions have been ordered to progress from a general, theoretical level to the specific, practical level of application.

Research question 1:

How does the theoretical relationship between Smart City and Sustainable City in an epistemological context affect the SSC theory development?

The first research question is intended to characterize the understanding of the relationship between Smart City and Sustainable City from an epistemological perspective. That is, attention will be payed to the way in which the relationship can be understood, based on the existing understanding of Smart City and Sustainable City and what kind of terminology is applied to describe them. Other aspects of interest are the relative emphasis that may be placed upon either Smart City or Sustainable City

(which one is discussed more than the other?) and what their perceived function is in urban development.

Examining the relationship at this level of abstraction will yield important insights into the features that are likely to dominate SSC theory development, which ones are (perhaps undeservedly) left out of consideration and how the terminology to describe Smart City and Sustainable City with might influence the terminology within SSC.

Research question 2:

How does the theoretical relationship between Smart City and Sustainable City in an economic, political and social context affect the SSC theory development?

The second research question approaches the relationship between Smart City and Sustainable City from a similarly theoretical angle as the first question, but this time using the perspectives of economy, policy and society. These perspectives have been chosen, because they have a profound influence on the functioning and development of urban areas and represent the three most important groups of stakeholders: business, government and society. The area of politics has decisive power over the implementation and practical features of urban development projects and coming to understand how Smart City and Sustainable City are related to each other by politicians therefore gives important insights for the SSC.

The political process in agreeing upon and shaping a project is to an important extent governed by the economic situation of a city, which in turn is shaped by the public opinion and the democratic process. Examining Smart City and Sustainable City from this perspective will therefore also provide cues as to how the SSC can best be financed and modeled.

Lastly, society is directly affected by any initiative and intervention into its living environment, framed by the economic situation and political decisions. Getting to know the position of citizens influencing and being influenced by Smart City and Sustainable City projects will thus show how these concepts are understood and dealt with by those for whom these projects are conducted or should be carried out. Important lessons for the SSC can consequently be drawn from them.

Because these three areas of the urban system so intertwined, they are combined into one single research question. They together constitute external factors influencing and framing the way in which smartness, sustainability and the combination of the two is dealt with.

Research question 3:

How does the relationship between Smart City and Sustainable City as expressed in already existing urban development projects affect the SSC theory development?

The last question is practically oriented and takes the findings from the first two questions as input to learn how Smart City and Sustainable City are being treated in real world projects. This perspective allows for yet another view on the topic at hand and – importantly – moves beyond the discussion that is ongoing within the scientific community and relates the theoretical findings to the practical circumstances of urban planning projects. Adding this level of abstraction to the project is intended to provide a useful insight in the manner in which theory currently is transferred to the real world, with tangible consequences and results. Especially this question might give clues about the current value of the link between Smart City Sustainable City.

1.3 Scope of project

1.3.1 Practical and academic justification

There are several reasons, both regarding the practice of and research on urban planning, as to why this project was worthwhile to be carried out. Regarding the practical drivers, this project is catering to multiple fields, including policy, sustainable urban development and ICT in urban management. For each of these topics, there can be something to learn from this project and the efforts for bridging the cooperation gap that exists between these 'silos' may be further supported by this project.

Academically, the project can be viewed as an evaluation of the SSC development so far, as it seeks to look back and examine the foundation upon which SSC is founded, instead of concentrating on the 'forward' looking research suggestions given by Bibri and Krogstie (2017). Uncovering points for improvement or change at the currently early stages of SSC development may be of good use for those involved in the discourse.

Furthermore, there are several authors who vocally call for a better understanding of the relationship between Smart City and Sustainable City. Höjer and Wangel (2015, p.334) are explicit in their wordings when they say that "while there are a numbers [sic] of definitions of smart cities and sustainable cities, the combination of these two has been less explored." Ahvenniemi et al. (2017, p.234) in their assessment of indicator frameworks for urban development express their concerns similarly: "…there is a need to better understand the relation of the smart and sustainable city concepts." The same has been expressed by Bifulco et al. (2016), claiming that understanding how Smart City and Sustainable City relate to each other is important for their own development.

1.3.2 Positioning and audience of project

It is worthwhile to mention in which way this project will relate to other contributions in the urban development discourse. Although this report is specifically concerned with the contribution of Smart City and Sustainable City to the new proposition of the Smart Sustainable City, it is possible to extend the project's implications to the general concepts of 'smart' and 'sustainable' development. As Smart City is a specification of 'smart development' and Sustainable City of 'sustainable development', other fields in which sustainability and smartness are applied might benefit from the way in which urbanism is taking advantage of the two concepts. The other way around, any contradictions and problems between the two might also yield valuable lessons.

Another dimension to place this project in, is the relationship between research and practice of urban development. Since this project seeks to understand how Smart City and Sustainable City are shaped in both theory and practice, one can perceive this project to stand in between these levels of urban development, drawing lessons from both of them and contributing to their connection.

The audience for which this report is written, therefore consists first and foremost of the scientific community one the one side and practitioners in urban planning and development on the other side. Yet, because implications of the findings could also be useful for other fields, any professional or researcher in similar fields to urbanism could find value in this document. This could range from architects and civil engineers to policy makers and researchers in sustainability sciences. On the contrary, it is expected that laypeople will need additional reading and information before fulling grasping the concepts and references made explicit in this report, although efforts are made to leave as few loose ends as possible.

1.3.3 Delimitation project

Following from the positioning of the project, it is also noteworthy to specify how much 'ground' this project covers by explaining which areas this project touches on, which it does not touch on and for which reasons.

As is clear from the previous sections, this project is situated within the academic field of urban development and more specifically, in a field that addresses future forms of practice with which cities can be prepared for the coming decades. In this case, the project will add to a relatively new discussion concerning the Smart Sustainable City, which is said to be a combination of insights from multiple different fields of research. An in-depth examination of the relationship between the Smart Sustainable City theory's components will be given, both from a theoretical and practical perspective. This means that, instead of elaborating on the future of the theory by using existing knowledge, this

project traces back the roots of the theory to enable a better understanding of its basic premises and in that way contribute to the future of the theory, which has been found to be promising if developed correctly.

On the other hand, there are also some aspects that are consciously not included in this project. This includes the narrow and specific definitions of both Smart City and Sustainable City: although their individual meanings play an important role in understanding their relationship, this project will restrict itself to working definitions that contribute to highlighting their differences and commonalities. After all, these differences and commonalities constitute the focus of the research.

Secondly, no specific suggestions will be given as to how the Smart Sustainable City theory should be changed or amended based on the findings of this project, if that would be necessary. This step would be a project in itself and thus will not be part of the research. Instead, this project will restrict itself to giving a more nuanced understanding of the theory's components, which then can act as the foundation for further research into its application to the theory.

1.3.4 Assumptions

To enable the research conducted for this project, some assumptions had to be made to provide for a starting point from which the research could convene. The first one is related to the logic of the research being carried out: it is not certain that the development of an SSC theory should happen in a linear order, with knowledge on a certain subject (in this case *clarification* of a certain relationship) constituting a defined step in a finite process. This is a perspective that is informed by a positivist, technical view of the world in which optimization and fixed goals are to be achieved. The advantage of taking on such a standpoint is that the result will however show how much sense there is in perceiving the urban system as such: optimizable to a certain performance and configurable at will.

The second assumption is that the Smart Sustainable City will be followed through to maturity by the scientific community and that this project thus constitutes a useful step in a process that is worthwhile to work on. In other words, it is assumed that SSC has a future that researchers and governments will invest in, instead of letting it die off after any period of time.

Thirdly, it is assumed that this report will not give a full, comprehensive picture of the Smart City, the Sustainable City or the Smart Sustainable City, based on the recognition that these fields are very broad and by now have already branched off in myriad directions that cannot all be covered in one thesis research project. Thus, this report can only cover part(s) of what would truly make for a complete account of the subjects in question. The time limitations of this project (as further

described below) did not allow for the project to fully cover all aspects of “smart” or “sustainable”, in the first place.

A fourth assumption is concerned with the goal of the conducted research: the of goal of the main research question is to arrive at a more detailed, exhaustive understanding of the Smart City-Sustainable City relationship, so as to facilitate the successful development of a Smart Sustainable City “theory”. This implies that this study assumes a theoretical construct of SSC to be necessary as a first step in the overall SSC development, followed by implementation and evaluation of the theory. This linear way of thinking can be challenged through the analysis findings, but nevertheless provides a stable starting point for the project.

The last assumption is that the chosen perspectives for the research questions (broadly categorized as theorical and practical) will be sufficient to give a comprehensive view on the relationship of Smart City and Sustainable City.

1.3.5 Limitations

Apart from the assumptions made for this project, as described in the previous paragraphs, the limitations under which the research was conducted also influenced the practical possibilities for gathering and analyzing the necessary data (further specified in Chapter 2).

Concerning the gathering of data, the literature used in the report’s literature review and analysis was often located in databases for scientific papers with restricted entrance (pay-walls). Therefore, for literature to be accessible, it either had to be designated for open access or be available through Aalborg University’s library associations with research databases.

Secondly, any practical activities were, as far as the location was concerned, restricted to the area of Greater Copenhagen, due to the limited traveling resources of the author.

Thirdly, the available time of approximately four months was an influential restriction to the research, since the chosen methods for research and the evaluation of the analysis results had to be manageable within the given time frame.

Taking the limitations regarding data gathering and time into account, all activities carried out for the project had to fulfill the requirements as postulated by the study board of the study program Sustainable Cities at Aalborg University. These are described in the semester description of the fourth and final semester of the program, which include directions for the content and form of the final product, as well as deadlines and learning objectives.

1.3.6 Disposition

After this introductory chapter, the report is structured as follows:

Chapter 2 will detail the methodology applied to this project, including the theoretical foundation, the research design, the necessary data (types), as well as the chosen methods for data collection and analysis.

Chapter 3 to 5 cover the analysis results of Research Question 1 (Chapter 3), Research Question 2 (Chapter 4) and Research Question 3 (Chapter 5).

Chapter 6 contains a discussion of the analysis results of the previous three chapters.

Chapter 7 concludes the report.

2. Methodology

The methodology of this project fulfills a connecting role between the problem statement and research questions as identified in the previous chapter and the actual research carried out to answer the research questions in the following chapters. Through the specification of the methodology, the chosen theoretical direction of the research and the reasoning behind it will be presented, as well as the research logic that follows from it and the methods that were employed to collect and analyze the necessary data.

Each consecutive step further specifies the methodology of this project. With this approach, the research design steps as given by Saunders, Lewis and Thornhill (2007) were followed, which have been depicted through the widely-used 'research onion' (see Figure 3).

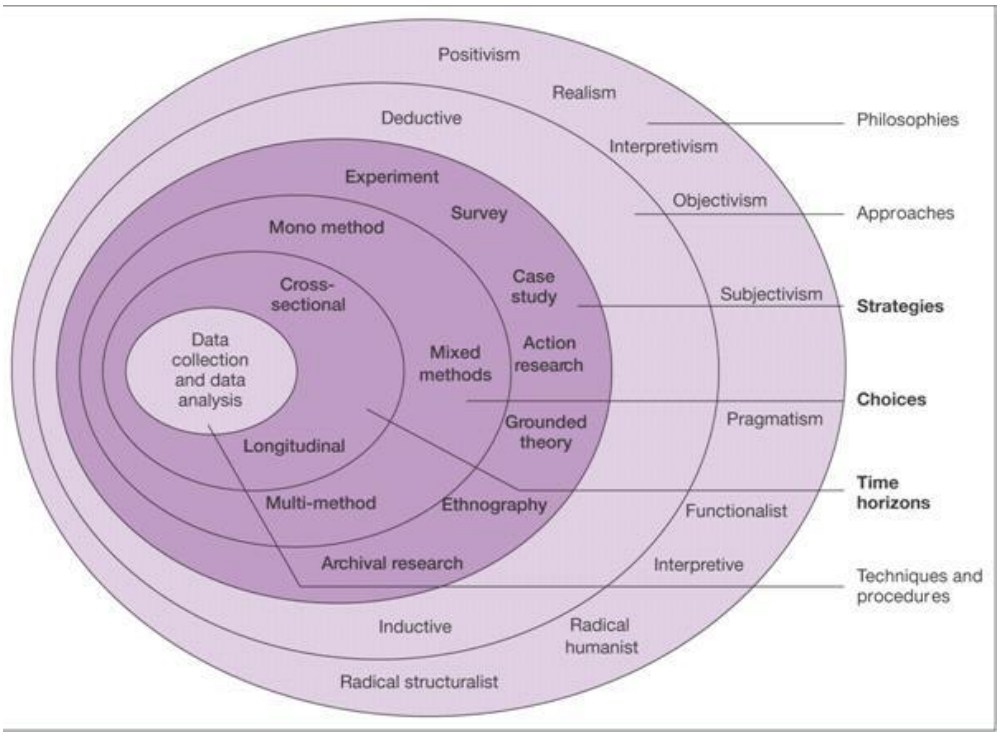

Figure 3: Research onion (source: Saunders et al., 2007*)*

2.1 Theoretical foundation

The discussion surrounding the Smart Sustainable City is situated within the wider discourse about urban planning and development. This field interacts with both technical, as well as social sciences: the infrastructure necessary to facilitate life in the city is designed, constructed and managed by engineers, while the on the other hand the lives, behavior and decisions of a city's inhabitants also affect a city's functioning. The theoretical foundation of the research to be carried out for this project

should therefore take this duality into consideration. That is, Smart City and Sustainable City are to be examined by using perspectives that allow for the influence of technical and social sciences on them to be identified and judged against the requirements of the research questions.

This is achieved by first investigating how other authors thus far have approached Smart City and Sustainable City in both ontological and epistemological contexts: What do they understand knowledge to be? Where do they obtain it from: through rational reasoning or by taking into account the changes environmental and economic circumstances in which a city develops? This knowledge can then be used to determine which philosophical approach is most suitable for this project, after which the research design as a concretization of the chosen ontology and epistemology can be specified.

2.1.1 Theoretical approach of other authors

Ontology is defined as a branch of philosophy that is concerned with the question what kind of knowledge can be known. It is the most basic question in the philosophy of science and has a decisive effect on the way in which knowledge is produced through scientific research. Over time, a spectrum of standpoints has emerged with two opposing ends: the one extreme, called ‘realism’, takes its point of departure in objects and knowledge existing outside and independently of the human mind. Knowledge is said to be objective and steady. The opposite of this view is ‘relativism’, which advocates knowledge to depend how one’s perception and consideration; knowledge is not objective, but subjective (see Figure 4).

Epistemology builds on ontology and is a branch of philosophy that asks, after having established *what* can be known, *how* this knowledge can be known. Here, too, there are two main schools of thought. ‘Positivism’ is the epistemological consequence of ontological realism and posits that the knowledge existing in the universe can be obtained via sensory experience from the outside world and evaluated through logic and reason. The opposite of positivism is ‘interpretivism’ or ‘constructivism’, which belongs to ontological relativism, and treats knowledge as being dependent on the social interaction between humans, always being influenced by theory and not value free.

From ontology and epistemology, the third step is the methodology, which asks how knowledge can be obtained. There are again two extremes, corresponding to the extremes of ontology and epistemology. Technically oriented research (e.g. engineering and natural sciences) often apply quantitative research principles, relating directly to realist ontology and positivist epistemology, to evaluate hypotheses. In social sciences, on the other hand, researchers tend to rely on qualitative reasoning, thus adopting relativistic ontology and interpretative epistemology.

Lastly, the methodology is applied through methods to be used in the research, with the leading question what tool is to be used to obtain the desired data. In quantitative research, often-applied methods are experiments, surveys or measurements. Interviews or literature reviews are examples of qualitative research.

