

Oomens, Ivette M. F.; Sadowski, Bert M.

Conference Paper

The importance of value creation in smart city initiatives: An ecosystem approach

28th European Regional Conference of the International Telecommunications Society (ITS):
"Competition and Regulation in the Information Age", Passau, Germany, 30th July - 2nd
August, 2017

Provided in Cooperation with:

International Telecommunications Society (ITS)

Suggested Citation: Oomens, Ivette M. F.; Sadowski, Bert M. (2017) : The importance of value creation in smart city initiatives: An ecosystem approach, 28th European Regional Conference of the International Telecommunications Society (ITS): "Competition and Regulation in the Information Age", Passau, Germany, 30th July - 2nd August, 2017, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/169491>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

The importance of value creation in smart city initiatives: An ecosystem approach

Ivette M. F. Oomens, Bert M. Sadowski***

**Technopolis Group, Amsterdam, The Netherlands*

*** School of Innovation Sciences, Technische Universiteit Eindhoven, The Netherlands*

Abstract

Within the growing literature on smart cities, much research has focused on issues related to the formation stage and the roles of different actors in these initiatives. The large number of failures of smart city initiatives, however, points at an existing gap between the understanding of the formation of these initiatives and the practice of their management. In this context, the purpose of this paper is to address this research gap by discussing determinants of smart city initiatives and the experiences in smart city management. By taking an innovation ecosystem perspective, the paper focuses on the management experiences of four smart city initiatives (WoonConnect, Mobilty Portal, Vehicle2Grid, Straatkubus) in the Netherlands. The empirical research has been undertaken during the period May and June 2016. In linking to the discussion on smart cities, the research shows that most studies on smart cities have focused on the formation stage of the initiative and the roles of partners in these initiatives. In order to better understand problems surrounding smart city projects, it is necessary to examine the fundamental business model underlying these initiatives (i.e. processes of value creation and appropriation) and the role of business partners in these ventures. By using an innovation ecosystem perspective, the paper is able to identify shortcomings of existing approaches in smart city research related to the (static) form of analysis and the firm-level type of analysis. For smart city managers, key issues related to smart city projects are rooted in the second stage of managing these ventures (i.e. the coordination stage) and the role of private firms in this stage.

Introduction

In Europe, smart city initiatives are a catalyst for urban transformation (The Economist 2016) and are part of the digital single market (DSM) strategy by the European Commission (European Commission 2015). They are aimed at providing better access, creating the right conditions and a level playing field for digital networks and innovative services and maximizing economic growth (European Commission 2015). In order to stimulate smart cities, the European Commission initiated in July 2012 the European Innovation Partnership on Smart Cities and Communities, which finally led to some 370 commitments to fund and develop smart city solutions involving more than 3,000 partners from across Europe (European Commission 2017). The European parliament defined smart city initiatives as: a “*multi-stakeholder, municipally based partnership aimed at addressing problems of common interest with the aid of ICTs, which underpin ‘smart’ classification*” (European Parliament, 2014, p. 24). As smart city initiatives are growing across Europe, viable business models or scaling of these initiatives beyond city borders have rather been scarce (European Parliament ITRE 2014). As a result, a growing literature on smart cities has focused on possible determinants underlying the success (and failure) of particular business models (Baccarne, Mechant et al. 2014; Anthopoulos 2015) (Harmon, Castro-Leon et al. 2015), but rarely addressed the tension between determinants of smart city initiatives and experiences in smart city management.

In smart city initiatives, a large variety of combinations of business models and traditional business models have been developed using new information and communication technologies (ICT). These models had in common, first, that they were aimed at addressing social problems facing cities with respect to e.g. declining quality of life, increased congestion due to heavy traffic or increasing energy consumption. In order to provide solutions to these problems, these projects, secondly, used ICT applications to generate smart solutions for better living conditions at home (i.e. smart home solutions), improved traffic flows (i.e. regulating traffic flows in a top down or bottom up manner) or more efficient energy applications (i.e. using new energy-saving technologies or implementing energy controls at the user end). For most of these solutions, however, it remained unclear if the business models actually created value, what kind of stakeholders were affected by value creation, what kind of consumers were addressed with these solutions, etc. In more general, the interaction between the main public and private stakeholders in the process of generating sustainable business models was rarely investigated.

In order to address these questions, research on innovation ecosystems (for a survey (Autio and Thomas 2014; Oh, Phillips et al. 2016)) has provided a unifying framework to analyse the process of value creation in ecosystems (Adner and Kapoor 2010; Adner 2012; Adner and Kapoor 2016). By analysing the process of value creation, the analysis shifts from a stand-alone innovation of an individual firm to a system of interdependent innovations, in which a focal actor is dependent on the other partners in the ecosystem (Adner and Kapoor 2010). In the smart city context, focal actors like municipalities or companies develop joint projects in different areas (e.g. smart living or smart energy) which are depending in their success (or failure) on the value creating activities

of different stakeholders and the underlying business model driving the innovation ecosystem. In introducing a conceptual discussion between the formation phase and the coordination phase of innovation ecosystems, the analysis separates key activities that account for differences in the form of management and the nature of governance in the ecosystem. With respect to key characteristics, the *formation stage* of an innovation ecosystem can be described by creating a joint vision, the generation of complementarities, rules and regulations as well as trust between partners and sufficient funding. At this stage, the key business activities are partner search, partner identification and value creation. In contrast, the *coordination stage* is characterized by well-functioning learning capabilities, a high degree of network embeddedness, low adoption chain risks, lock-in effects and different firm strategies. The key business activities are related to coordination and interfacing of partners as well as facilitating growth (or upscaling) of the innovation ecosystem. Interestingly, the literature on innovation ecosystems has mainly focused on the coordination stage and the different forms of governance of existing ecosystems (Adner 2012; Autio and Thomas 2014; Oh, Phillips et al. 2016). The literature on smart cities had a stronger focus on the first (formation) phase of these initiatives (Schaffers, Komninos et al. 2011; Anthopoulos 2015). With an increasing focus on problems of upscaling (the second phase in the ecosystem growth), the literature on innovation ecosystems can therefore provide new insights into the determinants facilitating the growth of smart city initiatives.

In the following, we develop a framework of analysis for smart city projects by focusing on the structure of the innovation ecosystem and the dynamics of the innovation ecosystem towards a sustainable business model. In a first step, we present a synthesis of the literature on innovation ecosystems and business models to provide a framework for the analysis of value creation in smart city projects. In a second step, we generate a set of important structural and dynamic determinants driving value creation in smart city projects by surveying literature. In a third step, we analyse four different smart city initiatives according to these determinants. The analysis allows us to categorize different business models of smart city initiatives according to the extent to which they were able to generate a sustainable business value proposition.

