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Factors driving business stakeholders to collaborate in smart city ecosystems and the role of local government

Case Study: RUGGEDISED, Rotterdam

Author:
Marilou Das, 401712

Coach: Marcel van Oosterhout
Co-reader: Koen Dittrich

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Preface

Acknowledgements

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Executive summary

With the yearly increasing amount of people moving into cities, the demand for jobs, housing, security, energy and transportation also rises. Though the growth of cities also come with benefits, the rise of city population creates several unprecedented problems (Ojasalo, 2015). Over the last years, cities have turned to the implementation of technologies in order to respond to the emerging city needs and with that the concept of smart cities was born. Cities are being developed by a strong ecosystem of research institutes, private and public stakeholders. For smart city ecosystems to reach their full potential, mainly two transformations are needed. First, a high level of collaboration amongst all stakeholders is required for the co-creation of solutions. In this regard, collaboration includes interactions, co-creation and sharing of information (Schaffers, Komninos, Pallot, Aquas & Almirral, 2013). Second, the complex ecosystems demand for a new role of local government to coordinate and facilitate the collaborations (Visnjic, Neely, Cennamo & Visnjic, 2016). Since the concept of smart cities is a relatively new subject, knowledge in this field is limited. This study focuses on finding influencing factors on the level of collaboration in smart cities. So far only limited research has been done on which conditions positively or negatively influence the collaborations in smart cities. This study contributes to existing literature by investigating the drivers of collaboration of business stakeholders. Furthermore, this study will formulate recommendations for local government to adopt governing role to foster collaboration and drive successful smart city. Consequently, the following research question is formulated: '*Which factors drive business stakeholders to collaborate in smart city ecosystems and how could local government facilitate this collaboration?'*

In order to develop a theory on the influencing factors of the willingness to collaborate, exploratory qualitative research by means of a case study on the smart city project in Rotterdam, namely Ruggedised, performed. Through two phases of interviews a deeper understanding on the topic is obtained. The first phase of interviews was meant to validate the pre-conceptual framework, which was developed on theoretical concepts from literature. Further, the stakeholders from the selected case were interviewed to obtain a deeper understanding on the drivers of collaborate. The findings present several factors which positively influence the willingness to collaborate. Three factors related to ecosystems collaboration, namely an integrated vision, view on perceived objectives and stakeholder trust, were identified. Furthermore, three factors related to the adoption of the urban data platform were found to positively influence the willingness to collaborate, namely platform standardization, data quality and clear platform governance. Furthermore, the presence of innovation enabling factors and contextual constraints was identified to have an impact on the willingness to collaborate, respectively a positive and negative effect. Lastly, the role for local

government in smart city ecosystems was formulated. From the business perspective, a local government should both function as the regulator and coordinator of the ecosystem to foster the willingness to collaborate.

This study builds on the existing research by providing a link between the influencing factors on willingness to collaborate and the role of local government to foster these. The findings also shed a light on the implications for stakeholders to share data on the urban data platform. In addition to the creation of the conceptual framework which contributes to the academic literature, this study provides several practical implications for local governments. Therefore, this study serves as a guide for other smart cities in the realization of becoming a smart city. This study has several limitations, mostly related to the scope and generalizability of the findings. Further research could focus on expanding the interviewee sample by taking more cases into account. Additional studies can also do an in-depth analysis of the identified constructs to further comprehend the influencers of willingness to collaborate.

To conclude, this study holds both academic and managerial relevance. As the popularity of smart cities increases, so will the need for a better understanding of developing and maintaining smart city ecosystems with the presence of an urban data platform. The findings of this study provide a solid ground for local governments to drive collaborations and realize smart city projects successfully.

Key words: smart city ecosystems, urban data platforms, smart governance

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1 Introduction

More than half the global world population is currently living in urban areas and projections estimate that this percentage will grow towards 70% around 2050 (Schaffers et al., 2013). During the latest decades, globalization, industrialization and urbanization have been accelerating all over the world. Cities are attracting more and more people from the country side as they often provide better opportunities for living, working and studying. However, urbanization has also created unprecedented problems that are quickly undermining the benefits it once created, such as increased pollution, congestion, waste and criminality. In order to deal with the urgent matters of climate change, governments from around the world are forced to become both smarter and greener (Bolivar, 2015; Lee, Phaal & Lee, 2013).