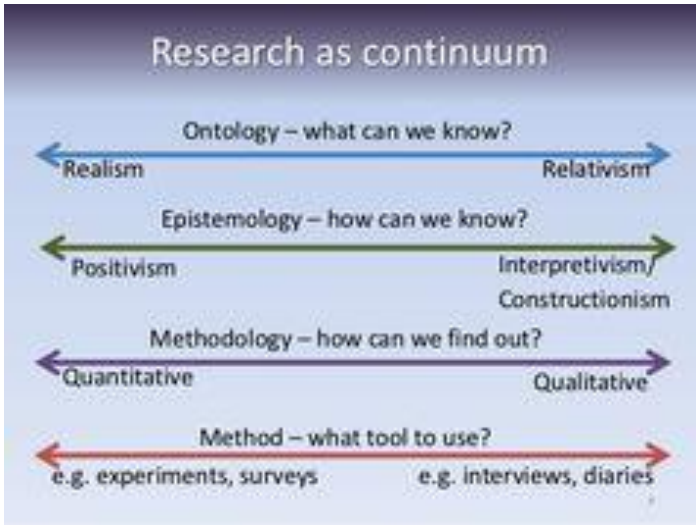

Figure 4: Research continuum (source: Divandari, 2015*)*

From the literature that was used for the literature review in the first chapter (Chapter 1.1), it was concluded that there exists a preference for a realist kind of ontology and positivist kind of epistemology regarding knowledge generation about the Smart Sustainable City. This is most notably seen in papers concerning the role of ICT in Smart City and the Smart Sustainable City (Bibri & Krogstie, 2017). According to these authors, the city is to be perceived as an objective system consisting of well-defined sectors or sub-systems, in which ICT solutions can achieve economic and managerial gains. The Smart Sustainable City in this view is a combination of two other, defined concepts: Smart City and Sustainable City, which have a set of properties that are measurable in the real world.

What furthermore stands out from this approach to reality is the perception of human beings as economically rational actors, thereby implicitly blending out the complexity of human behavior and favoring a positivist view of the world by taking reality and knowledge to exist outside the human mind and social interaction. In Smart City, for example, the ICT-dominant view on urban development perceives citizens not as complex, variable actors with different sets of interests, but simply as data suppliers through the services they use, and that they can be steered by altering the services.

Some authors were identified to give counterweight to this way of developing the SSC, most notably because of their objection towards the emphasis on digital technology and economic concerns at the

expense of social and environmental sustainability (Hollands, 2008). Their opinions are rather oriented towards taking the position, role and influence of the public more serious, thus suggesting that constructivism and interpretivism as ontological and epistemological approaches, respectively, should be given more importance.

2.1.2 Theoretical approach of this project

Thus, it can be concluded that Smart City and Sustainable City are assumed by some authors to be two building blocks to be combined into the SSC, effectively acting as measurable, definable and independent entities. Hence, they follow an ontologically realist and epistemologically positivist approach. This project also treats Smart City and Sustainable City as two independent entities to examine, thereby adopting a realist ontology. However, this study will not also take on a positivistic epistemology, because it is deemed that an interpretivist angle of research fits best to the problem and research questions, as they ask for answers that are related to the understanding of the research community and the practical results of urban planning regarding Smart City and Sustainable City. Interpretivism stands closer to the realities and complexities of human interaction in the act of shaping cities and is therefore expected to counterbalance the otherwise realist understanding of most researchers.

From the interpretivist epistemological approach, it follows that the study will be of a qualitative nature. This approach is supported by Kohlbacher (2005) and Yin (1984) who state that qualitative research is to be preferred, when the field of research is still unknown or not, yet well understood. The research will therefore also be of an explorative nature (Van Wyk, n.d.) and can take on both positive and negative standpoints regarding the contribution of Smart City and Sustainable City to the SSC. Instead of testing hypotheses or evaluating theories, the aim will be to generate them. Regardless of the findings, the goal of generating this new knowledge is for it to be useful as input in the further development of the SSC.

When taking the realities of urban development then into account, the order in which knowledge in this project is produced must therefore take its point of departure in externally collected data. By analyzing this data and processing it into a theory that acts as the answer to the main research question, the project accordingly follows an inductive research scheme (see also Figure 5). The combination of both the cause and effect of the use of the terms Smart City and Sustainable City will lend itself to produce a theory that may explain how the relationship between Smart City and Sustainable City can be characterized.

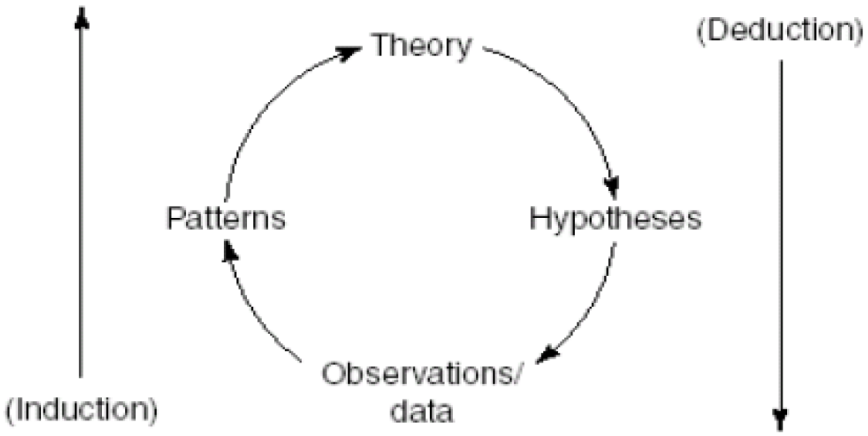

Figure 5: Inductive and deductive research logic (source: Van Wyk, n.d.*)*

Furthermore, in the discussion chapter of this report, the resulting theory will be used to abduce conditions for a better use of the concepts Smart City and Sustainable City. In other words, by taking the identified effects of the way in which the relationship between Smart City and Sustainable City is perceived and connecting them to the newly developed theory, it may be possible to derive lessons that specify how the existing relationship has come to be and what can be changed to alter the relationship in favor of the SSC. The socially informed and constructed meaning of Smart City and Sustainable City will be the leitmotifs throughout these steps.

2.2 Research design

Based on the theoretical guidance that governs the analysis of the gathered data in this project, the research design takes its point of departure in the aforementioned inductive research approach: because an answer to the main research question is sought after by combining individual observations from data and abstracting a theory that generally applies to the observations and beyond, the research design type can be summarized as one that aims at analyzing existing data for the purpose of exploring an under-exposed aspect of urban development theory (explorative study). This project thus takes on a qualitative nature, relying on personal accounts and developing knowledge using an interpretivist epistemology, while still being based on an ontological realism.

The logic of the research is a deepening of the knowledge available on the relationship between Smart City and Sustainable City as they are to be combined into the Smart Sustainable City. This deepening will take place through a stepwise approach by which the unit of analysis is examined from different levels of abstraction (cf. Chapter 1.2.3). Combined, the findings on these different abstraction levels will provide a detailed and elaborate view on the subject.

There are in total three phases through which the project is to be carried out. The first research phase starts with the definition of the research foundations, which consists of locating a knowledge gap, identifying the problem caused by this knowledge gap, and finally the formulation of the appropriate research questions to solve the problem. This phase was already fully addressed in the previous chapter.

The next phase is concerned with the research design as a preparatory step before the actual data collection and analysis. In it, the theoretical framework is set up, including the ontological, epistemological and practical approach to the research. For both the first phase and the second phase, literature reviews provide useful and important input for designing the further analysis.

Lastly, phase three will consist of the analysis, the discussion of the analysis results and the resulting conclusion of the project. The collected data, as specified in the methodology in the second phase, will act as the input for the analysis. Which analysis type is best suited also depends on the type of collected data but is as much as possible aligned with the interest of obtaining the best possible answer to the research question.

Following from this set-up, the quality of the research will greatly depend on the quality of the collected data. The limitations imposed on the project (cf. Chapter 1.3.5) are in this regard restrictive factors for the data gathering and thus the data quality, as the researcher is limited by time, location and available tools. This means that the data quality is to be maximized, while taking into account the practical restrictions for obtaining it. Consequently, the research questions governing the data gathering had to be adjusted along the way in an iterative process.

2.3 Methodology

Based on the theoretical foundation of the project and with the problem statement and research questions being defined in the previous chapter, the methodology will establish the practical steps and details to answer the research questions at hand. As indicated above, there are three phases of research, with each having multiple subordinate activities. With the problem, research questions, theoretical foundations and the research design now ready, the following will provide details on the necessary data and the sources from which it is to be drawn, the methods through which it will be collected, as well as the methods employed to analyze it.

2.3.1 Necessary data and sources

Each research question requires its own set of data to be answered. In the following, the necessary information for the research questions will be specified, in turn, together with the sources from which the data will be collected.

Research Question 1

The first research question is expected to require input on the existing definitions of both Smart City and Sustainable City, as well as accounts on what function they are intended to have. These sources may also reflect on which of the two receives more attention than the other, but such a conclusion can also be drawn independently by comparing the number and quality of the collected papers. The data is to be gained from primary and secondary research publications, which may be scientific, journalistic or otherwise. Because of their accessibility, ease of use and vast contents, the internet and the Aalborg University library will act as the primary providers of these publications.

To be able to triangulate (Rothbauer, 2008) the findings to increase the trustworthiness of the results, personal interviews with people active in the urban development realm are a valuable second data source (for details on the interviewees, see Chapter 2.3.2 below).

Research Question 2

To answer the second research question and give a comprehensive view on the general economic, political and societal approach to the link between Smart City and Sustainable City, it is necessary to obtain research findings on both topics, as well as what has been said about their relationship thus far, be it in or outside of the SSC discourse. The sources for this information will be the internet and Aalborg University's library.

For this question, too, interviews with professionals from the field will offer valuable triangulation opportunities.

Research Question 3

For the third and final research question, and different from the other two, information from the practical realm of urban development is needed. This will be gathered from two sources: for one, the internet and the Aalborg University library will be searched to provide knowledge on urban development projects that have been or are being carried out and explicitly claim to be related to either Smart City or Sustainable City.

Secondly, interviews with people directly related to smart and/or sustainable urban development projects will be conducted to get a first-hand insight in the practicalities of projects, which are often not that easily deductible from written sources. Their insights could also be of benefit in the work related to the other two research questions. This also provides the opportunity to triangulate the research methods and thus increase the robustness of the analysis.

2.3.2 Methods data gathering and selection

To facilitate the goal of examining the qualitative relationship between Smart and Sustainable as expressed in literature and in practical projects, the methods for data gathering will include structured (online) literature search and personal interviews with professionals within urban planning. They will be specified in turn in the following.

Structured literature search and selection

The gathering of literature will be done through structured literature search. This will be done through several databases for (scientific) literature on the internet that might contain relevant information within the topics of Smart City, Sustainable City, sustainable development and related areas. In practical terms, each structured search action will be conducted after the following steps:

1. Formulating a search question
2. Defining terms, concepts and/or words that should be contained in the search results
3. Selection of the databases or search engines through which the sources are to be found
4. Definition of search terms to be used
5. Definition of search queries using the defined search terms

The selection of documents to be used in the analysis already starts during the literature search, based on their title and key words. After the literature search is finished, the documents to be analyzed will be selected using two further filtering stages: based on the source's abstract (if applicable) and finally based on its content. Thus, there are three stages that a document needs to go through to be deemed eligible for inclusion in the analysis phase (Myllärniemi, 2015):

1. Selection based on title and (if applicable) terms used in the source's contents (done during literature search)
2. Selection based on the abstract of the source (if applicable)
3. Selection based on the content of the source

Once documents are abstracted from the databases, there also is the possibility to obtain additional documents through the 'snowballing' method. By applying this method, the references in the

bibliography of a given source are assessed in search for sources that might also be applicable to the research for the project. The sources found through this method are then assessed using the three steps as specified above, too.

Interviews

Regarding the interviews, a number of people active in urban development and urban planning were contacted, based on their expertise within either urban policy, smart city and/or sustainable development. Those willing to take part in an interview were the following:

Camilla Føns Mortensen, Smart City and digitization consultant, Municipality of Frederiksberg (Denmark)

Mrs. Mortensen is responsible for the realization and management of projects related to Smart City in the municipality of Frederiksberg (Denmark). She has experience with the political and organizational process behind Smart City projects and can thus provide valuable insights into the reasoning of the Municipality when it comes to their definitions, ambitions and goals for the future of the city when it comes to digitization, sustainability and the role of the public these ambitions.

Emil Moreau Braunstein, GIS and data specialist, Municipality of Frederiksberg (Denmark)

Mr. Braunstein is active within the technical department of Frederiksberg Municipality and supports the activities and projects of all other departments through the provision of data. In this coordinating role, he has a broad knowledge of the technical aspects of Smart City projects and how sustainability plays a role in practical contexts. His experience will therefore be of great value to the project, as it provides a technically oriented view on the relationship between Smart City, Sustainable City and their application in the real world.

The interviews were conducted using a semi-structured approach, meaning that the author conducted the interview using a list of questions and topics to be discussed, but without a strict adherence to it and deliberately taking the opportunity to ask spontaneous questions or sidetrack to different topics. This way, the expectation was to gain valuable opinions and anecdotes, while still following the research questions and making the interview's findings relatively comparable.

2.3.3 Methods analysis

When it comes to the analysis of the gathered information, all research questions were found to be suitable for answering using a combination of three methods as described in the following. These methods were chosen in accordance with the theoretical framework aiming for socially informed,

inductive knowledge generation: critical discourse analysis, document analysis and constant comparison.

Discourse analysis was popularized by the French philosopher and scientist Michel Foucault in the 20th century and aims at coming to understand the generation of knowledge from the use of language in a broad sense, informed by social norms, values and history (Cheek, 2008). Especially *critical* discourse analysis is useful to study the use of terminology and jargon in a wider context than only a linguistic one, which helps to understand how Smart City and Sustainable City as individual entities in research are understood and approached within the wider discourse of urban development, with all its connections to social, technical and economic issues.

Document analysis is a method consisting of *content analysis* and *thematic analysis* (Bowen, 2009). In a first step, content analysis allows for the structured abstraction of relevant information from multiple sources "into categories related to the central questions of the research." (p.32) Secondly, thematic analysis is used to find patterns in the data abstracted through content analysis, with themes emerging from that selected information then becoming the categories for the actual analysis. Effectively, this method is thus used as a two-stage filter to obtain the needed insights from the literature and interviews to answer the research questions. Furthermore, the use of this method provided the opportunity to relate information from different sources to each other beyond the level of terminology as is done by critical discourse analysis.

Lastly, constant comparison is a method stemming from Grounded Theory (Glaser & Strauss, 1967), which emphasizes the construction of new knowledge through the comparison of each new piece of information to the entire understanding of the matter as has been developed up until that point by the researcher. This method will therefore streamline the research as one in which incremental steps are consciously applied to build a new knowledge construct from the ground up.

2.3.4 Coordination of data and analysis

To make the laborious work of reading, analyzing and comparing the information easier to handle and to coordinate, there are several software tools available on the market. The tool to be used in this project will be the software package *NVivo®* (professional edition 12). This program makes it possible to centrally manage all written, spoken and visual sources as needed and compare them to each other using multiple different built-in tools, including word counters and word clouds. It is therefore also particularly suited for discourse analysis. NVivo was selected above other tools for the research, because Aalborg University at the time of research had a license agreement with NVivo's developer for the use of the professional edition by all its students and staff.

2.3.5 Conclusion

Following the structure of Saunder's research onion and the philosophical spectrum regarding ontology, epistemology, methodology and methods, this chapter has specified and justified each of these steps. The ontology of the project was chosen to follow realism, by Smart City and Sustainable City to be entities in the real world that can be examined and known.

However, the epistemology and methodology do not follow this ontological approach and were chosen to be interpretivist and qualitative, respectively, instead. This was done to meet the project's research question's requirements and the relatively unchartered area of Smart Sustainable City research.

Lastly, interpretivist and qualitative research methods were selected for the research, while also bearing in mind the research limitations imposed on the project. A graphical representation of the chosen theoretical and methodological approach is given in.

3 Analysis results research question 1

The first research question to answer for the project is: How does the theoretical relationship between Smart City and Sustainable City in an epistemological context affect the SSC theory development? From the content, thematic and discourse analyses, which were performed on the collected literature and interviews, multiple themes were abstracted and grouped into three separate sections. The first section is concerned with the way in which Smart City and Sustainable City are currently understood by those involved in discussing them. The second section covers the question whether emphasis is currently placed on either Smart City or Sustainable City or for which reason. Lastly, a third section devoted to the perceived function of Smart City and Sustainable City will explain what they are thought of to do in practice.

For all sections, there will be intermediate conclusions in which the research findings will be used to characterize the Smart City-Sustainable City relationship. The last section of this chapter will then bundle all results from the three earlier ones and from them derive implications for the development of the Smart Sustainable City, such that the research question can be fully answered.