The paper explores value creation processes by stakeholders in smart city initiatives. By studying four cases in the Netherlands, it shows that the stakeholders in smart cities have different effects on value creation in smart city projects and as such on preventing or facilitating their scaling. It argues that a better understanding of the dynamics of smart city initiatives is rooted in disintegrating the different stages of formation and coordination of these initiatives. In contrast to the formation stage, the coordination stage of smart city initiatives requires new forms of management as well as new responsibilities and roles by private partners.

2. Smart city projects as innovation ecosystems

2.1 Innovation Ecosystems: Complex network relationships and firm strategies

Within the innovation ecosystem literature, the structure and dynamics of collaborative arrangements with different stakeholders have been studied in greater detail by focusing on the nature of the interaction between complementary participants (Autio and Thomas 2014). Within an innovation ecosystem, focal firms have to achieve complementarity in order to coordinate the interrelatedness of innovations based on existing organizational competencies of different stakeholders. In order to guarantee the interrelatedness of technologies and to provide organizational competencies, processes of co-adoption with suppliers or complementors and processes of co-adoption with users are vital for the economic health of the innovation ecosystem (Adner 2012). The technological challenge of emerging interrelated technologies has been that they are developed by co-innovators in a different industry and therefore also follow a different dynamic in its growth. In this respect, smart city projects are rooted in at least one traditional industry like the energy or the logistics sector but they are combined with smart solutions developed in the ICT sector (Kramers, Höjer et al. 2014). Companies with their origin in these traditional sectors display different incentives to invest in these new technologies compared to ICT firms.

In the literature, *innovation ecosystems* are defined as a network of interconnected organizations, including the use and the production side, that are jointly focused on value creation through innovation. The network is often linked to a focal actor and incorporates both production and use-side participants. These participants include communities of organisations, institutions, individuals, customers and suppliers, regulatory authorities or research institutions, that have an impact on the fate of the focal firm (Autio and Thomas 2013). Focal actors in a healthy ecosystem can scale and respond to shocks more easily than traditional vertically integrated firms. Unhealthy ecosystems and symbiotic dependencies can however negatively impact firms (Iansiti and Levien 2004; Fransman 2010). The value of the innovation ecosystems approach lies in the possibility to shift the focus of analysis towards the interdependencies between organizations and allows to study, in greater detail, specialization, co-evolution, and co-creation in the process of value appropriation and use (Autio and Thomas 2014).

Networking relationships

In order to analyse the structure of and positions of different actors in an innovation ecosystem, network analytical concepts have been utilized to study the structural and relational determinants of their networking interactions in these ecosystems. Based on these network concepts, notions of network visioning, network embeddedness and trust can be included in the analysis (Autio and Thomas 2014). In this context, *network visioning* is related to shared goals of

multiple participants aimed at undertaking collective efforts, usually defined by the central 'hub' in the innovation ecosystem (Autio and Thomas, 2013; Iansiti and Levien, 2012). *Network embeddedness* refers to the need for strong relationships between partners that allow smooth transactions, collaborations and knowledge sharing in innovation ecosystems (Autio and Thomas, 2013). However, network embeddedness can also be a constraint because of unproductive relationships and co-dependence. As too tight coupling with a partner can result in high switching costs and a high dependence on partners. Loose coupling is preferred since this gives the partners the possibility to negotiate with the focal actor and allows to more easily switch partners (Iansiti and Levien, 2004). With respect to *trust*, research has related this issue to the nature of the relationship between network participants. In case there is sufficient trust, value will be appropriated fairly. Key enablers of trust building are complementarity of obligations over the product lifecycle, balance between value creation and community values and differing perceptions of obligation fulfilment (Autio and Thomas, 2013).

Learning capabilities

Recently, studies on innovation ecosystems have discussed the dynamics of these systems by studying the extent of value creation as a process of inter-organizational learning and the role of different strategies of firms within ecosystems. Learning capabilities have been linked to value creation in ecosystem development based on the interaction between participants and between groups and organisations facilitated by strong network embeddedness (Autio and Thomas 2014). Learning capabilities in ecosystems are related to the shared set of knowledge and skills between actors (Nambisan and Baron, 2012). A process of *learning* is taking place, when an actor progresses along a learning curve, i.e. it gains market experience and improves production processes and value creation. Both technological and organisational routines may need to be changed and challenges may be internal or come from the surrounding ecosystem (Adner and Kapoor, 2010). In order to explain the dynamics of the ecosystem in relation to the external technological environment, Adner and Kapoor (2015) examined the replacement of an old technology by a new technology. They proposed that new technologies may struggle with an *ecosystem emergence challenge* when bottlenecks in the system constrain the performance of the new technology. Old technologies, in contrast, may provide *ecosystem extension opportunities* when improvements in the system can enhance the performance of the old technology system. The interaction between emergence challenges and extension opportunities result in different so-called substitution regimes. An incumbent firm may want to invest in the new technology and embrace creative destruction (where a new technology destroys the industry of an old technology), or might want to maintain its focus on the old technology. The incumbent firm may also invest in complements. Adner and Kapoor (2015) also state that sometimes policy-makers are needed to create additional incentives to overcome the emergence challenges of new technologies.

Adoption chain risks

Research in the innovation ecosystem tradition has concentrated on the role of users in the development process by examining their role in the adoption chain (Adner and Snow 2010; Adner 2012). It has been proposed that the role of users must be defined in relation to the added value of a product or service, i.e. the relative benefit compared to available alternatives. The definition of relative benefit allows to study a possible *assessment gap*. This gap emerges if relative benefits for a customer do not exceed the total cost of the innovation, while the innovator thinks they actually do (Adner, 2012). In this case, the innovator considers the price charged (including adoption costs) as the determinant of a customer's costs. But if the extra costs of adoption are excluded, a customer actually might use the innovation.

Strategies

With respect to strategies, different options related to leading (e.g. first mover advantages) or lagging firms (e.g. imitation advantages) have been discussed by focusing on the role of the focal firm in the ecosystem (Adner 2012). Furthermore, Nambisan and Baron (2013) proposed that there are different forms of entrepreneurs in ecosystems based on their vision, goals and structures and their function as an ecosystem leader. These strategies are also aimed at managing conflicting interests within the ecosystem. An entrepreneur should ensure its company is aligned with the rest of the ecosystem, but should also maintain independence and pursue a unique value proposition. Entrepreneurs are able to position themselves at an advantageous spot in the network by using a range of institutional, relational and coordination strategies. Entrepreneurs can circumvent structural constraints when creating a network (Autio and Thomas 2014).

Rules and regulations

Research on ecosystems has been limited with respect to addressing the *rules and regulations* affecting the structure and dynamics of actors in ecosystems (Gawer and Cusumano 2014). However, these factors are important as they provide legitimacy to the ecosystem as a whole and the roles taken on by different actors in the system (Hallingby 2016).