As a result, the majority of the leading cities across the world are turning to the possibilities of implementing technologies in their solutions to tackle these urban problems. With the use of the Internet of Things (IoT) cities are experimenting with integrating technologies in their daily city operations, called 'smart city initiatives' (Albino, Berardi & Dangelico, 2015). These initiatives vary from small-scale, independent applications to immense projects transforming entire urban fields in terms of planning and development (Lee et al., 2013). The implementation of IoT enables municipalities to monitor, understand, analyse and plan various aspects of the city to increase efficiency and improve the quality of life for its citizens (Meijer & Bolivar, 2016). In smart city ecosystems, private and public partners as well as research institutes are coming together to improve city operations. The development of the new solutions arises from jointly generated ideas in the smart city ecosystem. These ideas emerge from the extensive sharing of information, knowledge and data (Zott, Amit & Massa, 2011).

Together with the rise of smart city collaborations in cities, the role of municipalities is quickly changing. The traditional role and functions of a local government is shifting towards so-called 'local governance of public networks' (Span, Luijkx, Schalk & Schols, 2012). Municipalities are challenged with refining smart cities as an environment of innovation, empowerment and participation of their citizens, businesses and other stakeholders (Schaffers et al., 2013). In order to facilitate and stimulate the interactions amongst stakeholders, various types of local platforms are developed. These appear to be a crucial element for the acceleration and upscaling of smart city initiatives. However, the knowledge of this area is still in its infancy (Ojasalo & Tähtinen, 2016). This study will provide a deeper understanding of the driving forces behind successful realization of smart city collaborations.

1.1 Motivation

Assuming that the current urbanization trend continues, the future of society belongs to cities. With this, the implementations of technologies in city operations will become even more relevant. Although cities are gradually taking shape, many cities are facing challenges in becoming a smart city. Due to the novelty and broad scope of this topic, further research is needed to guide the cities through their transformation (Ojasalo, 2015).

Academic literature has identified two main dimensions that impact the realization of a smart city. First, with the rise of ecosystems comes the need for a high level of collaboration through cooperation strategies and formulation of public-private partnerships (Schaffers et al., 2011). Furthermore, smart city collaborations often include sharing information with stakeholders over the urban data platform (Edelstam, 2016). The level of collaboration thus depends on the willingness of stakeholders to collaborate with each other and the willingness to adopt the urban data platform. Although the existing literature has widely agreed on the importance of collaborations in ecosystems, especially by adopting urban data platforms, the knowledge in this field remains limited (Ojasalo, 2015). Additional research is desired to investigate the drivers of collaboration, which will contribute to the successful realization of smart cities.

Second, now cities are irreversibly turning into complex ecosystems, the role for local government needs to change. Local governments increasingly adopt the role of ecosystem manager, provoking interactions and aligning the at times conflicting objectives of the stakeholders (Edelstam, 2016; Visjnic et al., 2016). Cities can reach their full potential when the highest level of stakeholder collaboration is achieved. The key for local government is to trigger the motivation within stakeholders (Edelstam, 2016). Even though some research has been done on the adapted governance role, it lacks to describe what local government can do to foster collaborations. More importantly, most literature on smart governance concerns the perspective of city government and does not account for the perspective of the other stakeholders (Bolivar, 2015; Ojasalo, 2015). Additional research could help to develop guidance for cities to drive collaborations to their full potential.

1.2 Research question

This study combines the two dimensions of the development of a smart city ecosystem, namely the level of stakeholder collaboration and governance of the smart city ecosystem. It aims to provide deeper insights in the driving factors of collaboration which contribute to the successful realization of a smart city. As sharing data over the urban data platform plays an

important role, this aspects of collaboration will be widely discussed. Furthermore, this study will shed a light on the role of local government in managing the smart city collaborations. The findings will result in recommendations for the local government on how to foster collaborations. Thus, the following research question is formulated:

Which factors drive business stakeholders to collaborate in smart city ecosystems and how could local government facilitate this collaboration?

In order to answer the central research question of this paper, several sub-questions are presented:

i. What do business stakeholders perceive as key drivers for collaboration in smart city ecosystem?
ii. What do business stakeholders perceive as key drivers for adopting the urban data platform?
iii. Which role is expected from local government to facilitate collaborations in smart city ecosystems?