3.1 Dominant understanding of Smart City and Sustainable City

The relationship between Smart City and Sustainable City was found to exist of commonalities and differences. Regarding the dominant understanding of both, the analysis delivered two themes, which will be addressed in the following paragraphs. The first theme concentrates on the efforts that are being made to come to definitions of Smart City and Sustainable City: there are differing views on whether they should be seen as a physical entity or status that cities should chase after, or rather as processes towards other kinds of goals. The second theme is about the varying terminology that is used in the definitions, with the finding that both Smart City and Sustainable City appear to be a visionary, holistic strategies for urban development.

3.1.1 Theme 1: definitions

As already indicated in the literature review in the beginning of this report, the unclear and changing definitions of Smart City and Sustainable City result in ongoing discussions at both academic and policy levels about how to best get a hold of them. This difficulty is caused by disagreement about (1) the range of applicability of Smart City and Sustainable City, (2) by the question whether they should be seen as end-goals in themselves or rather as processes towards other goals and (3) by difficulties of distinguishing them from other terms, concepts and strategies, with which they seem to be in ‘competition’ with.

Regarding Smart City, for instance, the disagreement about its applicability can broadly be categorized into two extremes: on the one hand, Smart City is approached from a technocentric point of view, in which a city's infrastructure and economy are to be optimized with the use of ICT (Bibri & Krogstie, 2017). On the other hand, there are those who advocate a wider understanding by taking into account economic, social and environmental development and seeking a balance between these three (Hollands, 2008; Kitchin, 2015).

The choice for either the one or the other has consequences: by taking the broader approach, many more features of the urban system become eligible to be included in a definition, such as "hard" domains including buildings, energy grids and water management, but also "soft" domains like advancement of education, culture and social inclusion (Neirotti et al., 2014). Consequently, the more features there are, the harder it is to devise a fully comprehensive definition of Smart City. To avoid having to fit too many aspects in one definition, one could therefore also go with a narrower definition of Smart City that is rather concerned with the development and application of ICT, as that is generally considered to be Smart City's most prominent feature (Batty et al., 2012). Many authors have highlighted the possibilities of digital technology to improve urban management within all kinds of domains (Bibri & Krogstie, 2017). Yet, this technocentric view has also been criticized for perceiving the city as a mere system with many components, thereby ignoring the 'human factor' (Hollands, 2008).

A second dichotomy in the definition of Smart City is the question whether Smart City is to be perceived as a goal in itself or rather as a process towards goals expressed in terms of e.g. sustainability or social justice. In the literature, those who advocate a rather technocentric view of urban development also appear to perceive the Smart City as a fixed status that can be obtained by going through a transformational process: a city starts out with a given set of properties and finishes with a different set of properties (Ibrahim et al., 2015). On the contrary, those who take the features of Smart City rather to be tools towards other goals, tend to think of Smart City itself as a process.

As explained in the interview, Mrs. Mortensen aligns with the latter view, referring to Smart City as a "way of working" and a "way of thinking", implying that Smart City is rather an umbrella that encompasses different initiatives and projects, instead of the presence of certain technical features in a city's fabric. This general understanding of Frederiksberg Municipality was further detailed by Mr. Braunstein, who described his role as data supplier as one in which he does not have his own projects, but continuously performs a supporting role by delivering data to projects of other departments when needed.

The third factor contributing to the difficulties in understanding Smart City is the competition it experiences from other terms, concepts and ideas. In their comprehensive study of the ever-changing landscape of concepts in urban development, De Jong et al. (2015) point out the relationship that Smart City bears towards such things as "Digital City" and "Intelligent City"; there are both commonalities and differences between all of them, making it easy to confuse one with the other. The – perhaps inevitable – consequence is that terms like 'smart', 'digital', 'intelligent', and so on, are being used interchangeably, since they (willingly or not) are perceived as meaning one and the same thing (Albino et al., 2015). This issue will be further elaborated upon in Chapter 4.2.

When it comes to Sustainable City, its roots in the Brundtland definition of sustainable development lead to the same wide-ranging applicability issue as with the Smart City. Because sustainability in an urban context can be applied to many different sectors (sustainable energy generation, sustainable traffic systems, sustainable construction materials, etc.), it may be complicated to define where Sustainable City has any degree of influence or not. Over the years, many sustainability indicators have been developed and still new ones are made (Freeman, 2017), illustrating the complexity of understanding what belongs to Sustainable City and what does not.

Furthermore, like Smart City, Sustainable City is competing with other concepts, too. In the literature, "Eco-City" and "Resilient City" are named as being closely related to what Sustainable City entails (De Jong et al., 2015; Hodson & Marvin, 2017; Koh et al., 2010).

3.1.2 Theme 2: terminology

The difficulties with defining Smart City and Sustainable City are expressed through the used terminology by authors. From a discourse analysis, it appears that every author seems to have a different word to categorize Smart City and/or Sustainable City with, but overall, it also seems that they seem to agree on a common visionary, holistic nature of the two discourses.

For both Smart City and Sustainable City, it stands out to which extent both are being described by terms to have a forward-looking, visionary connotation. Albino (2015) finds the term Smart City to often be treated as "an *ideological dimension* according to which being smarter entails *strategic directions*." (p.5, emphasis added) Similarly, Trindade (2017, p.11) describes Smart City as a "vision, manifesto or promise" of what is to come. In line with such terminology, Smart City is thus not to be perceived as a product, but as a "stream of visioning and thinking" (Angelidou, 2015, p.104), that is much in line with the findings in the previous section of this chapter pointing at the Smart City as a process. The dichotomy can be further underpinned by the description given by authors espousing a

technocentric view, comparing Smart City to a "large organic system connecting many subsystems and components." (Chourabi et al., 2012, p.2290)

The terminology of authors regarding Sustainable City bears similarity to the holistic, visionary nature of Smart City. Because of its origins in the general notions of sustainability and sustainable development, Sustainable City is approached as a mode of development for goals that lie in the future: Egger (2006) describes two parameters defining the sustainability of a city (connectedness and resilience) to result in 'potential' as the third parameter. In other words, the better a city can utilize its sustainability parameters for its own development, the better it can "control its own *destiny* and finally its resilience." (p.1238, emphasis added) Indeed, Jenks and Jones (2010) contend that a city's sustainability is dependent on rather abstract ideas, based in environmental, social and economic notions, making the Sustainable City a concept with visionary tendencies, while Lorr (2012) finds urban sustainability to refer to a "future goal" (p.23) that is to be reached through "urban sustainable development" (p.23) and improving human behavior.

This interest in improving human behavior may however also be interpreted as an ideologically loaded one. Lorr (2012) recognizes this tendency and states that this is should not come as a surprise, as "from Haussmann to Olmsted to Howard to Le Corbusier to Wright, urban planning and development have always been ideological – sustainability is no different – (…)." (p.23) By categorizing sustainability as not only a goal for the future, but also as part of an ideology, Lorr takes the discussion a step further, connecting it to the world of politics.

Others have highlighted this relation as a remedy against sustainability turning into a misty-eyed vision of what once was; as argued by Campbell (1996), the visionary and ideological approach to sustainability as the root of sustainable urban development is prone to criticism of "vague idealism" (p.296) to an extent that it endangers urban development. Although sustainability may be seen as a holistic vision, it should not hark back to a "romanticized view of pre-industrial, indigenous, sustainable cultures" (Campbell, 1996, p.296) which never truly existed. Instead, it should be rooted in the practice of political conflicts and be used as a "lightening rod" (p.297) at the service of economic, social, and environmental interests. Williams (2010) also sees the holistic visioning of sustainable urban development as a cause of the difficulty to define it, because in practice, every urban sector has differing interests and ideas about what sustainability should mean.

One possible solution to treating Sustainable City as an unachievable dream would be to not treat so much as an entity, at all; Moffatt (1999, p.137) is quite explicit in his wordings when he states that "some researchers argue that we should be discussing sustainable development *and* cities rather than sustainable cities *per se*." A similar view is given by Martinotti (1997; cited in Martino, 2009,

p.238), who suggests that sustainability in cities should apply “to a larger unit than the city itself”, thus implying that sustainability should be an independent entity acting at a higher level of abstraction than the one the city as such is located on.

Comparison

It can be concluded that the dominant understanding of Smart City and Sustainable City is characterized by a shared visionary, holistic nature and a wide range of applicability, which however also makes them hard to define in concrete terms. When considering their orientation to the future and being processes towards a set of goals, Haarstad (2017) sharply notices that instead of asking what Smart City (and in extension, Sustainable City) really *is*, they are possibly best understood by asking what they *do*. When answering this question, it has been found that the role of people’s own understanding plays a decisive role, while also the mutual overlap between Smart City and Sustainable City could have an influence.

Considering the existence of ‘competitors’ to Smart City and Sustainable City, there seems to be a ‘pool’ of different concepts, strategies and ideas. With one concept after the other rising to prominence and then being replaced by another (De Jong et al., 2015), one can deduct from these findings that the interest in defining Smart City and Sustainable City is not only for the sake of driving urban development forward, but also in legitimizing their usefulness as opposed to other concepts.

Moreover, given the overlap between the individual concepts, one could ask to what extent Smart City and Sustainable City ‘borrow’ features or aspects from each other and how distinct they then are. The theory on Smart City, for example, claims to have sustainability in both an ecological and sociological sense to be an integral part (Ahvenniemi et al., 2017), but so does Sustainable City. Are they then only variations on the theme of sustainability? In the literature, a Smart City is being claimed to not truly be smart, unless it is also sustainable (Ahvenniemi et al., 2017). From the interviews, too, it was learned that the mutual connection between Smart City and Sustainable City regarding sustainability is taken for granted: when asked, Mrs. Mortensen and Mr. Braunstein reported on Smart City and sustainability to naturally flow into each other in the municipality’s projects, and that the municipality also never understood Smart City to be disconnected from sustainability in the first place.

Thus, defining Smart City or Sustainable City remains difficult; even keeping them apart may pose a challenge. Whereas some views advocate an approach of working towards a final goal that is specified through performance standards, others like to concentrate on the process and take a more holistic perspective. The relationship between Smart City and Sustainable City is characterized by

these two extremes and without any more clarity on which of the two sides works best, the status quo will not be changed.

3.2 Emphasis

When considering the combination of Smart City and Sustainable City, the question rises which of the two enjoys greater emphasis: does the literature rather prefer Smart City to become more sustainable, or is most attention payed to the Sustainable City becoming smart? Or is there perhaps a different perspective altogether, aiming at a balance between the two or a clear preference for one at the expense of the other? To understand how SSC is likely to develop in the future, it is important to understand which approach towards the combination of Smart City and Sustainable City would likely dominate the development of the theory.

Theme: Dominance Smart City

The analysis on the available literature to identify whether Smart City or Sustainable City enjoys a greater emphasis than the other resulted in a clear preference of researchers towards Smart City. Smart City receives this much attention because it is generally assumed to provide the best possibility to 'solve' urban sustainability problems (Martin, Evans, & Karvonen, 2018; Yigitcanlar, 2015).

The reasons for prioritizing Smart City over Sustainable City are manifold. The most dominant argument points at the potential and wide applicability of ICT (Haarstad, 2017). Höjer and Wangel (2015) claim that ICT is "the most constructive way forward" (p.339) for urban development. More than that, they warn that denying the role of ICT would dilute the very meaning of Smart City to something insignificant. Other scholars, too, mention ICT as the best available tool for generating solutions in urban development: Trindade (2017, p.11) names "ecological, societal, economic and management challenges" to be solvable by ICT, while Albino (2015) also sees the harnessing of ICT as the most promising way for successful urban development. Bibri and Krogstie (2017, p.185) go even further and claim ICT to be "the key to a better world."

Another driver of the emphasis on ICT in urban development debates is found in the influence of corporate actors and in their capacity as specialized technology providers (Albino, 2015). They are seeking and creating niches in the Smart City market to sell their technologies and products, thereby emphasizing the opportunities and capabilities of digital technology. For example, Harrison and Donnelly (2011) go to great lengths to highlight the possibilities of ICT for urban management but does so as an author for the digital technology corporation IBM.

The technical possibilities of using ICT in urban management have proven to be effective and also during the interviews, the pervasiveness of ICT in urban planning was confirmed by the interviewees. Mrs. Mortensen pointed out that Smart City projects by the municipality are mostly data driven. Furthermore, Mr. Braunstein, in his capacity as data expert of the municipality, said that his work spanned all four major sectors the municipality's organization: services; city and environmental management; youth; and social, health and labor market services.

Another reasons for the emphasis on Smart City in the urban development debate are, firstly, the inclusion of sustainability features (Estevez, Lopes, & Janowski, 2016), not only in an economic sense, but also socially and environmentally. Several authors were found to place emphasis on the need to let the sustainability aspects included in the Smart City theory have a more prominent position in the theory's practical implementation (Ahvenniemi et al., 2017; Höjer & Wangel, 2015; McFarlane & Söderström, 2017). Since it includes both ICT and sustainability principles, Smart City therefore is seen as more complete than Sustainable City, which has been found to mainly contain elements that promote ecological and social sustainability, but to lack the technical characteristics that Smart City capitalizes on and are also necessary for urban development (Ahvenniemi, 2017).

Furthermore, from 2010 onwards, Smart City as a research topic has been receiving a substantial and ongoing amount of funding through the Horizon 2020 development plan of the European Union (Cocchia, 2014; Freeman, 2017). It was through the release of this politically motivated plan that the current worldwide attention for Smart City was created (De Jong et al., 2015).

Critique on public participation

With the increased popularity and funding for Smart City, there however also came critique. As elaborated upon in Chapter 4.2, many have criticized the influence of corporations on the direction in which Smart City development is heading, since they are said to only respect the interest of the citizens being affected by their products, as long as this interest serves their own financial goals (Greenfield, 2013). Criticasters have pointed at cities such as Songdo (Korea) and PlanIT Valley (Portugal), which are said to have failed because of their disregard for the actual functioning of cities as complex interactions between people, goods and knowledge (Greenfield, 2013).

One other known critic of the contemporary understanding of Smart City, Hollands (2008, p.315), also demands cities to do more than only install computers and sensors before they claim themselves to be smart: "…progressive smart cities must seriously start with people and the human capital side of the equation, rather than blindly believing that IT itself can automatically transform and improve cities." The risk cities are running by aligning themselves too much with technical

matters of urban development, is that other sectors of importance (social justice, ecological sustainability) are ignored and the general political debate might be lamed (Williams 2010).

There are also problems with the ICT, itself. As was found in the interviews, one of the most pressing problems for Smart City projects in Frederiksberg is the mutual incompatibility of individual solutions from different companies. As explained by Mrs. Mortensen, every digital product delivered contains its own piece of software, which however often does not properly connect to the city administration's own systems or other systems the product is supposed to work in junction with. Mr. Braunstein pointed out that some smart city related products and technologies are not yet mature, which makes it harder to navigate in the market for solutions.

Between the two extremes of Smart City advocates and those disapproving of it, there are however also those who chose a golden mean: because of the multiple sectors that influence and are influenced by Smart City, Washburn et al. (2010) notice that ICT indeed may be critical for Smart City, but only as far as the technology perspective goes. Others also perceive ICT as an important component of Smart City, but not any more important than other components it forms the Smart City with (Albino et al., 2015; Batty et al., 2012; Saujot & Erard, 2015). Cocchia (2014, p.33) explicitly notes that although 7 out of 9 Smart City definitions in some way contain ICT, "it emerges that the ICT is ever an important element characterizing the Smart City, but not the only one, instead together with other aspects." Neirotti (2014) elaborates on this notion by clarifying how the number or pervasiveness of ICT systems in a city not necessarily make cities perform better, but rather are a sign of the efforts made to improve the overall quality of life for citizens.

Critique on ecology

Following from the critique against the dominant position of Smart City because of its ICT centered understanding, there is also a discussion concerning the inclusion of ecological sustainability in Smart City theory. On the proponent's side of the discussion, Smart City is rightfully given such a prominent position, as there exists recognition of the connection between Smart City and sustainability through the opportunities provided by ICT (Albino et al., 2015; Kramers, Höjer, et al., 2014). Saujot and Erard (2015) identify sectors like Smart Water Management, Smart Power Grids and Intelligent Transport Systems as just a few examples of in which ICT can contribute profoundly to greater sustainability and efficiency. In this context, Kramers (2014) refers to Smart City having the potential to reduce GHG emissions by 16.5%, due to the efficiency potentials provided by ICT. Indeed, Saujot and Erard (2015) even go so far as to designate Smart City as the successor to Sustainable City, pointing at the same kinds of challenges both concepts try to take on. As explicated by the UN (Estevez et al., 2016), such concepts as "digital city" and "intelligent city" concentrate mainly on ICT

and online services for information exchange, whereas Smart City includes such aspects as quality of life and knowledge management through e-Learning. It also found that, in line with the findings of Cocchia (2014), Smart Environment is one of the key dimensions of Smart City in 21% of all evaluated definitions, just second after Smart Living at 25%.