Formation and Coordination Stages in Innovation Ecosystem Development

In general, most research on innovation ecosystems has examined in detail determinants of value creation at the coordination stage of ecosystems by focusing on the complex interactions between actors in the process of value appropriation and use. To analyse the position of actors in these ecosystems, research has focused on the structure and the dynamics of the networking relationship between partners in an ecosystem. At the coordination stage, well-functioning learning capabilities, a high degree of network embeddedness, low adoption chain risks and lock-in effects should be realized, which can be done with different firm strategies. The key business

activities are related to coordination and interfacing of partners as well as facilitating growth (or upscaling) of the innovation ecosystem. Based on these theoretical insights, the innovation ecosystem perspective can contribute to the discussion on smart city initiatives which has mainly focused on the planning phase of these initiatives based on a static analysis.

2.2. Smart city projects: Complex interdependent innovations as solutions to urban problems

In the discussion on smart city projects, these initiatives have been defined as a complex set of interrelated innovations rooted in ICT-based solutions and applied to urban problems in order to improve the quality of life, productivity and stimulate economic growth (Shapiro 2006; Caragliu, Del Bo et al. 2011; Schaffers, Komninos et al. 2011). Based on Information and Communication Technologies (ICT), smart city projects generate complementarities with existing technologies which can radically change value propositions of existing business models. In the electricity sector, for example, smart grids can lead to radical changes in business models by raising consumer expectations with respect to a higher quality of supply and less power outages (Shomali and Pinkse 2016). The complementarities provided by ICT can therefore be used to bundle (or unbundle) different smart technologies and services together. Private investments in these inter-related innovations can therefore lead to sustainable economic growth and a high quality of life, in case resources are wisely managed (Caragliu, Del Bo et al. 2011). With the emergence of Internet of Things (IoT) technologies, the management of resources is increasingly focused on “collaborative” commons management in the context of the sharing economy (Rifkin 2014; Kitchin 2015; Bradley and Pargman 2017). Within the smart city literature, collaborative arrangements with different stakeholders are considered as vital for their success (Kitchin 2015). In addition, stakeholders can share facilities, user groups and experimentation methodologies in smart city projects (Schaffers, Komninos et al. 2011).

As surveys on smart cities are currently not available yet, the search for most relevant articles in the area has to be incomplete. On the Web of Science, a key word search generated a total number of 664 articles (accessed at 07-04-2016). In a first step, results were ordered according to title, authors, year, journal, database and key words. In case articles were not available, this was indicated with N.A. This procedure resulted in 338 non-overlapping results with some 36 articles which were not available. In a second step, articles were excluded in which no real-life implementation in Europe took place or there was no empirical basis of the study. In a third step, articles were checked with respect to determinants generated from innovation ecosystems research. This generated 10 articles on smart cities (see Table 1) which can be considered as fulfilling these criteria. In order to check the validity of the results, two experts on smart cities were asked to verify the findings.

Nr	Article	Topic	Case
1	Hakkarainen, L., & Hyysalo, S. (2013). How Do We Keep the Living Laboratory Alive? Learning and Conflicts in Living Lab Collaboration. <i>Technology Innovation Management Review</i> , 16–22.	Smart Floor	Finland
2	Mastelic, J., Sahakian, M., & Bonazzi, R. (2015). How to keep a living lab alive? <i>Info</i> , 17(4), 12 – 25.	Energy Living Lab	Switzerland
3	Rizzo, F., & Deserti, A. (2014). Small Scale Collaborative Services: The Role of Design in the Development of the Human Smart City Paradigm. In <i>Distributed, Ambient, and Pervasive Interactions</i> (pp. 583-592). Springer International Publishing.	MyNeighborhood	Italy
4	Sauer, S. (2012). Do Smart Cities Produce Smart Entrepreneurs? <i>Journal of Theoretical and Applied Electronic Commerce Research</i> , 7(3), 63 – 73.	Climate Street Amsterdam	Netherlands
5	Schaffers, H., & Turkama, P. (2012). Living Labs for cross-border systemic innovation. <i>Technology Innovation Management Review</i> , 2(9), 25.	Living Lab	Europe
6	Scholl, H. J., & Al Awadhi, S. (2016). Creating Smart Governance: The key to radical ICT overhaul at the City of Munich. <i>Information Policy</i> , 21, 21 – 42.	Munich Smart Government	Germany
7	Veeckman, C., Schuurman, D., Leminen, S., & Westerlund, M. (2013). Linking living lab characteristics and their outcomes: towards a conceptual framework. <i>Technology Innovation Management Review</i> , 3(12).	Living Lab	Belgium and Finland
8	Walravens, N. (2015a). Mobile city applications for Brussels citizens: Smart City trends, challenges and a reality check. <i>Telematics and Informatics</i> , 32, 282 – 299.	Mobile City Applications in Brussels	Belgium
9	Walravens, N. (2015b). Should there be an app for that? Inhibiting and contributing factors to the development of a mobile smart city strategy for Brussels, <i>Brussels Studies</i> , 88, 1 – 11.	Mobile City Applications in Brussels	Belgium
10	Baccarne, B., Mechant, P., & Schuurman, D. (2014). Empowered cities? An analysis of the structure and generated value of the smart city Ghent. In <i>Smart City</i> (pp. 157-182). Springer International Publishing.	Smart City Ghent	Belgium

Table 1- Selected articles systematic literature review

From the systematic literature review, we derived the following major determinants affecting the outcome of smart city initiatives: vision, value creation as well as rules and regulations. First, a well-defined and shared vision was recognised by several authors as a prerequisite for success. Stakeholders of the city of Munich reported the widely shared overall vision as a contributing factor to the success of the initiative (Scholl and Al Awadhi, 2016) and the loose project plan in Finland aided the flexibility of the smart floor developments (Hakkarainen and Hyysalo, 2013). Veeckman and colleagues (2013) also note that one of the initiatives failed to succeed because

of the failure to build a mutual *vision* or common purpose. Second, value was considered important in terms of adoption chain risk where some technologies did not add sufficient value for the entrepreneurs to continue using them (Sauer, 2012). Furthermore, missing links in the value chain and insufficient added value for the different stakeholders was leading to problems in several initiatives (Veeckman et al., 2013; Baccarne et al., 2014). Veeckman and colleagues (2013) also stated that it is of vital importance that shared value creation takes place. Third, rules and regulations were mentioned often as major barriers to the success of a project. The importance of these rules and regulations for smart cities was discussed with respect to, e.g. the termination of mandates of outgoing politicians and insufficient support provided by newly elected politicians (Mastelic et al., 2015), the complexity of the political organisation of city councils (Walravens, 2015a; Walravens, 2015b) and constraints imposed on the form of the initiative by national regulation and policies (Rizzo and Deserti, 2014).