It is also generally known that Smart City in theory contains sustainability aspects that ensure sustainability in at least a social sense (Ahvenniemi, 2017). Among those concepts capitalizing on a technical approach to urban development, Smart City even comes closest to taking social and environmental sustainability fully into consideration (Cocchia, 2014). Höjer and Wangel (2015) also conclude that Smart City has a *potential* for bringing about sustainability but is not *essential.* The lack of sustainability in Smart City projects is the best evidence of the contradiction between theory and practice (Yigitcanlar, 2018). Smart City rather seems to be a "popular version of sustainable development" (Freeman, 2017, p.60) without much evidence to substantiate this claim.

Yet, there are also voices who point at the seeming contradiction between what Smart City can do for sustainability in theory and how this plays out in the real world. Martin (2018) abstracted five kinds of tensions between Smart City and sustainability goals from his own literature review, finding the neglect of environmental protection to be one of them. Monfaredzadeh and Berardi (2015) conducted a study on assessment frameworks used by cities around the world to monitor their progress in urban development, of which the result was that whenever there was a Smart City project to be implemented, its success in an environmental sense was mainly measured through virtual and human ones, instead of the physical one. Ahvenniemi (2017, p.241) did a similar study and came to similar results, thereby sharply noticing that "the small number of environmental indicators in the smart city frameworks is a remarkable deficiency because reducing energy consumption and CO2 emissions is one of the major goals of smart cities." As McFarlane (2017, p.313) confirms, there is "little genuine commitment" of Smart City for anything related to social or ecological sustainability beyond its theoretical pledges. The "paramount importance" of especially environmental sustainability to the entire sustainability of a city is however underpinned by Bithas and Christofakis (2006, p.178), saying that the environmental sustainability of a city constitutes the basis upon which all other forms of sustainability in a city (social, economic, etc.) build.

Regarding sustainability, there are also more principle problems for ICT's contribution to sustainability. As noted by Ahvenniemi (2017) and Ringenson (2017), the potential of ICT for energy efficiency is partly nullified because the amounts of energy needed to keep the ICT functioning. Furthermore, the well-known rebound effect of the wider public becoming introduced to energy saving ICT measures is noticed by Bibri (2016) as another factor to take into consideration.

Comparison

When looking at the relative 'popularity' of Smart City versus Sustainable City, it has been found that Smart City receives significantly more attention than Sustainable City, mainly because of its ICT feature and the influence of business on policy directions. The dominant emphasis on Smart City and specifically its ICT feature however has led some authors to suggest that the role of sustainability is undervalued. Currently, though, the focus of the scientific community is on the promises of digital technology for making urban systems become smart in different sectors. This raises questions over possible negative side-effects for sustainable development in general, especially given the substantive critique given in the above paragraphs.

Based on the reasons for the dominance of Smart City and its inclusion of sustainability, one could wonder what then makes Sustainable City still unique in comparison; whereas Smart City in theory contains both technological progress and economic, sociological and environmental sustainability, Sustainable City mainly seems to be concerned with the environment (Ahvenniemi, 2017).

3.3 Function

Following from the way authors and interviewees define Smart City and Sustainable City and also which of the two receives more attention, the third aspect of the analysis in this chapter is concerned with the function that Smart City and Sustainable City are supposed to fulfill. From the content and thematic analysis, it was learned that both concepts are meant to *improve* cities stepwise, whereby the economy, the environment and the quality of life are often-mentioned areas in which this is to happen.

Theme: City improvement

Regarding Smart City, Ahvenniemi (2017) found economic performance indicators to dominate the assessment frameworks of Smart City initiatives. If the ecology of a city was included, this was mostly expressed in terms of efficiency or energy use. As mentioned in the previous section, Ahvenniemi notices how this situation is a contradiction between the theoretical commitment of Smart City to contribute to environmental sustainability and its practical elaboration. As can be derived from Freeman's (2017) findings, the roots of Smart City in the Smart Growth movement point at the desire to bring down the levels of e.g. air pollution and traffic congestion through lower emissions and energy use, but this does not necessarily mean that an increase in sustainability; a lower level of fossil fuel usage is still fossil fuel usage.

On the contrary, Sustainable City is rather meant to bring about a balance between economic, social and environmental sustainability, but in practice has been found to mainly focus on environmental sustainability (Ahvenniemi 2017). Indicators for economic performance were found to only be included in 10% of the reviewed assessment frameworks.

Comparison

Although Smart City and Sustainable City throughout this chapter were found to share significant similarities, they do appear to have differing functions within urban development. Although both derive their aims from their visionary imaginaries of the future, the Smart City is connected to overall city development and city branding through digital infrastructure. On the contrary, Sustainable City is mentioned as strategy that aims at environmental sustainability through blue-green infrastructure. When comparing these functions, it stands out how Smart City and Sustainable City then complement each other.

3.4 Implications for SSC

From the findings in the three sections above, one can draw conclusions about their implications for the Smart Sustainable City. They will be dealt with in turn in the following.

Regarding the understanding among scholars of Smart City and Sustainable City, one can see their combination as a possibility that is reinforced by their shared nature as visionary strategies for urban development. They both have – in theory – a holistic approach to the city, in that the economy, the society and the environment are all to benefit for their offerings. Because Smart City and Sustainable City continue to change depending on people's interpretations and opinions, the SSC is likely to be affected in the same way, as its own definition is founded on the definitions of its constituents. Similar to Smart City and Sustainable City, however, the best leading question for SSC would probably also be to focus on what it does, rather than what it is.

A further parallel is the 'competition' with other concepts. From the findings above, the question rises why Smart City and Sustainable City have been singled out from the vast 'pool' of possible concepts to be combined into something new. How did they become so popular? Several reasons were given for the dominance of Smart City in the general urban development discourse, but the critique on its current position should not be ignored. The advocates of SSC will have to take these complications into consideration to distinguish it from other concepts and legitimize its very existence by assuring that it does not cause any further confusion among theoreticians and politicians than there already is.

The perspective from which the combination of Smart City and Sustainable City would be approached in the context of Smart Sustainable City leads to the recognition that the SSC is likely to be framed in terms that highlight the position of ICT, but this time with a greater emphasis on social and environmental sustainability, as the current application of Smart City notoriously fails to take these into consideration. Indeed, as suggested by Ahvenniemi (2017), it would make sense to perceive the SSC as a new version of the known Smart City strategy, but with the decisive difference of a prominent presence of sustainability indicators. The SSC should – in line with the Mrs. Mortensen's view and the broad approach to Smart City as outlined in the first section of the chapter – rather approach the ICT in Smart City as a tool for achieving goals, such that the sustainability interests are best served.

Following from this, the Smart Sustainable City's right to exist could well lie in its aim to combine the original goals of Smart City and Sustainable City, which were found to oppose, but therefore also complement each other. It however remains to be seen how these goals are to be successfully included in SSC, when these same aims were already existent in Smart City itself but failed to materialize.

Concluding, the relationship between Smart City and Sustainable City is characterized by a number of commonalities, though also some differences, that are likely to affect the development of SSC because of their importance to the way both Smart City and Sustainable City are currently understood. The difficulties with defining Smart City and Sustainable City, their visionary nature, dominance of ICT and opposing aims constitute useful knowledge in the further development of the SSC and its demarcation as a distinct strategy that builds upon, rather than competes with other concepts.

From the findings, one can also see that through the constructivist approach to the given research topic, the terminology and discussion among people in both academia and policy appear to play a decisive role in the way Smart City, Sustainable City and – in the future – SSC are to be understood. Although throughout the analysis, the goal was to examine Smart City and Sustainable City from an objectivist approach (as done by other researchers), the many similarities between the two, their vague nature and their dependence on what people think they are, one could now be led to doubt the correctness of strictly perceiving Smart City and Sustainable City as separate entities that can be defined along clear lines.

3.5 Conclusion

The first research question sought to learn how the relationship between Smart City and Sustainable City affects the Smart Sustainable City from an epistemological perspective. Based on the findings regarding the dominant understanding of the strategies, which of them is perceived most important and what their function is perceived to entail, it can now be concluded that Smart City and Sustainable City have commonalities that may have an influence on the future development of the SSC theory.

Regarding the existing understanding of the relationship, telling Smart City and Sustainable City apart from other concepts requires a level of specificity that currently is not there when defining either of the two. Their shared visionary and holistic terminology and framing connects to their perceived function to improve cities and their individual subsystems. Also, the strong emphasis on Smart City in the academic discourse implies a negligence of Sustainable City that may amplify into the SSC theory.

For the SSC, this all may mean that it inherits the forward-looking, visionary aspects already found in Smart City and Sustainable City. It will however have to be distinguishable from other concepts, which, as shown on the examples of Smart and Sustainable City, can be complex and require more specification than is currently available.

4 Analysis results research question 2

This chapter will present the analysis results for the second research question, which was formulated as: How does the theoretical relationship between Smart City and Sustainable City in an economic, political and social context affect the SSC theory development? This question seeks to learn how the Smart City-Sustainable City relationship is theoretically embedded in the governing worldwide economic paradigm, as well as in the political process of democracy and in a societal context.

Using content and thematic analysis methods as described in Chapter 2, the results will be given in the following order: first, the economic aspects of the relationship between Smart City and Sustainable City will be dealt with, after which the same is done for political and societal dimensions. The implications of the findings in all three sections for the Smart City-Sustainable City relationship are given at the end of each section. Next, the analysis results are bundled and reflected upon to find out how the SSC theory development will likely be affected by them. Finally, the chapter will be summarized in a conclusion.

4.1 Economy

The governing economic system of a country has a considerable influence on the development of both urban and rural areas. It is therefore follows that the models proposed for future urban development both originate from and influence the economic system by which a city is affected. Both Smart City and Sustainable City share their economic background in neo-liberal capitalist thinking, that is currently governing much of the world's economic development.

Theme 1: Capitalistic foundation

Starting with Smart City, the strengthening of a city's economic performance was found to be one of the pillars on which Smart City stands. The economic aspect of Smart City is covered by the so-called Smart Economy (Giffinger, 2007) and includes business, commerce, service and manufacturing that is enabled by ICT to increase productivity and connectedness between flows of goods, services and knowledge (Manville et al., 2014). This description testifies of Smart City's roots in the capitalist goal of continuous economic growth; as explained by (Luque-Ayala and Marvin 2015, p.2112), the discourse surrounding Smart City and its contribution to urban and economic development is to be understood as "supply orientated, usually concerned with growth and economic priorities and more formal modes of social organisation." Hollands (2008, p.308), too, finds "business-led urban development" to be one of the five characteristics of Smart City.

Especially corporate actors are benefiting from the economic growth-principle behind today's Smart City (Kitchin 2014), because it promotes an "a-political or post-political view of urban development strategies", thus ruling out the influence of policy-makers and strengthening the position of business (McFarlane and Söderström 2017, p.313). Thereby, the Smart City can be framed in terms of technological push and demand pull, by which "technology vendors and consultancies are looking for a niche in the smart city product market" (Angelidou 2015, p.99) to make profits, while the challenges of urbanization, climate change and economic competition drive cities to seek for anything that can help solve problems and gain a competitive advantage over their neighbors (Grossi & Pianezzi, 2017). This influence of the market on city development and politics is one of the hallmarks of neo-liberalism, which is said to profess "the public "goodness" of privatization, lean government, and deregulation […]." (Grossi 2017, p.80) Smart City thus is shaped by market mechanisms, managerialism and competitiveness as vital tools for driving urban development forward.

There are however consequences of such an approach, which has been by critics. Neo-liberalism in itself, for instance, has been found to be "a macro-logical concept difficult to outline due to its hybrid character", creating a contrast between what neo-liberalism is in theory, as opposed to neo-liberalism in reality (Grossi, 2017, p.80). According to Grossi, urban development after Smart City principles becomes much more a question of management and the organization of collaboration between government and stakeholders than a matter of good policy; the city is 'steered', not 'governed'. This in turn leads to a "concentration of urban power in the hands of a few political and business elites" (Grossi 2017, p.80), with the city becoming a business like any other company, in which the "primacy of economic logic" (p.81) goes over political and social issues and financial profit is a driving force. Ironically, the economic crisis of 2008 was found by Pollio (2016) to even be one of the causes for a strengthened position of neo-liberalism in cities through 'austerity urbanism', which forced cities to rely on the market even more than they previously had done.

It is for this influence of 'business thinking' that several scholars have voiced critique about this feature of Smart City, as it would be principally incompatible with the interest in sustainability and sustainable development (Monfaredzadeh, 2017). Martin (2018) goes further and connects ICT as Smart City's dominant feature to the discussion of Smart City's economic groundwork, questioning whether digitization truly can bring about sustainability, especially when it comes to the aspects of environment and social justice.

Similar concerns have been raised over the economic background of Sustainable City. Although Sustainable City was found to pay more attention to environmental sustainability than Smart City

(Ahvenniemi et al., 2017; Monfaredzadeh & Berardi, 2015), it seems to be based on the assumption of ever-happening economic growth (Hodson and Marvin 2015), too. The logic behind this assumption is that economic gains would provide the (financial) resources to fund the transition to sustainable energy sources, transport, production, and so on (Hassan and Lee 2015). Since the economic and financial crisis of 2008, however, the question what to do if there happens to be no economic growth has gained traction and remains unanswered. As aptly summarized by Hodson and Marvin (2015, p.14), "this struggle, in many ways, can be seen as a contemporary twist on debates between eco-capitalists and eco-socialists." Ironically, this struggle goes further back than 2008, as the contradiction concerning the underlying principles of sustainable development was already noticed after the economic downturn in the 1970s (Hodson and Marvin 2015).

The very term 'Sustainable City' even has caused arguments among theorists: how can a capitalistic oriented, singular system like a city ever be sustainable, if sustainability depends on a more holistic approach than only caring about the city level and goes against the principles of ever-happening growth? According to Rees (1997), putting the terms 'sustainable' and 'city' together would by oxymoronic, since "no city or urban region can be sustainable on its own." (p.307) The reasoning behind this statement is the recognition that for a city to be sustainable, it is to a decisive extent dependent on its hinterland, instead of being isolated entities (Martino, 2009). One of the biggest contemporary challenges for urban sustainability is therefore to integrate cities with their wider surroundings, thereby to effectively "embed the city in its larger natural ecosystem." (Martino, 2009, p.249). Rees (1997) picks up on this connection between the city and its surroundings and notices that through the current approach of "sustainability-through-growth" (p.308), the desire of cities to keep increasing the yields from one unit of land will effectively result in an increased erosion and eventually declining sustainability. As Bithas (2006) expresses this issue, cities rely on the import of their resources from their hinterland, but only export environmental impacts instead of contributing to the health of itself and its surroundings.

Comparison

Based on these findings, it is remarkable to see the similarity of Smart City and Sustainable City when it comes to their economic foundations. Both concepts have been shown to be based on the currently governing paradigm of economic growth through neo-liberal capitalism. However, a combination of Smart City and Sustainable City does not rule out the deficiencies of each other. As stated by Alawdah (Alawdah 2017, p.56), ecological and social sustainability may loose out from this focus on the economy, the protection of the environment and the development of economies are "in opposition to another", thus pointing at a competition between the three, instead of cooperation.

Stilwell (2000, p.207f.) also recognizes the confrontation between economy on one side and society and ecology on the other, characterizing ecological sustainability as (1) the maintenance of biodiversity, (2) avoidance of going beyond the carrying capacity of the Earth and (3) the consideration of future generations in today's management of resources, thereby stressing that "the gulf between these ecological principles and current economic practices is all too obvious" and that "nowhere is this more evident than in cities."

Stilwell goes on to also highlight the loss of social sustainability, reminding the reader of Margaret Thatcher's stance as one of the foremost drivers of neo-liberalism that 'there is no such thing as society' (p.207). Consequently, Stillwell sees threats to the very cohesion of society, if the existence of society at all is ignored. The economic structures as we know them, according to him, are "fundamental obstacles" (p.214) to sustainability, explicitly pointing capitalist market principles as the cause for the modification of society and nature. Grossi (2017, p.84) aptly summarizes the incompatibility of Smart City's neo-liberal capitalism with sustainability as a "smart city utopia", as he highlights the need to direct attention away from technological solutions and towards the challenge of urbanization that requires a long-term planning perspective.