A fourth factor derived from the literature was *learning capabilities*. These capabilities are vital as the implementation of a certain technology requires learning how to use it and organise moments to involve users in learning processes (Sauer, 2012). Furthermore, learning capabilities allow to generate new expertise, skills and development capacity for the members in the initiative (Scholl and Al Awadhi, 2016).

A fifth factor the literature survey was pointing at is the importance of (good) *networking relationships* between the partners in the initiative. A well-developed social network will enable the focal partner to identify the right potential collaborators in the initiative (Schaffers and Turkama, 2012). However, emphasis has mostly been put on the business network where for example the resignation of several members of the smart floor project brought the project on the verge of collapse (Hakkarainen and Hyysalo, 2013) and the fact that involving all partners in the coordination of the ecosystem may make collaboration more difficult (Baccarne et al., 2014).

A sixth factor generated from the literature was *user considerations*. These considerations were related to e.g. a different understanding of engineers and care professionals in the case of the smart floor in Finland with respect to the nature of the initiative (Hakkarainen and Hyysalo, 2013); the use of the ideas of entrepreneurs and the generation of sufficient motivation of different participants if technologies were not used as in the case of the climate street pilot (Sauer, 2012).

A seventh factor mentioned in the literature was related to the *governance* of the initiative. Governance aspects were mentioned in seven articles, and related to issues like “defining clear roles and responsibilities of living labs, small firms and other network partners” (p. 29, Schaffers and Turkama, 2012). In the case of the smart city initiative in Munich, the challenge was to accept the leading role of the central change agent (Scholl and Al Awadhi, 2016). In the case of the smart

city project in Brussels, the initiative was divided into two levels of governance with a lacking internal change agent having an facilitating impact on the initiatives (Walravens, 2015a). The smart city project in Finland, it went so far that a struggle for power arose, where the hiring of an independent negotiator by the new project coordinator saved the project (Hakkarainen and Hyysalo, 2013).

Finally, the eight factor considered as important in the literature was related to the cognitive and normative *rules and structures*. In Amsterdam, for example, entrepreneurs considered the climate street pilot in Amsterdam as an attractive opportunity (Sauer, 2016). In Munich, a culture of consensual decision making and the understanding that change had to take place was important for the success of the project (Scholl and Al Awadhi, 2016). Informal mechanisms were also mentioned several times, for example when a lack of openness constrained smaller companies that were part of the initiative from accessing the critical assets (Veeckman and colleagues, 2013) or when “the availability of ample information greatly helped resolve problems at subproject levels” (p.3, Scholl and Al Awadhi). Table 2 shows the effects of the different factors at the formation and coordination stages of innovation ecosystem.

Formation Stage		Coordination Stage	
Factor	Explanation	Factor	Explanation
Joint Vision	Shared goals of multiple participants - static	Well-functioning learning capabilities	Shared set of knowledge and skills between actors - dynamic
Generation of complementarities	Bundling of different (smart) technologies and services - static	High degree of network embeddedness	Strong relationships between partners - dynamic
Rules and regulations	Rules and regulations affecting the structure and dynamics of actors - static	Low adoption chain risks	Added value of product/service - static
Trust	Trust among network partners - dynamic	Lock-in effects	Connectedness of the different actors to the network - dynamic
Sufficient funding	Enough funding available - static	Different firm strategies	Managing conflicting interests - dynamic
		Governance	Aligning partners and maintenance of knowledge sharing facilities - dynamic

Table 2: Innovation Ecosystem Factors for the Formation and Coordination Stage

In the following, we examined these nine factors to examine, in greater detail, four case studies in the Netherlands.

3. Smart city projects in the Netherlands

3.1. The problem of scaling in smart city projects in the Netherlands

In the Netherlands, a number of smart city initiatives were stimulated bottom-up with small initiatives and pilots funded by private investors or by local authorities creating so-called ‘Living

Labs' (Zygiaris 2012; European Parliament ITRE 2014). Smart city initiatives have recently been undertaken in Amsterdam, Utrecht, Eindhoven and Almere, where the city promotes a smart city vision and a smart society agenda or a smart city board is installed.

Among these cities, *Amsterdam* is mentioned most often in the smart city literature (Zygiaris 2012; European Parliament ITRE 2014). The Economic Board of Amsterdam launched the Amsterdam Smart City Platform in 2009, together with the net operator Liander and telecom provider KPN. Since then, it has gained a lot of attention in Europe and the platform developed into a partnership with more than 70 partners and 37 smart city projects in 2013. With its own "Chief Technology Officer," the city is ahead of many others (Amsterdam Smart City 2016). The Amsterdam Smart City projects are small scale and even though the projects generated savings in CO2 emissions and might have a great potential when the projects are fully deployed, the current direct savings are small. In 2014, none of the projects investigated was scaled up to the city level (European Parliament ITRE 2014).

The city of *Eindhoven* also recently started the next step in their policy, where to become a sustainable city the quadruple helix approach was implemented. This approach connects not only education, government and businesses, but also citizens. It shifts the focus to the application of technology and results in the transfer of innovation to the application level of the city (Metsemakers and Henstra 2014). The city promotes this approach as a 'living lab' where smart products and services can be developed and implemented, in close cooperation with end users in real-life settings. These living labs can be either actively led by the municipality or merely facilitated by the municipality. The latter construction should ensure that the living lab can extend beyond the territory of the city (ENoLL 2016). Furthermore, Eindhoven started a work programme called *Eindhoven Smart Society* where the municipality collaborates with the organisation 'Het Nieuwe Instituut' in order to enhance the position of the citizen, also through the use of technology (Brouwers 2016).

The third city, *Almere*, started the project Almere Smart Society in 2012. The project was instigated by the Economic Development Board Almere and an agreement was signed between the municipality Almere and several private parties. The different parties took part on a voluntary basis, with the possibility to sign formal contracts when the collaboration resulted in tangible projects. The municipality would play a facilitating role and the focus would be on the creation of (open) data platforms for citizens, businesses and institutions to develop specific applications, resulting in the creation of further growth of the city. It was expected that citizens would quickly see tangible results of the project. During three years (2013 – 2015), the municipality invested €450,000 in the project. The project started with the creation of a roadmap of the project around the themes; talent & poverty, welfare and energy. The intermediates that were determined in

this roadmap translated themselves into several projects of which some were considered successful while others failed to result in tangible solutions. After the period 2013 – 2015, the roadmap and vision of Almere Smart Society were the basis for a new collaboration. A new multiannual programme was set up between the Netherlands Organisation for applied scientific research (TNO) and the municipality for the next four years and is called the Innovation Agenda.

However, for most smart city projects, a large societal impact has not been achieved so far and many initiatives fail to upscale geographically across the city and the region (European Parliament ITRE 2014). The reason for this might be that the initiatives are subsidy-driven - which often indicates no viable business case is present - and are therefore unsustainable once the subsidy ends, or when value considerations are not harmonised (Dameri and Rosenthal-Sabroux 2014). This is very similar to the innovation ecosystem perspective and its emphasis on value creation, where for effective and efficient innovation, convergence of multiple elements in the value proposition and shared understanding and agreement among partners is needed (Adner 2012).

To study smart city initiatives in these four cities, the following selection criteria have been used:

- The smart city initiative should have taken place in a city with at least 100,000 citizens.
- The initiatives should correspond with at least one of the smart city domains as defined by the European Parliament (2014), in specific to the domain “Smart Living.” This domain comprises initiatives that are aimed at improving the quality of life of citizens through smart technology and often take place in the areas health, housing and security.
- The initiative has to be running for at least a year.
- The initiative had a well-defined ICT component.
- The initiative had a potential for upscaling.

The four cases have been selected so that they predict similar results, also called a *literal replication* (Yin 2003). Which means - in the context of this research - that cases are expected to indicate similar factors as less or more crucial for upscaling. Second, desk research was undertaken on the four cases, to gather background information on the initiatives and to target possible interviewees. This research was mostly done by analysing the relevant web pages and documentation such as strategic plans, annual reports and management reviews. Third, interviews were held with key individuals involved in the initiative from the beginning, in order to ensure that the interviewee could provide sufficient information about all factors influencing upscaling of the initiative. Fourth, the data was prepared for a detailed analysis. Finally, the interviews were written up and analysed based on a content analysis using NVivo.

3.1 WoonConnect Eindhoven

WoonConnect enables a user to create new houses and make adjustments to existing houses in 'real-time' through the use of dynamic 3D information-models. In this way, citizens are able to adjust a house according to their expectations. The system can be used by individuals, building companies, project developers, architects, buyers and sellers, municipalities and housing corporations. The platform has a number of different components like direct feedback over energy savings produced by a certain adaptation in the 3D information-model; reports and pictures that can be added to the model: a neighbourhood platform to share information with other citizens, a social survey on experiences and expectations of citizens, direct generation of licences and more. In 2013, the first prototype of WoonConnect was finalized and in 2014 an agreement was reached between the developers, their strategic partner and the municipality to implement WoonConnect in the neighbourhood Eckhart Vaartbroek in Eindhoven, as part of the municipal programme Eindhoven Smart Society. The project obtained €900,000 co-funding from the European Commission. Other partners joining the project were Eindhoven Technical University and the SPARK campus for construction innovation.

In Eckhart Vaartbroek, 4,500 houses have been digitalised so far. By the end of 2016, this should have increased to 7,500 houses. Furthermore, two projects have been executed in 's Hertogenbosch, 200 houses have been digitalised in Arnhem and digitalisation of 300 houses in Rotterdam is taking place. In the meantime, the project was selected by the B5 in the province Noord Brabant and was selected as a CityDeal: a collaboration agreement between cities and the national government with the goal to strengthen growth, innovation and liveability in the Dutch cities. In the context of the agenda Brabantstad, the aim is to digitalise 100,000 houses in the province Noord-Brabant (Brabantstad 2015). The number of houses that would be digitalised for the CityDeal would be even bigger, but the deal has formally not been closed yet.

3.2 Vehicle2Grid Amsterdam

Vehicle2Grid is a smart city initiative in Amsterdam that tries to provide a solution for the surplus of energy that is generated by renewable energies during the day, when demand by customers is low. The solution provided by the initiative is the storage of energy in batteries of Electric Vehicles that function as an 'energy buffer.' The stored energy is released in the evening to meet peak demands. The aim of the initiative is to create impact in a threefold of ways: managing of peak loads will become cheaper, the need for fossil fuels will be reduced and the sharing economy will be promoted. Scaling this initiative is attractive, since different profiles of household consumption and vehicle usage might complement each other and create greater overall efficiencies. Furthermore, scaling up of the project is believed to result in more positive environmental impact and therefore city liveability. The precursor of the project started in Zaanstad, and was called 'tanken op eigen dak' (generating energy from your own roof) where

the municipality tried to balance the supply of sustainable energy that came from municipal solar panels with the demand of charging electric vehicles. A visualisation was added to show how much energy used by the cars was produced by Zaanstad itself. In 2013, municipal cutbacks resulted in the discontinuation of the project as all employees with temporary contracts were dismissed. An unintended consequence was reduction of the number of employees in the department for sustainability from 13 employees to two, which resulted in the end of the project. One initiators of the project decided to continue the project concept in Amsterdam and in 2013 a collaboration was formed with the companies MasterVolt, Liander and Resourcefully. A functional and technical concept was made for a houseboat and the pilot system was started in 2014. The system has been running from 2014 until now (2016) and has resulted in a lot of data about the functionality of the system such as amount of energy generated, stored, used and the loss of energy. Currently, the project initiators are trying to obtain funding from the European Commission to implement the concept on a larger scale in Amsterdam.

3.3. Amsterdam Arena Innovation Centre – Mobility Portal

The Amsterdam ArenA Innovation Centre (AAIC) is set in the ArenA stadium in Amsterdam, surrounded by a fast-growing urban area. It started in 2015 as a living lab for smart city innovation to enable rapid development, testing and demonstration of smart applications and solutions. The stadium is being renovated because of the European Championships in 2020, which provides the opportunity for the AAIC to transform the stadium, make it sustainable and 'sensing'. The AAIC has several strategic partners (Huawei, Microsoft and KPN) that ensure the availability of several core facilities. The programmes using these facilities have own consortia that also pay for the facilities. Data from the stadium and its surrounding neighbourhood can be used for all kinds of projects. The projects discern themselves because of the embeddedness of scale in the project plan. An example is the 'mobility portal', where the ArenA aims to enhance customer experience by getting in touch with the customer at an early stage and to provide advice on sustainable transport options and to provide up-to-date travel information on the road and in the ArenA area. It is connected to the 'mobility room', where social media is monitored to provide people with up-to-date, personal information for one of the venues in the area.

This mobility portal is designed to scale, where options such as creating a 'corridor' with Schiphol Airport and the Floriade are being developed. The corridor entails a connection between Schiphol Airport and the ArenA during the European Championships, where a visitor of the ArenA will be scanned at the airport, making the security process at the ArenA faster and easier, thereby also enhancing the customer experience. The same will be done between Schiphol and the Floriade in 2022.

3.4 Almere Smart Society – the Straatkubus

One successful projects that resulted from the project Almere Smart Society is the Straatkubus. Development of the Straatkubus started around 2010 and it is currently being implemented in several municipalities. The Straatkubus is an instrument to monitor the development of the liveability in Almere. It is used to map liveability issues as soon as possible. It is a simple information system, similar to Google Maps. Different variables can be selected, for example the number of elderly people, the number of youngsters, the number of cars. These variables are then visualised. The results of the Straatkubus are intended as a starting point for conversations within the municipality. This can be internal with other departments, but also with partners in the city, such as building corporations, volunteer organisations or other partners in the city. Currently, the Straatkubus is being further developed and also extended to be applied in the health and welfare domain, where it is called the Zorgkubus. Continuation and upscaling of the Straatkubus project to other municipalities is taking place.