4.2 Politics

Regarding the political realm, there today is a widespread understanding of the urgency to bring about sustainable development in all parts of society. Ever since the Brundtland definition of sustainable development (1987) and the adoption of the Agenda 21 at the Rio conference in 1992, sustainable development has been high on the agenda of policy makers. From the literature, it was learned that in the context of the political debate, Smart City and Sustainable City are often discussed with regards to the terminology used to convey thoughts, ideas and meaning. It was observed that theorists tend to underline the power decision-makers have concerning the way in which the understanding of Smart City and Sustainable City is directed. In extension, this also brings along a certain responsibility, as there appears to be a delicate balance between what cities – technically speaking – in the future *could* become and what politicians *want* cities to become. Furthermore, a second theme in the literature was found to be connected to the governance model that nowadays is preferred for urban development projects.

4.2.1 Theme 1: Smart City and Sustainable City dependent on understanding people

Given the popularity of Smart City (see Chapter 3.2), much debate is currently happening around how best to understand and employ Smart City related concepts and technologies. Albino (2015, p.8) even notices there to be a "cacophony" of definitions and terminology. The consequence of this

cacophony, according to Albino, is diffusion of Smart City into an “urban labeling” phenomenon. Indeed, as stated by Haarstad (2016, p.424), Smart City in politics is being reduced to an “empty signifier”; a term to use in conversation and debate, but without any substantive meaning.

Additionally, the existence of multiple other, competing terms and concepts (see also Chapter 3.1) makes it complicated for politicians to get an overview. Such adjectives as ‘intelligent’ and ‘digital’ are frequently used to replace ‘smart’, which exemplifies the fuzziness of the debate, despite ‘intelligent’ and ‘digital’ – strictly speaking – having different meanings from ‘smart’. For instance, Yigitcanlar (2018) notices how the term ‘smart’ has come to replace ‘sustainable’, leading to the insight that their greatest value seems to be in supporting policy proposals in the democratic process. Indeed, Name and Pardo (Nam & Pardo, 2011) found ‘smartness’ to be the preferred term by companies to sell their products with, as it has a different connotation than e.g. ‘intelligent’. A practical consequence was found by Yigitcanlar (2018) in China: whereas the newly built city of Tianjin was initially advertised as “Tianjin Eco-City”, nowadays it is branded as “Tianjin Smart City”.

Such developments show confusion and opportunism catching on easily in the political debate, due to what seems like a margin of interpretation that permits anyone to think of Smart City as he wishes. Especially the widespread application of Smart City to all kinds of urban sectors is one of the reasons policy makers use ‘smart’ after the assumption that the desired results in transport, energy or housing will probably come about one way or another, as long as they are smart (Albino, 2015). In this regard, the Smart City with its digital technology is rather seen as a tool for solving urban development problems and increasing the chances of getting a majority vote than as a holistic strategy for balanced development (Martin, 2018).

From the interview with Mrs. Mortensen, it was learned that this mechanism can be nuanced by discerning between the municipality’s departments and the city council: according to the interviewee, sometimes, the department (where an idea is conceived) must alter its proposal for a project or intervention to the wishes of the relevant committee. This stage of altering plans, not because of technical or procedural difficulties, but because of political standpoints, can have a profound influence on what is eventually being implemented and in extension, what Smart City becomes in reality as opposed to theory.

As was already indicated in the previous section concerning the economic foundation of Smart City, policy-makers appear to value economic growth and competition of their city to be of paramount importance at the expense of other areas. The technical and social ‘spheres’ are often seen as distinct and opposing, with a concentration on one of the two being claimed to lame the democratic process (Williams, 2010). As further elaborated upon in the following section, the public is put into a

dependent position through this inclination, leaving the responsibility for the state of urban services in the hands of politics. Although engineers and scientists in their role of advisers and educators are responsible for remedying this situation, they are criticized because of their own lack of understanding of how their own inventions are to be taken up by end-users (Williams, 2010).

When it comes to the position of Sustainable City, there is uncertainty among policy makers, too, about how to understand what it is. Williams (2010) finds urban policies to be "infused" with sustainability and already many initiatives to implement it can be found around the world. Yet, she also notices that everyone involved in such initiatives does have a different vision of sustainability and how achieve. This point is further exacerbated by Hodson and Marvin (2017), who examined Sustainable City and found that in the past, the term used to have a fairly defined and understood meaning, based on its origins in the Brundtland definition of sustainability. However, after the economic crisis of 2007, Sustainable City disintegrated into many different "logics", ranging from 'urban resilience' to 'low carbon transitions' to 'sustainable growth for cities', driven by the competition between companies, consultancies and others to capitalize on the request of cities turning to the market to solve their development challenges. The political debate is flooded with terms, ideas and concepts that seem connected, but are also distinct in their own way, leading to confusion (cf. Chapter 3.1).

There are however also voices who perceive this vagueness of concepts to be something positive. Moen (Moen 2001, p.61) explicitly states that actors in urban development should be let free to decide for themselves what they want to do with Sustainable City or any other form of strategy, because "the simplest way to spread a statement is to leave a margin of negotiation", so that this statement can adapt to local circumstances and more people can work with it. At the end of the day, the margin of negotiation has allowed Sustainable City to come so far as it has.

4.2.2 Theme 2: Top-down governance model

A second theme that surfaced during the content and thematic analysis was the top-down governance model that is nowadays often used in both Smart City and Sustainable City projects. According to the top-down model, a strategy is developed by the government, using public money and its adoption is also driven by government driven initiatives (Estevez et al., 2016). The public is on the receiving end, playing only a little or no role.

The same study by the UN showed the top-down model to be the most applied governance model in all projects reviewed with a total of 83% (Estevez, Lopes, and Janowski 2016, see also Figure 6). According to Lee, Hancock and Hu (2014), such an approach leads Smart City projects to be rather

preoccupied with technical matters. This is in the interest of corporate actors, who actively frame the Smart City to be a matter of "optimization through technology", leading Smart City to be defined by an ICT architecture to "interact with infrastructures and adjust parameters to predefined optima." (Breuer, Walravens, and Ballon 2014, p.155).

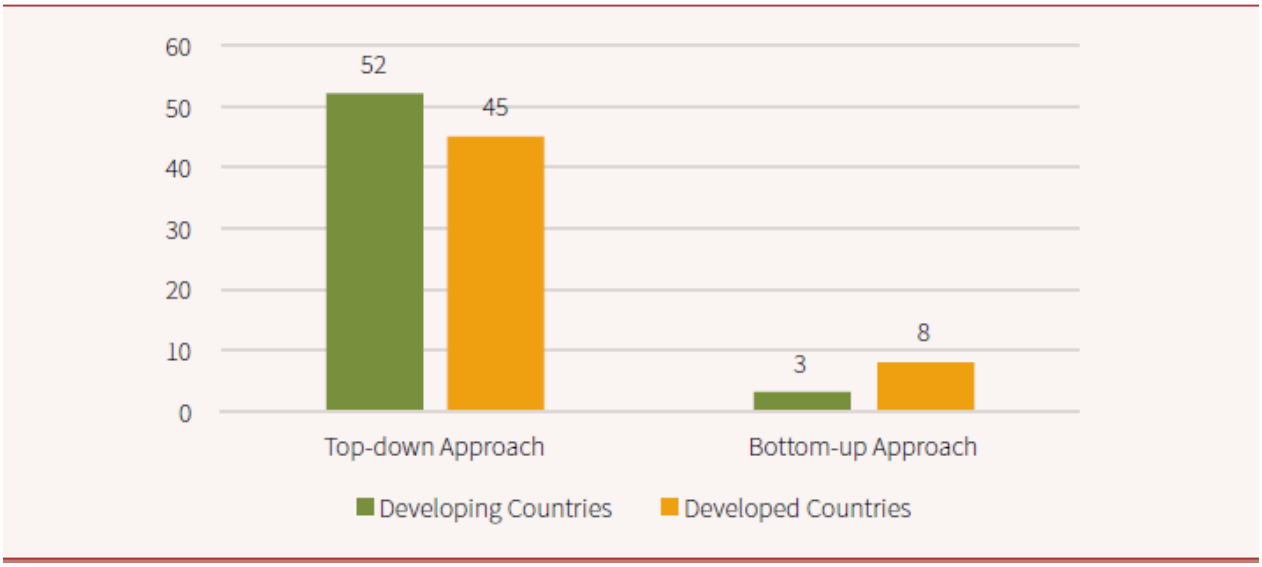

Figure 6: Comparison number of top-down and bottom-up approaches to urban development projects, in developing (green) and developed (orange) countries (source: Estevez et al., 2016, p.77*)*

There has however been widespread critique against this approach, with opponents claiming that cities are too complicated to be understood as a set of components interacting with each other following predefined rules (Hughes, Chu, & Editors, 2018). Breuer et al. (2014, p.155) provides the cities of Songdo (South Korea) and Masdar (United Arab Emirates) to explain what the consequences are of top-down city planning: "…sterile, overly planned, prohibitively expensive, anonymous, uniform and conformist" cities, which fail to be completed within the proclaimed timeframe and attract little to no economic activity.

From the interview with Mrs. Mortensen, it was learned that projects implemented through the top-down model are potentially vulnerable to change or cancellation, due to the democratic model prescribing elections every four years, and thus a potential change in policy direction as a consequence. Although according to Mrs. Mortensen this does not occur in her work and policy-making is a fairly stable process in Frederiksberg, the principle of a political change of direction after a new election could however cause problems at other places.

Furthermore, there are concerns about the privacy of citizens, as in top-down visions, people are thought of as data-producing machines at the service of commercial interest (Breuer 2014). This may lead to "too much monitoring and too many integrated technologies and infrastructures" (Breuer

2014, p.156) with the Smart City providing the government a “control room” for watching over citizens’ behavior. The best known real-life example of such initiatives is found in the Rio de Janeiro (Brazil), where exactly such a control room was built for the claimed purpose of improving city services (Gaffney & Robertson, 2016). Ironically, these improved city services are effectively hindering the development of a city, as the packages of solutions provided by companies require all parts of a city to be aligned with the central management hub, thereby stifling spontaneous, uncontrolled economic development (Breuer, 2014).

Comparison

Based on the two themes identified in the literature and the interviews, it appears that the political realm has a significant influence on the eventual outcome of Smart City and Sustainable City projects. Policy-makers have a responsibility to know what they are talking about, as their choices affect the lives of many. On the other hand, however, in the current top-down governance system, politicians are largely dependent on the knowledge provided by academics and company representatives. As Peris-Ortiz (Peris-ortiz, Bennett, and Pérez-Bustamante Yábar 2017, p.8) argues, the success of top-down governance in such cases rests upon the commitment and leadership capacities of those in charge, someone who “shows belief in the concept and exercises leadership to drive it forward.”

4.3 Society

In comparison to the role of the political institutions in contemporary urban development and as already indicated above, the understanding and application of both Smart City and Sustainable City has been found to have consequences for the position of the public. The theme most dominant in the literature points at Smart City and Sustainable City including citizen involvement in a theoretical sense, but critics say that in the actual implementation, the public is largely ignored.

Theme: Citizen participation

Citizen participation is referred to by Rupprecht Consult (2013) as the integration of citizens in the process of political decision-making, such that they can take part in the sharing of power. She builds this definition on the writings of Arnstein (2007), who envisioned an eight-rung ladder, with each rung symbolizing an increased involvement of citizens, starting from non-participation to full control (see Figure 7).

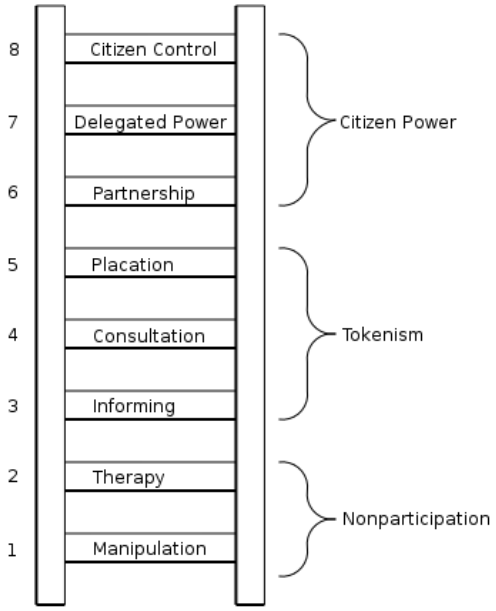

Figure 7: Ladder of participation (source: Rupprecht Consult, 2013, p.4*)*

In Smart City theory, there is explicit attention for the contribution and importance of citizens: one of the six characteristics of Smart City according to Giffinger (2007) is Smart Citizens, while also Chourabi (2012), Nam & Pardo (2011), as well as Ahvenniemi (2017) includes citizens as an integral part of any successful Smart City. The notion of Smart Citizens is said to include work in an ICT-enabled environment, with access education and training, such that citizens get to experience and benefit from the production, use and storage of data in Smart City projects and create new products and services (European Investment Bank, 2012; Manville et al., 2014). As general as this may sound, an often-used phrase in this context is the improvement of the 'quality of life' for citizens, by informing and educating them, such that they can take part in governing and managing the cities they live in (Berntzen & Johannessen, 2016b). In fact, Maltese, Mariotti and Boscacci (2016) found quality of life to one of the most occurring aspects in Smart City definitions, together with the feature of sustainability. They furthermore go on to state that in that sense, one other pillar of the Smart City as given by Giffinger (2007) called Smart Living, is synonymous to 'quality of life'. To achieve such a 'smartification' of citizens, the European Investment Bank (2012) proposes to work towards influencing people's behavior, so that in the process of learning to thrive in the Smart City, they contribute to lowering carbon emission levels.

Indeed, citizens are perceived by theorists as indispensable when it comes to urban development (Hughes et al., 2018; Lopes & Oliveira, 2017; McFarlane & Söderström, 2017). Berntzen and Johannessen (2016) place their contribution to Smart City on the same level as their importance to

democracy as a whole; they links cities' adoption and implementation of policy directly to citizen participation. They can not only wield political influence, but also share their expertise for the good of their communities, solve their city's problems and improve services (Berntzen & Johannessen, 2016b). Also, when it comes to controlling the government and the private sector on their accountability, individual citizens and organizations are "watchdogs" to keep these actors responsible (Taipale, Kaarin. Fellini, Claire. Le Blanc, 2012).

Smart City in this regard theoretically fulfills all requirements and compared to other concepts even comes closest to full citizen involvement at all stages of the city's development (Ahvenniemi 2017). Whereas "digital city" or "ubiquitous city" only focus on the application of ICT, it is the Smart City that should be capable of including citizens in achieving sustainable development, with the intention of improving the overall quality of life (Albino, 2015). ICT is thus perceived as an essential tool to mobilize and integrate citizens in the Smart City (Berntzen & Johannessen, 2016a; Viale Pereira, Cunha, Lampoltshammer, Parycek, & Testa, 2017). The concept of e-governance is often mentioned as a way to achieve this goal: governance is to be mediated via ICT, such that Smart City initiatives can be brought to people's attention and the decision-making process is transparent and accountable. However, this would require the citizens to actively take part and be the driver behind their own participation (Albino, 2015).

According to several authors however, initiatives in Smart City currently leave citizens either disempowered (Martin, 2018) or forgotten about (Freeman, 2017). One reason for this situation is to be found in the "top-down and company-driven actions taken for creating a smart city." (Albino, 2015, p.8) It is often assumed that through this approach and the proliferation of ICT, greater sustainability can be reached, but it was found that one of the most important factors in making a city sustainable – people's consumer behavior – could not be affected sufficiently by doing so (Wangel 2017). This achievement would be considerably important, however, as citizens are recognized as crucial actors in sustainable urban development. Vanolo (2016, p.31) gives four rather daunting visions on possible configurations of 'citizen participation', ranging from citizens being only informed by 'experts' about the services they are supposed to use, to citizens who can take part in the Smart City, but are mainly seen as 'data suppliers', leading to a situation in which "there is the risk that we are not going to create machines that are more and more similar to humans, but rather humans who are more and more similar to machines, both in their bodies and in their behavior."