3.5. Summary

The four initiatives introduced here each differ with respect to their success in terms of upscaling. Whereas Vehicle2Grid - after 3 years of development - is still a small initiative, WoonConnect is a smart city initiative that is currently busy with upscaling on both a regional and a national level. Compared to other smart city initiatives, it can be considered successful. In contrast to first two initiatives, the mobility portal and the Straatkubus are part of larger programmes that contain multiple initiatives. While the Amsterdam Arena Innovation Centre has only recently started, it has already led to the involvement of several strategic partners and with the goal of the European Championships of 2020 in mind it is already working on scalable products such as the mobility portal. Almere Smart Society, on the other hand, has experienced several setbacks and some initiatives that were initiated have failed, while others, such as the Straatkubus, were successful. In contrast to the initiatives, the Straatkubus is almost solely developed and being upscaled by municipalities. The other initiatives are based on public-private partnerships, either with a private party in the lead or a public party as the initiator. Below a summary table with the major characteristics of the different Smart City initiatives is provided (See Table 3).

Project	Smart Area	Initial Investment	Companies involved	Level of implementation	Start date	End date	Members of Consortium	Number of users
Amsterdam arena	Mobility /Living	€100k per strategic partner in cash + further in kind contributions	Huawei, KPN, Microsoft	Regional	2015	2022	Huawei, KPN, Microsoft, TNO, KPMG,	In 2022: 18M
Straatkubus	Living	Est. €100,000	No	Pilot	2013	Ongoing	Municipality	Several municipalities
Vehicle2Grid	Energy/Living	€1,6M	Liander, Mastervolt, Resourcefully	City	2013	Ongoing	Vehicle2Grid, Liander, MasterVolt, Resourcefully	A few early adopters
Woon-Connect	Living	€900,000 by European Commission	KPN, BouwConnect	National	2010	Ongoing	WoonConnect, Municipalities, province Noord-Brabant	Around 5,000 (aim: 100,000 in Brabant)

Table 3: Characteristics of the different smart city initiatives

4 Results of empirical analysis

In order to analyze the factors that are important for the success of upscaling of smart city initiatives in the Netherlands, 10 interviews were performed with major stakeholders who had been or are still involved in one or several of the initiatives. Three interviews were held with key stakeholders in the municipality of Utrecht, but since these initiatives had only recently started and no attempt to upscale the initiatives had been made, these interviews were excluded from the results. Nonetheless, the interviews provided helpful insights into internal and external processes of developing a smart city initiative and aided in the interpretation of the gathered data.

In order to analyse the cases, the same coding protocol was used as for the literature review. The analysis generated the following results (see Table 3)

Project	Amsterdam arena	Straatkubus	Vehicle2Grid	WoonConnect
Value creation	X	X		X
Network visioning	X	X		X
Inter-organizational learning	X	X	NA	X
Network embeddedness, coupling	X	X	X	X
Assessment gap, adoption chain risks	X	X		X
Lock-in	X		X	X
Rules and regulations	X	X	X	X
Advantageous positioning	X	X		X
Trust between participants	X	NA	NA	X
Implicit economic value ecosystem	X	X	X	X
Dominant strategies, emergence challenges	X		X	X

Table 3: Factors affecting upscaling of smart city initiatives in the Netherlands (NA = not applicable)

Value creation

Several factors were mentioned by all interviewees as being important prerequisites for the project to achieve upscaling. First, **value creation** was considered of influence in all initiatives. Interviewees in particular noted the lack of business models for private partners: *“In the past, pilots were started and the expectation was this would deliver a business case. For many of the market parties this was not the case, and the execution was theirs. Then it stopped”*. In the case of Vehicle2Grid an interviewee stated: *“we are a small organisation. If there had been a business model it would have gone much faster”*.

Especially in the public-private partnerships, interviewees described the problem situation as follows: *“there must be a trade-off between public and private value”* and in the case of WoonConnect: *“when I take a part of their business case and make it public, they do not like this. Still, I say: this is added value, otherwise we will not be able to scale”*.

Interviewees also mentioned several risks related to **funding**: One interviewee stated *“many times it is subsidy-driven. Whenever the subsidy is gone, the initiative is gone.”* Furthermore, issues with private funding were mentioned *“with companies it is a risk that you will get stuck in marketing budgets. Those are small budgets that are insufficient for scale. You become a showcase, a demo-centre”*. The issues with public funding has mostly been related as a reason for failure to scale: *“we are dependent of subsidies and public funding, there is no revenue model”*.

Interviewees stated that subsidies are a nice incidental benefit but should not be the focus. However *“money for bigger projects is easier than for smaller projects. With smaller budgets you end up in community-like things. If it is too small for an alderman, if it is no issue then politically speaking it is not of interest”*. Another major obstacle with public funding is the fact that many of the initiatives get funding from an ‘innovation budget: *“In the public sector there is a risk you are placed in an innovation budget, and innovation is always cut”*. In Eindhoven, attempts are also made to create one budget for WoonConnect within the municipality, which crosses domains. *“That was quite a challenge, because you have standard systems for budgets, which you partly let go”*.

Networking relationships

Network visioning was mentioned by almost all interviewees as important for upscaling. One of the interviewees stated that *“If you don’t know where you are going, it is never going to happen”* and *“a long-term vision is super important”*. One of the reasons for this is that *“for this innovation you need slow operating organisations, things go slow, you need to be patient”*. The interviewees add that the aim of the vision is to align people and that you should evaluate and adjust the vision if necessary. An interviewee added that it can be a pitfall when you make a vision too specific and a project too small. *“Ok. Then you have twenty smart lantern posts and no business case”*. In the case of WoonConnect it was also stated that *“the vision is dynamic, the developments happen extremely fast”*. A vision is most important on strategic and managerial levels: *“for the levels below you have to tell them what is in it for them, what are the benefits”*.

The different interviewees also considered their social **networks** as very important for success of the project. One interviewee states that *“people in a network find each other faster, which also makes the project quicker”* and another interviewee adds that *“no innovation happens without a network. It is a precondition”*. Innovating in business **networks** also comes with certain risks. For WoonConnect, things are complicated because *“you are dependent on housing corporations, the owners association, and others”* and another interviewee stated *“you are as strong as the weakest link in the chain.”*

Furthermore, **trust** was considered very important by several of the interviewees. *“Trust is extremely important. You have to ensure that the small and big firms interact, but also public and private parties have to interact in a trusted environment”*. This often goes wrong: *“usually, parties come together and all start watching the municipality. A project becomes subsidy-driven and the government and private partners oppose each other, no trade-off takes place. You really have to work together”*. *“Now you also recognise how much time these processes take. Organising collaboration, organising trust, that is very difficult”*. To facilitate information sharing you also need *“the creation of a safe environment, so parties know that things are well secured, and arranged via procedures and agreements”* and to prevent disloyalty *“if you say: I will not do it anymore, fine, I will go to party B. The contracts are also compiled that way”*.

Learning capabilities

Inter-organisational learning and learning on multiple dimensions were mentioned several times by interviewees. A learning curve that is shared by multiple organisations is considered important; *“This is because when you cross domains, you need to learn how to speak each other’s languages and understand what drives someone else”* and for WoonConnect to implement an innovation in other municipalities, *“people should learn how to unite different stakeholders”*.

The findings in the articles report the same, but also state that learning the right capabilities may take a lot of time. In the Climate Street in Amsterdam, this was one of the reasons the project failed (Sauer, 2012) and an interviewee added that in the Straatkubus case *“the pilot period took longer than expected, since it takes time before an organisation learns how to use such an instrument”*.

Adoption chain risks

User considerations were mentioned several times in all interviews. *“If there is no real need, this will not result in activation”* and *“people are building facilities and afterwards think about what to do with it. And then the subsidy ends and it is gone”*. Another interviewee stated that *“what we should not forget with these innovative projects is that it will only start ticking when it is being carried by people. It is an absolute requirement”*.

The **demonstration off added value** was also mentioned several times. Nevertheless, interviewees do state: *“we have enough pretty stories, but it is about the evidence”* and *“for governments, demonstrable added value for the city, societal challenges, for the public interest, that is the most important”*. WoonConnect encounters the same *“you have to convince the politicians that it will bring added societal value”* and *“if you cannot show the effect, no one will be willing to spend money on it”*. Recently, WoonConnect started with mapping the impact for individual parties: *“you see that all of a sudden an enormous acceleration in processes happens”*. The interviewee emphasises that *“societal impact will only happen when you start implementing and reach scale”*. Therefore you need a large scale pilot from the start *“with smart city it only works when it scales”*.

Strategies

Especially when collaborating with different partners, good governance structures were considered important. Interviewees also emphasized the importance of a neutral intermediary. *“You have to establish trust in the interaction between the little ones and the big ones. You very clearly need a neutral party for that”*. This intermediary should also be able to end a contract with partners that hinder the development of the initiative. *“The governance has to be flexible: when you are being unpleasant, I will trade you for another”*. Furthermore, to improve governance processes, in the case of WoonConnect *“we erected a smart city board, with all the sector leaders. We had to ensure people knew what was going on, bring them together”*.

Competition was also mentioned to a lesser extent. Nevertheless, in all the cases barriers by incumbents were encountered. With WoonConnect, interviewees experience resistance in the building sector: *“the building sector is conservative, you cannot just change that. Big companies determine the game, and you*

see little innovation". The same was mentioned about the AAIC. And it was added that "when someone feels like they have a position of power, especially big multinational companies, they will strangle you".

In the projects themselves, competition must be ensured. *"There must be a pressure of being replaceable"* and interaction between companies has to be considered: *"if I contract a Huawei, who will stay away?"*

More competition can however also be a barrier to scale. In the case of the Straatkubus, the municipality Eindhoven decided to build its own version of the product. *"It seems rational that more governments or municipalities will work with a similar application. Hopefully it will also include some Straatkubus users, but there are also different products available".* The predecessor of Vehicle2Grid in Zaanstad also encountered competition: *"at some point we came at a conference and saw a project that was going to do exactly the same".* One of the interviewees noted that it might be beneficial to organise initiatives in a complementary manner: *"to ensure you don't do the same everywhere. I see that happen a lot. The next project starts at zero again".*

Another barrier that was experienced by interviewees was **lock-in**, where especially a lack of standardisation was an issue: *"every self-respecting supplier has its own standards and building blocks and architectures."* and *"whenever companies cannot communicate software-wise, you have a problem. This is difficult every time, it has to be standardised".* Attempts to prevent lock-in are the requirement of open data (WoonConnect) and partners stating *"I do not want to own things anymore, I just want to have access to those things".*

Entrepreneurship was not a factor that first popped to mind in the interviews. Nurturing of innovation by entrepreneurs was mentioned the most. WoonConnect for example contacted a small contractor in Den Bosch and in Nuenen. *"You bring in a small contractor to get the project started"* and to *"break through the process in the contractor-world"*. In the case of the Straatkubus, an entrepreneurial project leader was a trigger for the success: *"the project leader was an advocate of the Straatkubus and especially in the beginning had set up the project very well. He also got others in the organisation to join in to make this possible".* Several interviewees also point out that sometimes entrepreneurship clashes with civil servants *"they find it difficult that the entrepreneurs get money out of it"* and *"municipalities differ in the strength of their civil servants".*

Rules and regulations

Rules and regulations were most often recognised as barriers to the success of a project, such as; privacy policy: *"an issue is what is legally possible.";* energy-regulations: *"it is no level-playing field, it is a completely overregulated market.";* and procurement law: *"this is rather complicated, the involvement of a private party, are you giving them a preferential position?"*

Other hindrances experienced by interviewees are for example the fact that *"every municipality has its own agenda"* and the fact that *"sometimes market parties are reluctant to share their knowledge".* These cognitive and normative structures are often easier to overcome than regulative structures. *"Most of the civil servants here, once you have explained the project, are welcoming".*

The bigger projects that are well on the way in terms of upscaling note the difference between municipal, regional and national or European levels of government. *“With the municipality every alderman has its own portfolio and does not speak with other aldermen. Even though you want to pass through different segments”*. Within municipalities changing this is easier than on higher government levels. *“Where it encompasses our own rules we can do rather much, but oftentimes you have to deal with European or national legislation that hinders open innovation or is in conflict with new (public-private) developments”*.

Conclusion

In sum, the interviews result in a list of factors that are perceived as important in the coordination stage of an initiative (e.g. network embeddedness, learning capabilities) The interviews also show that it is preferable to already install a good management structure in the formation stage, since this will also influence the success of a project in the coordination stage.

5. Summary and conclusions

The paper has shown that there is a growing literature on smart cities focusing mainly on the formation phase of these initiatives and the partners involved. However, an increasing number of failures of smart city initiatives, points at an existing gap between the understanding of the formation of these initiatives and the practice of their management in the initial formation stage and in the follow-up coordination stage of the smart city initiative. The paper has addressed this research gap by discussing determinants which are important in both stages of smart city initiative and the required experience of managing these projects in particular in the second coordination phase.