Because citizens are however of such importance to successful sustainable urban development (Oliveira, 2017; Hollands 2008; Rees 1997), Smart City is called for to adapt to people, instead of people adapting to the Smart City (Cugurullo, 2013; Kitchin, 2015; Vanolo, 2016). As stressed by

Allwinkle and Cruickshank (2011), ICTs should be used primarily to empower citizens to become part of the political debate and thus influence the environment in which they live. Even more bluntly stated, "…progressive smart cities must seriously start with people and the human capital side of the equation, rather than blindly believing that IT itself can automatically transform and improve cities." (Hollands, 2008, p.315) If this is achieved, the 'label' of Smart City would get a clearer and more fitting connotation by putting referring to people as the agents that can bring about solutions to urban problems (Albino, 2015). Thus, they would no longer be subjects of ICT, but be the active users of ICT to bring about sustainability themselves.

For this reason, several authors have pointed at the opportunities provided by "bottom-up" approaches, in which citizens actively contribute to planning processes in which public and private actors are combined (Estevez et al., 2016). Bottom-up initiatives are said to be first and foremost about the citizens themselves, and "dismiss any form of top-down urbanization, in particular with the involvement of powerful private companies." (Breuer 2014, p.157) This way, citizens learn to engage with and thus 'use' the city, instead of being subject to its centralization when the government and corporations are in charge. Ideally, a combination of top-down and bottom-up would deliver the best results, with the top-down actors providing the financial and policy foundation, while bottom-up actors can build on this foundation with their own, locally specified solutions (Estevez et al., 2016). The city of Berlin is mentioned as one successful example, in which a strict top-down program facilitates the inclusion of bottom-up participation (ERDF, 2013).

When asked about this topic during the interview, Mrs. Mortensen reported there to be a change in attitude happening among policy makers: while in the past there indeed used to be a focus on the technical of Smart City, the critique of scholars now seems to have reached policy makers, who are actively discussing about including citizens in Smart City beyond only the rhetoric, referred to as Smart City 3.0 (Van den Bosch, 2017).

Within the context of Sustainable City, there are less vocal concerns over the position of citizens in being active actors for sustainability, although their importance is highlighted just as much as with Smart City. As explained by Martino (2009), being a Sustainable City inherently means that a city's population should also be sustainable. Rees (1997, p.309) uses a similar wording when he claims that making a city sustainable could be helped more by "changing personal consumption patterns" than by concentrating on how other levels of the urban system could be improved.

Comparison

When comparing Smart City to Sustainable City, it is now apparent that especially Smart City is both praised and heavily criticized for its inclusion of citizens: in theory, the public plays a significant role in the very realization of Smart City projects, whereas the top-down governance structure and influence of corporations are named as factors that could hinder the public from really taking part in the decision-making process.

What is clear, either way, is that the problems with the position of society in Smart City and Sustainable City is causing theorists to worry more about the current political debate than the technical possibilities to engage citizens in the first place. Indeed, there as was found in the other sections of analysis, the role of political agreement and goals set through discussion appear to play a significant role in both Smart City and Sustainable City, and their relationship is governed by it.

4.4 Implications for SSC

The link between Smart City and Sustainable City in the economic, political and societal contexts points at deficiencies existing in their implementation that may have an influence on the SSC: although they are meant to prepare cities for the future, Smart City and Sustainable City's economic foundation is still rooted in the 20th century ideas of continuous growth. Following the reasoning of critics, though, an analysis of the current economic system lays bare that the capitalist desire for continued economic growth, which is to be spurred by Smart City projects, cannot coexist with principles of sustainable development – and, in extension, Sustainable City –, because this would require significant lower growth, no growth or even degrowth of the economy (Martin et al., 2018). The SSC will likely have to be designed after altered economic premises to avoid these mistakes characterizing the Smart City-Sustainable City link.

In the political context, it was found that unawareness and terms including 'smart' and 'sustainable' have become container terms that can be given any meaning, depending on situation and intention. The status of Smart City and Sustainable City as mere 'labels' could also become the fate of SSC. Furthermore, the addition of SSC to the already long list of terminology may confuse people, who thus far have thought that Smart City already was sustainable, which in theory it also should be. On the other hand, the 'margin of negotiation' introduced by Moen (2001) could also be applied to SSC and taken advantage of: by deliberately stressing SSC's advantages over Smart City and Sustainable City and other strategies but without getting too specific, the SSC could navigate between being a progression from earlier concepts on one side, while staying flexible enough to changes in circumstances on the other.

When it comes to the rights of citizens and the manner in which they are affected by the Smart Sustainable City, it was found that despite their potentially crucial role in the implementation and success of the concept, they are largely ignored by the Smart City in its function as the dominant tool of contemporary urban development. As summed up by Martino (2009, p.240), the participation of the public in the making of cities is essential for sustainability, but this is unlikely to happen within the governing political structures, in which citizens "have become taxpayers who receive services from an all-powerful state and its elected representatives." This problem is not easily solved by the Smart Sustainable City, although some authors do propose the SSC to be approached as a Smart City with a greater emphasis on sustainability (Ahvenniemi 2017). Nevertheless, because the Smart Sustainable City lacks an empirical basis and bottom-up approach (Höjer & Wangel, 2015), it is currently hard to see where citizens fit in. The advent of the Smart Sustainable City would be an opportunity to end the current top-down approach of Smart City, but it can be safely said that the SSC will not be able to fully deliver its promises without the involvement of the public.

4.5 Conclusion

The analysis of the data for the second research question has resulted in the finding that the economy, political arena and the society have a profound influence on what Smart City and Sustainable City are perceived to entail and to do in the development of a city. From an economic perspective, both concepts appear to profess sustainability to be an integral part of their functioning, while on the other hand, it was found that their economic roots in capitalism only make sustainability possible, as long as it is aligned with economic growth and a better competitive position of the city in question.

In a political context, it was found that top-down governance models are currently preferred over bottom-up or mixed top-down and bottom-up governance. This makes projects vulnerable, as strong leadership capacities appear to be necessary for project success in such cases. The influence of socially constructed knowledge on the definition of Smart City and Sustainable City also proved to be of importance to their being and implementation, instead of only their technical applicability.

Society is currently mostly left out of the discussion when it comes to projects in Smart City or Sustainable City. Nevertheless, there seems to be agreement over their crucial role in implementation and adoption of any Smart City or Sustainable City solution. The SSC is likely to be affected by this and there is an opportunity to lessen the influence of economic interests and include the public to a more thorough extent in SSC projects.

5 Analysis results research question 3

This chapter will present the analysis results regarding the research question "How does the relationship between Smart City and Sustainable City as expressed in already existing urban development projects affect the SSC theory development?" The analysis for answering this question took cases of existing cities to assess them on the way they perform within the six categories that Smart City and Sustainable City were also analyzed with for the previous two research chapters. One successful and failed urban development project was selected for both Smart City and Sustainable City, thus making a total of four different cities. The lessons to be drawn from these projects are meant to contribute to the characterization of the Smart City-Sustainable City relationship and in extension, give further input for the way in which this combination may affect the Smart Sustainable City.

The presentation of the analysis results will follow three steps: first, the projects connected to failed and successful efforts in Smart City will be described and afterwards analyzed according to the categories of 'understanding', 'perspective', 'function', 'economy', 'politics' and 'society'. Second, the same procedure is carried out for the exemplary cases connected to Sustainable City. The third step will be to bundle all the findings in a discussion to come to understand what can be learned from the practical side of urban development, how these findings relate to the theory that was established in the previous two chapters and lastly, what implications these findings may have for the SSC.

5.1 Case 1 – Successful Smart City project: Amsterdam (Netherlands)

5.1.1 Description

The city of Amsterdam (Netherlands) is widely regarded as an example for successful Smart City projects. Over the years, the city has received numerous awards (Bisello, Vettorato, Stephens, & Elisei, 2017) and has manifested itself as one of the six most successful Smart Cities in Europe.

The driving force behind any project related to Smart City is the Amsterdam Smart City (ASC) Platform. It was created in 2008 by the Amsterdam Economic Board, net operator Liander and telecommunications provider KPN (Manville et al., 2014) to "speed up and facilitate the take-up of new technologies that would benefit quality of life and sustainability in the metropolitan region." (Van Winden, Oskam, Van den Buuse, Schrama, & Van Dijck, 2016, p.16) Its goals have been established to be a 20% increase in the use of renewable energy sources, a 20% decrease in overall energy use compared to the level of 2013, make traffic "as clean as possible" by the year 2025, promote the circular economy model and work to improve Amsterdam's water management system (Van Winden

et al., 2016, p.18). As found by Bisello et al. (2017) and the European Investment Bank (2012), these goals are closely related to the New Amsterdam Climate Program, which foresees Amsterdam to become more sustainable city in the years to come.

Shortly after its founding, the ASC developed a comprehensive plan to realize the above goals, called the Amsterdam Smart City Program. Initiatives to be part of the program were allowed to come from all kinds of actors: from NGOs to city administration to citizen collectives (Van Winden 2016). Since 2009, projects were initiated across sectors ranging from energy to mobility to circular economy (Bisello et al., 2017; Somayya & Ramaswamy, 2016). The use of digital technology in these initiatives is seen as instrumental, but not as a goal in itself (Bisello et al., 2017; Van Winden et al., 2016).

As noticed by Sanseverino (2017), the cooperation between different partners, both within the ASC and the individual projects, is a distinct feature of Amsterdam Smart City and an important factor in its success. Van Winden et al. (2016) also highlights the possibility for the public to take initiate and/or take part in projects, which would make Amsterdam unique in comparison to other cities. Indeed, a combination of partners is valued higher than the development of a master plan and the focus on ICT (as found to be dominant in most Smart City theory, cf. Chapter 3.2) is exchanged for "collaboration, co-creation and partnering of stakeholders." (Manville et al., 2014, p.144)

5.1.2 Analysis

Understanding

Because of the clear goals with temporal deadlines established for the future, ASC can still be categorized as the realization of a vision (cf. Chapter 3.1), but understands the Smart City as a process, rather than a status to be obtained, once the projects are done.

Emphasis

Strikingly, the focus on collaboration and sustainability also means that ASC does not have ICT as a feature around which everything else is centered. Instead it uses ICT as a tool to achieve goals that critics have observed to only exist in theory, but not in practice (see Chapter 3.2).

Function

The function of the ASC has been described as bringing about more efficiency in energy use. In Amsterdam, there is thus a considerable overlap between Smart City and Sustainable City: environmental sustainability and also social sustainability (through citizen participation) have a

greater value than the theory identified in the previous two chapters would lead one to think, with accompanying good results as a consequence.

Economy

Despite the larger than usual role of social and environmental sustainability in Amsterdam, the economy still proves to be an important guideline for the established goals. As these goals have been established around efficient energy use (meaning saving of money) and promoting the circular economy as an alternative to the prevailing model, the principle of economic growth through efficiency of energy and resource usage is clearly visible.

Politics

Politically, the ASC differs from the theory as described in the previous two chapters, as multi-stakeholder projects with both top-down and bottom-up input are actively encouraged. The ASC platform has been described as a coordinating body, that however aims at taking minimal control over a specific project (Van Winden et al., 2016), such that the participants are responsible for their own success and stay committed. This approach has shown to be one of the decisive factors in success of the projects carried out in Amsterdam and serves as an example for other cities.

Society

Following from the political set-up of the ASC and distribution of responsibility, society in ASC is closely involved in the Smart City projects carried out, with a right to apply for grants, take control and take part in their conduction. The lessened role of politics and the increased role of citizens leads to a balanced approach to project making and an easier up-take of solutions by the public (Van Winden et al., 2016).

5.1.3 Conclusion

From Amsterdam Smart City, it can be learned that the reinforced position of collaboration between different partners in projects can make a decisive difference in their likelihood of success. Although ICT and economic priorities still play a major role in driving and conducting projects, they are being formulated to serve sustainability. In that regard, it is remarkable to which extent the goals of Smart City and Sustainable City overlap each other and for their meaning are dependent on what the ASC platform decides them to be.

5.2 Case 2 – Failed Smart City project: Masdar (United Arab Emirates)

5.2.1 Description

Starting in 2006, the Masdar City project has gained much attention and publicity around the world as it is claimed to be "one of the first examples of a development which has sought to incorporate smart technology throughout the development to achieve sustainable outcomes." (European Investment Bank, 2012, p.84) On an area of 6 km² and 15 km away from Dubai City (Ibrahim 2015), Masdar is supposed to provide livelihoods for 40.000 residents and also provide space for 50.000 daily commuters (UNEP, 2012). It is to achieve these goals as part of the bigger Abu Dhabi Economic Vision 2030 plan, which includes the Masdar Initiative, which again is divided into Masdar City, Masdar Carbon, Masdar Capital, Masdar Power and Masdar Institute of Science and Technology (a collaboration with the Massachusetts Institute of Technology). With an initial budget of $22 billion, the city will be constructed in seven phases, of which the first phase was completed in 2016 (Sanseverino, 2017). When finished, it is supposed to use 75% less energy compared to a similar conventional city, while its energy requirements will be between 200 and 240 MW, with 80% of it coming from solar power (Sanseverino, 2017). In fact, Masdar set itself the goal of becoming a "zero-carbon" city, "powered entirely by renewable energy, car-free and [producing] net-zero waste." (Alusi, Eccles, Edmondson, & Zuzul, 2011, p.7)

One of the most important features of Masdar is its inclusion of digital technology in the urban fabric. Several technology companies are contracted to assist in this undertaking: General Electric, Siemens and BASF are some examples of cities providing digital products. By doing so, Masdar positions itself as "a commercially driven enterprise that operates to reach the broad boundaries of the renewable energy and sustainable technologies industry." (Alusi et al. 2011, p.7)

5.2.2 Analysis

Understanding

Masdar City is an example of efforts to make a city a predefined vision, with clear features and performance standards. As described in this report's previous chapters, the understanding of the Smart City as an entity and status to be reached after the implementation of a series of actions is epitomized in Masdar, which was planned, designed and built by experts from architecture and engineering companies with the financial support of the Dubai government. This means that as long as Masdar is not finished, the Smart City is not finished either, which contrasts sharply with the approach of Amsterdam Smart City, which takes the Smart City to be more of a process towards an

end-goal that consists of energy and resource usage limits, rather than a system being successfully implemented, or not. The consequence of this understanding of the Smart City is a city without room to experiment and fail, which goes against the nature of urban development being a messy confluence of different interests and money flows.

Emphasis

As becomes clear from the case description, Masdar City deliberately has ICT as its main feature distinguishing it from other cities, with digital systems being embedded in virtually every aspect of the city fabric. It thereby follows a techno-optimistic path with the idea to achieve sustainability and prosperity through optimized performance of the city's individual systems. As was discussed in the previous chapters, however, the attention being solely directed towards the technical side of urban development leads to a negligence of the social aspect. In Masdar, this imbalance is expressed in most of the systems being constructed and functioning, but little to no growth in residential numbers.

Function

In the past, Masdar City set itself the goal to become the world's first city to function without the fossil fuels, which however had to amended later to at least compensating for every unit of fossil fuel used. As with Amsterdam Smart City, the function of the Smart City in the UAE was also to achieve sustainability outcomes, thereby preparing the traditionally oil-rich state for future decades, showing an overlap between the functions of Smart City and Sustainable City as described earlier.

Economy

The economy proves to be of a critical importance to the very existence of Masdar: the funding for the construction of the city's infrastructure is dependent on the economic situation of Dubai itself, with the government only spending when they deem this necessary and appropriate. During the aftermath of the financial crisis of 2008, this mechanism could be seen at work, as the budget for Masdar's development was lowered, because the money was needed elsewhere in the Dubai financial household. This dependency turned out to be a fundamental weakness of Masdar and constitutes a school book example of the influence that growth-oriented capitalism still has on supposedly smart and sustainable urban planning.

Politics

Another weakness of Masdar City is the governance model utilized to oversee its development. In contrast to the successful Smart City projects in Amsterdam, Masdar shows the consequences of too much top-down management as was already warned against by critics (cf. Chapter 4.2). Furthermore,

the Dubai government hired experts from around the world to design and build Masdar, without having much knowledge themselves about Smart City, except for the opportunity to make good publicity and use economic opportunities arising from the project. This disconnect between politicians and those with knowledge, although the politicians fulfill the role of commissioners, lays bare how much a successful Smart City depends on all parties to be one same page and with (roughly) the same amount of knowledge and understanding of what they are working with. Especially in comparison to Amsterdam, Masdar City proves to be a real-life example of all the critique that theorists over the years have had against the techno-optimist scheme of Smart City (cf. Chapter 4.2).

Society

The consequences of top-down governance in Masdar City are felt by society: so far, there has been no involvement of the public, which in turn has led to little awareness about, let alone enthusiasm towards the project. After several years of development, the number of residents is still far from the expected levels and without there coming a good reason to live in the city apart from its environmental sustainability standards, this situation is likely not going to change.

5.2.3 Conclusion

Masdar City took its starting point in the technical optimization of city management and for its construction depends on the economic situation of its host country. Although part of the city has been built and the project is still ongoing, Masdar is nevertheless perceived as a failure for its negligence of public involvement and aim for achieving sustainable goals that however depend on an economic system that works against the very principles of sustainability. As Masdar acts as a confirmation of the critique that was found in the literature for the previous chapters, its state reinforces the recognition that the discourse surrounding Smart City and Sustainable City is rather political than theoretical and more dependent on socially constructed meaning than on technical feasibility, especially when the success of collaboration across sectors in Amsterdam is taken as a counterexample.

5.3 Case 3 – Successful Sustainable City project: Bo01 in Malmö (Sweden)

5.3.1 Description

The district called “Bo01” in Malmö (Sweden) is generally regarded as a success in urban regeneration. As part of the City of Malmö’s efforts to implement Agenda21, Bo01 began as the first part of a larger regeneration project called Västra Hamnen (Western Harbor) and was supposed to act as a showcase of future living during the European Millennium Housing Exposition in 2001

(Freeman, 2017). It is also for this reason that the project was given the name Bo01, after the Swedish verb for 'to dwell' ("Bo") and the year of opening 2001 ("01").

Located along the coast of the Öresund and on a former shipyard construction site of 54ha, 70 buildings were constructed, with a total of 1.425 dwelling units (Austin, 2013) and 3.600 residents. According to Ekblaw, Johnson and Malyak (2009), the key word for Bo01 was diversity, which in practice meant that each housing unit was designed in its own unique way, painted in different colors and aimed for various types of people. This was all done under the guidance of a Quality Program, which was developed by all the project's actors during multiple meetings ("Creative Dialogues") under the auspices of main architect Klas Tham. The special feature of this plan was its lack of strict quantitative requirements of the buildings (except for their energetic performance), sanctions against failing the goals or incentives for achieving them. Nevertheless, the visitors of the expo and an additional contract which required the developers to report their performance, provided enough reason for them to do their best (Freeman, 2017).

5.3.2 Analysis

Understanding

The understanding of Bo01 as a neighborhood founded on ecologically sustainable principles and to act as an example for future neighborhoods connects to the characterization of the Sustainable City given in the theoretical part of this report; the visionary, holistic nature of Sustainable City was implemented in the wider project of Västra Hamnen through Agenda21, which in turn is based on the principles of sustainable development.

Emphasis

Bo01 constitutes an example of the possibility to build an ecologically sustainable place without the commonly assumed need for ICT to do so, as was found in Chapter 3.2. Instead of the implementation of ICT systems, the architects spent more attention on the rate between buildings and open space and the aesthetics of the individual houses (Austin, 2013).

Function

Based on the intentions of the project owners, Bo01 was first and foremost a regeneration project of run-down part of the city of Malmö. The short-term goal was to let Malmö give the visitors of the European Millennium Housing Exposition a good impression of itself, whereas the long-term goal was to give the city an economic impulse by attracting new, wealthy tax payers. It light of this situation, one could wonder what the specific function of Bo01's sustainability feature was: truly contribute to

lessening the impact of the houses energetic performance on the environment and provide an example for other cities, or to make the houses even more attractive to live than they would have been without the special care for sustainability? Apart from the fact that the project did fail at reaching the energetic goals, additionally, social sustainability was not realized either because of high costs of living, making it only possible for white, affluent people to afford a house in Bo01. The primary function for Bo01 therefore rather seems to be to show that projects within urban regeneration can be started and finished successfully, whilst letting multiple project partners partake in the project's development.

Economy

As was found with the successful Smart City example of Amsterdam and its main interest in achieving economic gains from i.a. energy efficiency, the capitalist foundations of Sustainable City are expressed in Bo01: a deliberate decision was made by the city council to try and attract wealthy citizens to the area, arguably to give the city's tax income an impulse. Therefore, as with Amsterdam, one can see the economic interest weighing up against social and environmental sustainability, which act rather as drivers for economic development instead of equally benefiting from Bo01's success. As was criticized in the theoretical part of this report, this real-life example goes to show that environmental and social sustainability under the current economic paradigm are only at the service of growth and ignored if they stand in the way of growth.

Politics

As with Amsterdam, Bo01 shows the strength of collaboration to be of importance to a project's success. Although the city of Malmö was the project owner, it was the combination of stakeholders and their commitment to the project that let Bo01 succeed within given the time frame until the 2001 Housing Exposition. What especially stands out is the effectiveness of letting project participants be transparent about their performance that made them stay committed; it the end, it was in their own (business) interest to cut a good figure, once the public got to see the results of what they had done. The political realm, as in Amsterdam, played a coordinating and driving role, but did not take as much control over the project as e.g. the government in Dubai did with Masdar City.

Society

As was established in the sections about the function and economic background of Bo01, the public was only targeted for their tax money and did not substantially partake in the project. The success of Bo01 among citizens nowadays is largely due to its attractive location and quality of life, but these factors were shaped without the input of the public. In that respect, the social segregation that is

apparent when comparing the demographic structure of Bo01 to the rest of Malmö is its greatest failure and shows how much a Sustainable City in real life depends on actively involving citizens from all levels of society.

Conclusion

Bo01 is generally regarded as a successful urban regeneration project that implemented principles of climate resilience and sustainable development in its fabric, such as to minimize its negative influence on the environment and prepare it for future decades. It shows that sustainability does not have to rely on ICT per se to still be successfully implemented, thereby being a counterexample to the claim that digital technology is the best available tool to build the future city. Nevertheless, Bo01's significant social segregation highlights that relatively quickly obtainable and easy to measure economic returns seem to have a decisive power over environmental and social sustainability, which do not deliver the same kinds of yields as quickly and measurable.

5.4 Case 4 – Failed Sustainable City project: Dongtan (China)

5.4.1 Description

The eco-city Dongtan (full name: Sino-British Dongtan Eco-City) is an unbuilt eco-city that was planned to be constructed on the undeveloped wetland island of Chonming on the outskirts of Shanghai (Chang 2017). The plan for Dongtan was conceived in 2004, according to which an area of 8.600ha with a 350ha buzzer zone was to be transformed into a city with 3000 housing units (in the first construction phase), 500.000 residents and 51.000 jobs (Alusi et al., 2011; Saiu, 2017). A collaboration between Shanghai Industrial Investment Company and the British engineering firm ARUP envisioned a city that would derive its energy from on-site solar panels, wind turbines and power plans burning rice husk (Chang 2017). Only 40% of the project site was to be urbanized, with the remaining land dedicated to for fishing and agricultural production.

An international team headed by Sir Peter Head of ARUP made a master plan for the development of Dongtan, which however never materialized. Already by the year 2006, it was clear to those involved in the Chinese planning community that the plan would not be carried out. By 2008, it was officially halted, with nothing more than a conference center (Chang 2017) and a bridge connecting Chongming Island to Shanghai being finished (Alusi et al., 2011). The project has not been reconvened until this day (Ghiglione & Larbi, 2015).

There are several reasons for the quick downfall of the project. In an analysis of Dongtan, El-Gazzar (2017) points at two challenges that eventually made the project unviable: corruption and over-

estimation of possibilities. In 2008, the former project coordinator (and member of the Chinese Communist Party) Chen Liangyu was charged for corruption charges and eventually convicted (Chang, 2017; Ghiglione & Larbi, 2015). His successor was not as committed to the project, which turned out to be a major impediment to the future of Dongtan. Also, ARUP's consultants were criticized for participating in "dodgy sustainable construction projects." (Caprotti 2013) Regarding the problem of top-down governance as touched upon in the previous section, Dongtan therefore provides an excellent example. Furthermore, the planners had set unrealistic goals for the sustainability of Dongtan, e.g. by aiming to reduce the ecological footprint per person to 2.2ha, whereas 1.9 is the maximally achievable level (Elgazzar & El-Gazzar, 2017).

There are also even simpler reasons for Dongtan's failure. According to Chang (2017), the very location of the city was inappropriate: wetland that was intensively being used as farmland, with high agricultural productivity. The project-site had to be procured first from the local population and then be prepared for development, thereby giving up precious fertile land. Additionally, Dongtan was to host many experimental and never tested technologies, which increased the risk of money spent on failing or only partly functioning systems (Chang 2017). Lastly, the difference in (working) culture and ideas about sustainability between the British planners and the Chinese authorities did not work to the advantage of the project, as communication was hindered and complicated by it (Chang 2017; Saiu 2017).

Despite these disadvantages, however, Chang (2017) found there to be a positive, albeit meager lesson from the fiasco with Dongtan: it is today regarded as the perfect example for how not to build an eco-city. Subsequent Chinese planners learned much from the failures of Dongtan and applied those to new projects.

5.4.2 Analysis

Understanding

Like Masdar City, Dongtan was understood from the beginning to be an entity built from the ground up and to be ecologically sustainable from moment it could be considered finished. This techno-optimist view in which a master plan was to be followed towards a final goal showed to be ineffective.

Emphasis

Although it was envisioned as an eco-city, Dongtan's goals regarding sustainability were mostly of a technical nature and aimed at efficiency of energy use, rather than letting residents have a minimal

impact on their environment. This shows the emphasis on technical solutions to achieving sustainability over sustainable lifestyles by individual people.

Function

From the case description, it is known that Dongtan was part of a wider effort of the Chinese government to facilitate livelihoods for the country's increasing number of people seeking to live in cities. The function of Dongtan could therefore be seen to first and foremost be to accommodate people and in the process also do something about China's notoriously high negative impact on the environment.

Economy

The goal of the Chinese government to create a city of 500.000 people and 51.000 jobs was the guideline for the development of the city. It was however not specified how this population size or number of jobs were going to contribute to the sustainability of the city. The nature of the jobs themselves was also not specified, whereas the type of work could make a significant difference for its impact on the local environment; factory or office jobs do not have the same influence as ecological farming.

Politics

Dongtan is a good example of the strong role the Chinese government plays in the development of the country and hence its cities. The top-down governance model is the norm in China, but ultimately failed in the case of Dongtan due to a lack of commitment and the consequences of corruption. Furthermore, the cooperation with a planning team from a foreign (working) culture proved to be complicating the management of the project and again shows (as with Masdar) that the disconnect between politics and expertise can have detrimental effects on projects that highly depend on clear communication and shared ideas of the actions to undertake.

Society

Due to the strong top-down governance style of the Chinese government, the public in general has little to contribute to urban development. In the case of Dongtan, owners of land had to be expropriated for the city to be constructed. As several 'ghost cities' after Dongtan in China however show (Angelidou, 2014; Saiu, 2017), the lack of public awareness and enthusiasm about urban development leads to new cities only functioning at a fraction of their capacity, if at all. Despite the promise of the Sustainable City theory, the political model of a country again proves to be decisive in the success of any project, rather than the technicalities.

Conclusion

Poor planning, strict top-down governance and the placement of the economy over other matters caused Dongtan to fail even before it was built. The sustainability of Dongtan came in second place and although it was marketed as one, the sustainability features were only expressed through infrastructure. The failure of Dongtan shows the importance of capital flows to come from several sides and commitment of the political leadership if a top-down governance model is to be used.

5.5 Discussion

5.5.1 Relation to theoretical findings

The theoretical findings about Smart City and Sustainable City in the previous two chapters provided a useful background against which the four cases could be analyzed and understood. One of the foremost findings is that the real-life projects show there to be considerable overlaps between Smart City and Sustainable City. The examined Smart City projects in Amsterdam and Masdar explicitly professed their commitment towards sustainability, albeit that because of the findings in the theoretical part of the report, this commitment, upon closer inspection, can be observed to be mainly shaped through measures that benefit the economic position of the city.

Furthermore, the cases serve as evidence that the critique against the dominance of digital technology and economic interests is largely justified: not only proved these factors to contribute significantly to the failures of Dongtan and Masdar, but also Amsterdam Smart City and Bo01 are affected by them, especially when it comes to the economic interests. In other words, the characterization of the Smart City-Sustainable City link to some extent is shaped by the ways in which they individually fail. The scholar Chris Martin, when interviewed by Freeman (2017, p.60) comes to the same conclusion by saying that “the conflicts are more prevalent than the synergies and that combining the two perspectives of sustainable and smart city represents a further dilution of sustainable development goals, a perspective he elaborates on in a forthcoming article.”

Conversely, the critique against Smart City and Sustainable City in the theoretical chapters also pointed at how it could be remedied: through a more balanced approach to sustainability in which the public and the environment receive a greater importance, and a reassessment of the economic foundation of Smart City and Sustainable City, the chances of succeeding at projects could increase. From the cases, it can now be seen that the political arena is the place in which this reassessment should take place; rather than taking a technocentric approach to urban development that assumes the development of cities to depend on the connections between different sectors, there appears to be a level in between the engineer and the actual city, namely the political one. It is through the

understanding of politicians of Smart City and/or Sustainable City and their own interests that a decision is made to follow through with a project or not and how this project will look like in reality.

5.5.2 Implications for SSC

Different from Smart City and Sustainable City, the development of an SSC theory may benefit from already existing projects around the world. This provides further reinforcement of existing theory or may refute claims that did not come to fruition in real life. In this chapter, four cities were taken as examples for successful or failed urban development projects in Smart City and Sustainable City, and from each of these, the SSC can draw lessons.

The success of Amsterdam Smart City and Bo01 in Malmö was found to significantly depend on the collaboration between stakeholders: the ASC platform in Amsterdam consists of the government, a utility company and a telecommunications company, and the ASC platform in turn coordinates projects with other partners. A similar structure was found in Malmö, with private parties and the government working towards the same goal. The Smart Sustainable City so far has been described as a balance between 'smart', 'sustainable' and 'city' (Höjer & Wangel 2015), with each aspect having an equal weight. What could be added in this case though, is that the balance between the three is not primarily reached through perfecting each aspect on its own, but through a holistic, political debate in which all stakeholders are represented.

The cases of Masdar and Dongtan confirmed the critique found in the literature to have real life consequences: the economic goals of both Masdar and Dongtan, together with a top-down governance model, resulted in cities that depended on funding from a limited number of donors and in practice only were sustainable in terms of infrastructure. Since Masdar and Dongtan represent both Smart City and Sustainable City projects, the Smart Sustainable City may also become driven by economic interests, with the same consequences as seen in the case studies. In the literature on SSC, however, no concrete mention was found as to how to avoid such a course of events.

To take this thought further, it becomes questionable by looking at this chapter's results, whether clarification of the relationship between Smart City and Sustainable City is truly going to support the Smart Sustainable City to a meaningful extent. The influence of the political discussion and the complex power dynamics between stakeholders was already found in the theoretical part of this project to have significant influence on urban development, and this appears to be confirmed by looking at the four cases. It seems that it is not as easy as suggested by Bibri and Krogstie (2017) to discern Smart City and Sustainable City as two distinct components and combine them into a new development strategy that constitutes a 'progression' compared to its predecessors. Whatever Smart

City and Sustainable City are, not only depends on what is technically possible or feasible, but also on what decision-makers want them to be, which leads to an ever-changing understanding of the two strategies, and this may well be true for SSC, too.

In philosophy of science, Thomas Kuhn (1962) famously stated that there can be no true progression of knowledge, as one scientific paradigm cannot be measured to be any better than the one that came before it. Drawing a parallel to this project, SSC may not per definition be an 'improvement' to Smart City and Sustainable City, as it depends on people's understanding rather than on physical systems for its substance. A theory for SSC can be devised for the needs of today, but these needs may have changed by the next day, week or year. As established in Chapter 4.2, a margin of negotiation, a deliberate vagueness of its definition, could propel the SSC forward. This insight goes against the project's initial intent for clarification and puts the positivistic, technocentric approach to urban development under pressure.

5.6 Conclusion

This chapter aimed at characterizing the Smart City-Sustainable City relationship using four cases of urban development in real life. The cases proved to be illustrative of the theory that was established in the first two chapters of this report and could also be explained using the theory. Each city was found to have characteristics that can be of use to the development of an SSC theory.