By using research on innovation ecosystems (Adner 2012; Oh, Phillips et al. 2016), the paper has focussed on the different determinants important for success in the first formation stage and in the second coordination stage of the ecosystem. The analysis has separated key activities during these two stages with respect to the form of management and the nature of governance in the ecosystem. The formation stage of an innovation ecosystem has been characterized by creating a joint vision, the generation of complementarities, rules and regulation as well as trust between partners and sufficient funding. Key business activities during this stage involved partner search, partner identification and value creation. During the coordination stage, in contrast, other characteristics become important such as well-functioning learning capabilities, a high degree of network embeddedness, low adoption chain risks, lock-in effects and different firm strategies. During this stage, key business activities are related to coordination and interfacing of partners as well as facilitating growth (or upscaling) of the innovation ecosystem.

In linking these stages to the literature on smart city, the focus shifted towards factors influencing the upscaling of these initiatives. To verify these factors, the paper studied the management experiences of four smart city initiatives (WoonConnect, Mobilty Portal, Vehicle2Grid, Straatkubus) in the Netherlands during the period May and June 2016. To better understand

problems surrounding smart city initiatives, it will become necessary to study fundamental concepts of these initiatives (i.e. value creation mechanisms and network relationships) and the role of business partners.

By using an innovation ecosystem perspective, the paper is able to identify shortcomings of existing approaches in smart city research related to the form of (static) analysis and the dyadic character of relationship. For smart city managers, key issues are rooted in the changing form of (successful) management and the changing role of private partners, in particular in the coordination stage.

References

- Adner, R. (2012). The Wide Lens: A New Strategy for Innovation. New York, Penguin Group.
- Adner, R. and R. Kapoor (2010). "Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations." Strategic Management Journal **31**(3): 306-333.
- Adner, R. and R. Kapoor (2016). "Innovation ecosystems and the pace of substitution:: Re-examining technology S-curves." Strategic Management Journal **37**(4): 625-648.
- Adner, R. and D. Snow (2010). "Old technology responses to new technology threats: demand heterogeneity and technology retreats." Industrial and Corporate Change **19**(5): 1655-1675.
- Amsterdam Smart City (2016). "Amsterdam Smart City." Retrieved May 4, 2016, from www.amsterdamsmartcity.com.
- Anthopoulos, L. G. (2015). Understanding the smart city domain: A literature review. Transforming city governments for successful smart cities, Springer: 9-21.
- Autio, E. and L. Thomas, Eds. (2014). Innovation Ecosystems. Oxford Handbook of Innovation Management. London, Oxford University Press.
- Autio, E. and L. D. W. Thomas (2013). Innovation Ecosystems: Implications for Innovation Management. The Oxford Handbook of Innovation Management. Oxford, Oxford University Press.
- Baccarne, B., P. Mechant, et al. (2014). Empowered cities? An analysis of the structure and generated value of the smart city Ghent. Smart City, Springer: 157-182.
- Brabantstad (2015, 2015). "WoonConnect/SPARK." Retrieved May 3, 2016.
- Bradley, K. and D. Pargman (2017). "The sharing economy as the commons of the 21st century." Cambridge Journal of Regions, Economy and Society.
- Brouwers, B. (2016). "Eindhoven Smart Society: lokale oplossingen voor mondiale problemen." Retrieved August 1, 2016, from <https://e52.nl/eindhoven-smart-society-10-lokale-oplossingen-voor-mondiale-problemen/>.
- Caragliu, A., C. Del Bo, et al. (2011). "Smart Cities in Europe." Journal of urban technology **18**(2): 65-82.

Dameri, R. P. and C. Rosenthal-Sabroux (2014). Smart city and value creation. Smart City, Springer International Publishing: 1 - 12.

ENoLL (2016). "Eindhoven Living Lab." Retrieved May 3, 2016, from <http://www.openlivinglabs.eu/livinglab/eindhoven-living-lab>.

European Commission (2015). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Digital Single Market Strategy for Europe (COM(2015) 192 final) Brussels, European Commission.

European Commission (2017). "Smart Cities " <https://ec.europa.eu/digital-single-market/en/smart-cities> accessed at 29-03-2017.

European Parliament ITRE (2014). Mapping Smart Cities in the EU. Brussels, European Parliament.

European Parliament ITRE (2014). Mapping Smart Cities in the EU. . Brussel, European Parliament.

Fransman, M. (2010). The New ICT Ecosystem: Implications for Policy and Regulation. Cambridge Cambridge University Press.

Gawer, A. and M. A. Cusumano (2014). "Industry platforms and ecosystem innovation." Journal of Product Innovation Management **31**(3): 417-433.

Hallingby, H. K. (2016). "Key success factors for a growing technology innovation system based on SMS Application-to-Person in Norway." Technology Analysis & Strategic Management: 1-15.

Harmon, R. R., E. G. Castro-Leon, et al. (2015). Smart cities and the Internet of Things. 2015 Portland International Conference on Management of Engineering and Technology (PICMET).

Iansiti, M. and R. Levien (2004). The keystone advantage: what the new dynamics of business ecosystems mean for strategy, innovation, and sustainability, Harvard Business Press.

Kitchin, R. (2015). "Making sense of smart cities: addressing present shortcomings." Cambridge Journal of Regions, Economy and Society **8**(1): 131-136.

Kramers, A., M. Höjer, et al. (2014). "Smart sustainable cities—Exploring ICT solutions for reduced energy use in cities." Environmental modelling & software **56**: 52-62.

Metsemakers, F. and J. Henstra (2014). "DNA van Eindhoven is de basis voor verduurzaming." Ruimtevolk. Retrieved June 9, 2016, from <https://ruimtevolk.nl/2014/06/09/dna-van-eindhoven-is-de-basis-voor-verduurzaming>.

Oh, D.-S., F. Phillips, et al. (2016). "Innovation ecosystems: A critical examination." Technovation **54**: 1-6.

Rifkin, J. (2014). The zero marginal cost society: the internet of things, the collaborative commons, and the eclipse of capitalism, Macmillan.

Schaffers, H., N. Komninos, et al. (2011). Smart cities and the future internet: Towards cooperation frameworks for open innovation. The Future Internet Assembly, Springer.

Shapiro, J. M. (2006). "Smart cities: quality of life, productivity, and the growth effects of human capital." The review of economics and statistics **88**(2): 324-335.

Shomali, A. and J. Pinkse (2016). "The consequences of smart grids for the business model of electricity firms." Journal of Cleaner Production **112, Part 5**: 3830-3841.

The Economist (2016). Empowering Cities: The Real Story of How Cities and Businesses Are Driving Smart Cities. London, The Economist Intelligence Unit Limited.

Yin, R. K. (2003). Case study research. Design and Methods. London, Sage.

Zygiaris, S. (2012). "Smart city reference model: assisting planners to conceptualize the building of smart city innovation ecosystems." Journal of the Knowledge Economy **4**(2): 217 - 231.