The city of Amsterdam is successful in its Smart City projects, because of its multi-stakeholder approach. The same can be said of Bo01 in Malmö, where the commitment of stakeholders to the project proved crucial to the project's success. Bo01 furthermore fulfills a role in a broader initiative called Västra Hamnen, which underlines the development of Malmö to sustainability to be a process rather than a goal.

Masdar City was found to fail because of its singular focus on applying technology in a city built from the ground up using government money, without the consultation or involvement of the public, leading to an empty city and a constant risk of budget decrease in case the money is needed elsewhere in the government's financial household. Dongtan in China today serves as an example of poor leadership in a project that was heavily dependent on that same leader because of its top-down governance structure.

Indeed, in all these cases, governance proved to be a critical factor in a project's success, regardless whether it concerns Smart City or Sustainable City. This characteristic of their relationship is likely to be of importance to the SSC. Furthermore, the dynamic, morphing political discussion deciding on how urban development gets implemented puts into question the added value of Smart Sustainable

City, as long as it does not stay flexible enough to adapt to the changing needs of stakeholders. Approaching the city from a positivistic standpoint may only hold value to a limited extent, as the confrontation of interests leaves a permanent scar on a city's being.

6 Discussion

In the following, there will be a reflection on the meaning of the analysis results of this project regarding the main research question: to what extent can the theoretical and practical relationship between Smart City and Sustainable City be more exhaustively characterized to increase the likelihood of a successful development of the SSC theory?

By taking a step back and examining the findings of the project against the background of the project's goals and purpose, it will be possible to derive the contribution of this work to the urban development discourse, to the development of the Smart Sustainable City and to the practically oriented world of politicians and urban planners. First, the analysis results will be examined to answer the main research question. Second, the theoretical approach towards the subject that was chosen to be followed will be critically evaluated regarding its advantages and limitations and how the chosen approach in hindsight has influenced the answers to the research questions. A similarly critical stance will be taken towards the chosen methodology, which will be assessed on its contribution to the knowledge generation and its limitations. Finally, suggestions and directions for future research will be given, based on the discussion of the research results.

6.1 Project content

As explained in the project's introductory chapter (Chapter 1), the subject of the research was approached from two angles: theoretically and practically. The first two research questions were both theoretically oriented, with the first research question being more related to the epistemology of the relationship between Smart City and Sustainable City, whereas the second research question navigated the relatively abstract perspectives of economy, politics and society. The third research question then turned towards the practical applications of Smart City and Sustainable City.

When it then comes to answering the main research question, one can conclude that the work for the subordinate research questions provided sufficient insights to give a detailed characterization of the relationship between Smart City and Sustainable City. The theoretical questions in this regard provided the necessary background against which the practical cases of Amsterdam, Malmö, Masdar City and Dongtan could be examined. Some of the findings of the theoretical questions, for example the economic foundations of Smart City and Sustainable City and the criticism against it, were mirrored not only in the cities failing at urban development, but also in the successful ones. The theoretical part thus proved to be valuable input to understanding the cases and both the theoretical and practical perspectives enabled a comprehensive characterization of the combination between Smart City and Sustainable City.

Central to the characterization of the Smart City-Sustainable City link is the finding that in some ways, they are distinct from each other, whereas in other ways, they share common grounds. This makes it difficult to classify the SSC: is it really a new entity composed of two different components, or is it just a rearrangement of ideas that are one and the same?

The first important takeaway from the analysis results is the great emphasis currently being placed on Smart City as the leading approach to future urban development. This is arguably because of the great amount of attention and research funding it is receiving. Compared to Sustainable City, this asymmetrical distribution of attention influences their relationship, making Sustainable City more of an 'add-on' to Smart City and thus rending the Smart Sustainable City as more of a Smart City model with more explicit sustainability concerns.

Secondly, it was already found during the first two research questions that the Smart City and Sustainable City by themselves are hard to be pinned down comprehensively, as well. When it comes to the implications of the theoretical findings for the future of SSC, the political and societal perspectives show the necessity for the research community to take responsibility when using such vague terminology as 'smart' and 'sustainable' to inform policy makers and the public. The relationship between Smart City and Sustainable City is fuzzy to such an extent that bombarding decision-makers with terminology could do more harm than good.

From this finding it follows that the introduction of the Smart Sustainable City should not be taken lightly. Its core elements are themselves little understood, and even within the research community there appear to be two streams of understanding the SSC: on the one hand, there are those who approach SSC as a combination between the equally valued, well-defined entities of Smart City and Sustainable City, which have technical properties that can complement each other (Bibri, 2018; Höjer & Wangel, 2015). On the other hand, there are researchers proposing the SSC to mostly be seen as a 'sustainability fix' to the conventional Smart City narrative (Ahvenniemi et al., 2017). If anything, instead of clarifying how Smart City and Sustainable City relate to each other to create more clarity, the theoretically oriented questions uncovered the complexity of the terminology and the various levels on which they influence each other.

Thirdly, the relationship between Smart City and Sustainable City in theory also plays out in practice. It was found that some of the problems identified in the theoretical part resurface in real life projects: in the failed Smart City of Masdar, economic interests always have the upper hand, at the expense of environmental and social sustainability. In the failed Sustainable City of Dongtan, the top-down governance model precluded every form of public participation. Even in the relatively successful

district of Bo01 in Malmö, the attraction of new tax payers was an important incentive for the local government to carry through the project.

From these projects, it was learned that many of the problems appearing in urban development do not have so much of a technical nature but instead are rather political: the intentions of decision-makers and their preferred way of bringing projects to life were shown to be important factors.

Following from this finding, a fourth aspect of the characterization is the dependence of the Smart City-Sustainable City link on however one *wants* to understand it. The terms Smart City and Sustainable City were found to be treated as container terms, serving whatever goal they could be used for. Although this finding goes against the interest of the project to clarify the relationship, some authors found there to be advantages in this fuzziness, allowing both Smart City and Sustainable City to be portable, communicable and morphable between people without losing their power (Moen, 2001).

Henceforth, it remains debatable to what extent the initial clarification of the relationship truly adds to the development of SSC: since Smart City and Sustainable City themselves have proven to be contested and undefined, the work for the clarification rather has uncovered their individual and mutual complexity. Instead of advancing the SSC discourse towards the end goal of creating a truly Smart and Sustainable City, this finding could be used *against* the further development of SSC, as it would rather create more complexity and confusion to the current situation than there already is.

6.2 Critique project approach

Following from the discussion regarding the project's findings above, it is worthwhile to also take a closer look at the influence of those findings on the assumptions and the approach that were chosen in the beginning stages of the project to guide the work.

When comparing the findings of the project to the main research question, it remains debatable how much the findings contribute to a *successful* development of the Smart Sustainable City. Through the analysis, two broad perspectives were identified that would either agree or disagree with the possibility to 'successfully' develop a theory; the one view is a rather positivist technocentric one, which approaches the city as a system consisting of subsystems, thereby taking knowledge to be absolute for the human being to collect from the outside world. The other view takes a relativist stance and lets the definition of Smart City, Sustainable City and SSC depend on socially constructed knowledge. The positivist would argue it to be possible to develop a theory from the ground up and either fail or succeed: the more data is available and the better the research, the greater the chance of success. Yet, the relativist approach acknowledges the ever-changing understanding of urban

development and what is needed for a city to thrive; 'successfully' developing a theory depends on what people want a theory to be, not only what data can provide.

This project initially adopted a realistic approach, through which it was assumed that by clarifying the relationship between Smart City and Sustainable City, the scientific community could be take one further step further towards the ultimate goal of a functioning, finished Smart Sustainable City. It did so, however, using a rather interpretivist, qualitative approach to knowledge generation, and it was the qualitative study of Smart City and Sustainable City that showed the importance of socially constructed knowledge over technical finesse. In other words, the realistic ontology of the project is now challenged by the finding that urban development is not as realistic and positivistic as one might initially think.

Thus, over the course of the project, the analysis findings caused cracks to appear in the initial realistic assumption at the foundation of the project. The technically optimal solution for a city's infrastructure and metabolism may or may not be realized depending on a host of other factors, which are remarkably political in nature. The reality of cities is that different stakeholders have different interests. In democracies, the compromise most often triumphs over the technically optimal solution, which became visible through the comparison between the first two and the third research questions: the definition of politics as fights over operative definitions of reality (Engberg, 2000) implies that the understanding of decision-makers of any given topic is shaped by their ability to realize their own interest, while sufficiently taking into account the interests of the others.

Hence, the consequence for the SSC behind this backcloth includes that the continuing concentration of attention and resources on the SSC's technical features should be shifted towards the political realm, as that is there where the SSC is framed, understood, decided upon and eventually realized, with the citizens as the ones being the most profoundly affected by it, instead of a city's infrastructure. Specifically, an improved transfer of any knowledge regarding the Smart Sustainable City from the research community to the social realm in which the public and politicians operate could benefit SSC more than designing its various technical architectures.

There is however an even deeper question to answer: as the socially informed influence on urban development has such a significance, what is then the added value of yet, another strategy in the form of SSC? Will the introduction of SSC perhaps not only add more confusion to the debate than its promise of progress can deliver? Furthermore, if Smart City and Sustainable City have so much in common with each other and with other concepts (see Chapter 3.1), why should these two have a more prominent role than others? The statement that Smart City deserves the attention, because ICT

is the “key to a better world” (Bibri & Krogstie, 2017, p.185), is immediately countered by those pointing out the possibly negative effects ICT can have on society (Vanolo, 2016).

Indeed, technical solutions may only be as valuable according to what people do with them. According to some, the SSC is approached best as a ‘fix’ of Smart City by adding more explicit attention to sustainability (Ahvenniemi et al., 2017), but can this really be done if a ‘fix’ is only relative to what the decision-maker deems most important? When the public and politicians are the decisive factors, a ‘fix’ to Smart City will only take shape according to what the decision-makers think the fix should look like. This realization could be extended to the SSC: when SSC is supposed to ‘fix’ what other concepts could not do, the intentions of the stakeholders should be concretely formulated to ensure that SSC truly does work differently from what came before it. Otherwise, it may end like its predecessor Smart City, which despite of its promises of ICT to be used for economic, social and environmental sustainability, had been never been needed if it had been implemented strictly after its own rules from the beginning.

6.3 Critique methodology

Regarding the methodology, there are some remarks to be made based on what has been learned from the literature and the interviews. In the chapter on Methodology (Chapter 2), an inductive approach to knowledge generation was presented which relied on external knowledge of other researchers and practitioners to come to new research conclusions. The rationale for the reliability of the findings took its point of departure in the reliability increasing, the more different authors came to the same conclusion.

To make for maximally reliable research results, data obtained through two different methods (literature review and interviews) were triangulated. Given the restrictions and circumstances under which the project had to be conducted, the literature review and the interviews were the most viable methods of data gathering to achieve the most reliable results. Nevertheless, the reliability of the research findings could have been improved, had there been the time to interview more practitioners in the field and perhaps some of the authors of papers referred to in this report. Having a third source of data would also have helped in terms of triangulation.

6.4 Future research directions

Based on the findings of the project and the discussion presented above, there are some avenues of future research that are worth exploring. Acknowledging the relativist and constructivist nature of urban planning as nexus between social and technical sciences, it would be worthwhile to achieve a better understanding of the way in which nowadays the research community transfers its findings to

decision-makers, the public and businesses, in order to identify pitfalls and improvement opportunities to make for better informed decisions and consequently successful development projects.

Furthermore, the nature of Smart Sustainable City as an extension of Smart City and Sustainable City provides the opportunity to avoid mistakes made in the past – particularly the tech-centeredness of Smart City – and thus achieve better results in social and environmental sustainability. Given that both Smart City and Sustainable City do not fully capitalize on these two aspects, the SSC constitutes a fitting 'vehicle' for chasing this goal. Future research could therefore spend explicit attention on the integration of triple- or quadruple bottom line of sustainability in the Smart Sustainable City.

7 Conclusion

For this project, various ways in which Smart City and Sustainable City relate to each other were analyzed and characterized. The goal was to thereby give other researchers useful knowledge for the (further) development of a Smart Sustainable City theory. In other words, the intention of the project was to take a step back and critically look at the SSC's individual components, how they relate to each other and what that relationship might imply for the SSC. By doing so, this project went against the existing suggestions made by Bibri and Krogstie (2017) for a forward-looking development of SSC through which evaluation frameworks and system architectures are to be made.

A critical look at the connection between Smart City and Sustainable City was indeed necessary, as it was feared that without having more clarity on their combined contribution to Smart Sustainable City, the very future viability of SSC could be put at risk. At this point, the research results give reason to deem the problem solved, as the Smart City-Sustainable City relationship has been successfully characterized through theoretical and practical analysis and from multiple different angles. It is expected that future research into SSC can make use of this report.

Since this project is a thesis and part of a graduate study program, however, the contributions to the body of knowledge in urban development research are not the only yields; the work for this project was also instructive in terms of learning how to conduct academic research and the author's own understanding of urban planning as not only a collection of technical issues, but also social and political ones.

7.1 Research questions

The subordinate research questions yielded new insights into the connection between Smart City and Sustainable City that underline the commonalities between them, the advantage of their vague definitions and the importance of socially constructed knowledge in the shaping of cities.

Question 1 was concerned with the epistemological nature of Smart City and Sustainable City and how they interact with each other on that level. The dominant understanding of the two in literature and interviews proved to be broad-ranging, with terminology pointing at Smart City's visionary tendencies and Sustainable City's holistic approach to urban planning. It was found that of the two, Smart City enjoys more attention and emphasis, based on the promises of ICT for the future of city functioning. Both Smart City and Sustainable City's function, however, is to improve cities to a point at which they are sustainable, smart and offer a high quality of life to residents. Their relationship is characterized by such commonalities, and even can be extended further to other models and

concepts in urban development, including “Intelligent City” or “Knowledge City”. The implications for SSC in this context, though, might therefore not be what it can include of its predecessors, but what it should exclude and how it wants to distinguish itself as a true step forward in urban development.

The second question stayed at the same theoretical level and looked at the position of Smart City and Sustainable City in economic, political and social contexts. It was found that, despite them being future-oriented and pledging sustainability to be their goals, the economic foundation upon which Smart City and Sustainable City are built is rooted in the traditional ideas of continuous economic growth and profit making after capitalist, neo-liberal principles. Furthermore, most Smart City projects around the world were reported to be conducted in a top-down governance style, with a strong influence of corporations and with economic development as the foremost goal. This all goes at the expense of environmental and social sustainability. Following from this, it was found that citizens and society at large are currently disempowered by Smart City and Sustainable City projects, having no real voice in the debate, although it is generally recognized that their role in urban development is crucial for success, also in future decades. The SSC will therefore have to have rethink its economic basis and more effectively include citizen participation, compared to its predecessors.

The third question took the results from the first two question of the project as input to examine how the theory works out in practice by looking at four cases: a successful Smart City and Sustainable City, as well as a failed Smart City and Sustainable City. From the positive cases, it was learned that the critique about the weak role of society in urban development is justified, given that the success of Amsterdam Smart City and Malmö’s Bo01 neighborhood to a significant extent depended on the inclusion of multiple stakeholders and bottom-up citizen initiatives. The negative cases on the other hand showed the risks of relying on top-down management for funding and leadership. The implications for the SSC are for it approach urban development more as a process and, as was already concluded after Research Question 2, to explicitly include citizens in projects.

7.2 Main research question

The characterization of the Smart City-Sustainable City link proves there to be both commonalities and differences between the two, with mistakes made both in theory and practice appearing to have more importance to Smart Sustainable City than their advantages. The vagueness of both concepts can both be seen as a curse and a blessing, while also the success of SSC seems to depend for a significant part on what people define success to be.

Especially this last aspect calls into question the technocentric, realist worldview that this project was built on. The interpretivist epistemological approach to the research showed that it may be justifiable

to place emphasis on technical questions and the complexity and promise of ICT, but one of the most important characteristics of the Smart City-Sustainable City relationship is its relativity and being dependent on socially constructed knowledge for their definition and direction of development.

The discussion of the analysis results raised new questions in connection to this relativity. It is recognized that SSC may become of importance to the future of urban development – but only where this is politically and technically possible. Even if this happens to not be the case and the Smart Sustainable City fails to materialize or is succeeded by a new kind of strategy, the findings of this thesis point at principles that are of importance to cities around the world and may educate academics, professionals and interested laypeople about how to shape their environment.

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