1.3 Relevance and contribution

The emerging trend of smart cities and the applications of urban data platforms have been widely discussed in literature. However, due to the novelty and broad scope of the topic, there are various areas which need to be further researched. This study contributes to a deeper understanding on which drivers influence the willingness of business stakeholders to collaborate. The findings will contribute to the formulations of recommendations for the local government on how to foster these collaborations. This paper contributes to both the academical as the business world for several reasons.

First, considering the novelty of the topic most academic literature so far has concentrated on developing general understanding of the concept. The literature provides a solid ground of definitions, concepts and potential outcomes of the emerging smart city trend, but it often lacks to describe the actual implementations of smart cities (Albino et al., 2015). In contrast, various smart city reports provide an in-depth study of real-life smart city cases but these often lack generalizability. This study contributes to bridging the gap between the theoretical frameworks and actual smart city practices. The aim of this paper is to guide and support cities in developing, implementing and successfully sustaining the smart city.

Moreover, existing literature has emphasized the necessity of an urban data platform in facilitating stakeholder interactions. This drives more and more cities to develop and implement a form of data platform in their ecosystem (EIP-SCC, 2016). However, cities are encountering various complications related to the design, implementation and maintenance of these platforms. Because of a lack of vision and knowledge on the purpose of information sharing, many stakeholders are hesitant in adopting the urban data platform (Edelstam, 2016). Thus, more research is required on the instalment and management of platforms to drive the co-creation effort towards a successful end (Ojasalo, 2015).

Third, in academic literature the importance of public-private collaboration in the ecosystem was emphasized. While the essential role for local government as a driver of collaborations is widely addressed, only little research in this field is done (Bolivar, 2015). By assessing the perception of business stakeholders, often the majority of the ecosystem, this study provides insights in how collaborations can be fostered through governance.

To sum up, by delivering a deeper understanding of factors influencing the level of collaboration in the ecosystem, this study contributes to successful realization of smart cities. The findings from this study will be valuable for all stakeholders who are currently involved in or aspire to form a smart city ecosystem. Especially for local government this paper holds a great value, providing insights in their perceived role and responsibilities from a business perspective. This allows for more effective governance of the smart city ecosystem, eventually contributing to the performance as a smart city.

1.4 Outline

The further outline of this paper is as follows. First, an extensive review of academic literature is provided to gain deeper understanding on the concept of smart cities, urban data platforms and smart governance. Following the literature review, the pre-conceptual framework with propositions is provided. Then, the research methodology is explained through an elaborate discussion on the research strategy and the process of data collection and data analysis through grounded theory. Subsequently, the findings will be discussed which result in the presentation of a revised conceptual framework, followed by a conclusion, limitations and recommendations for further research.

2 Literature review

As the concept of smart cities has been widely discussed in literature, this section helps to structure the perceptions of the various applications and builds a foundation for this study. First, the broad concept of smart cities is discussed followed by a closer look on the existence of ecosystems within these cities. Furthermore, the functionality of platforms in urban context and urban data platforms in particular are described followed by smart city governance elaborating on the changing role of local roles in smart city ecosystems. This section ends with a short description of the case studied in this paper, the Ruggedised project.

2.1 Smart cities

2.1.1 Definition

As urbanization spreads worldwide, more and more cities are joining in the smart city trend and implementing technology in various components of the city. The term ‘smart’ cities is often confused with similar ideas such as ‘digital’ or ‘intelligent’ cities. Digital cities refer to the implementation of digital tools in the city architecture, whereas intelligent cities use these digital implementations to enhance the city’s ability to innovate. Smart cities, however, add the people component to the concept and perceive human capital as a driver of urban growth, rather than solely assessing the technological infrastructure (Albino et al., 2015; Lee et al., 2013). In general, cities are considered to be ‘smart’ when communication infrastructure, such as transportation and ICT, together with investments in social and human capital drive sustainable economic growth. Consequently, quality of life is improved and natural resources are effectively used through participatory governance (Caragliu, Del Bo, & Nijkamp, 2011). Participatory governance and citizen involvement are key concepts in many smart city frameworks (Meijer & Bolivar, 2016). Smart city projects are mainly focused on resolving societal issues by creating solutions for more efficient energy systems, improved mobility networks and developments made to stimulate sustainable committees (Berrone, Ricart & Carrasco, 2016). The aim of smart cities is to create a fertile innovation environment for new business opportunities by actively creating interactive collaboration between government, businesses and citizens (Slob & Woestenburg, 2017).

2.1.2 Characteristics

Smart cities can be characterised in many ways, some authors apply the three characteristics identified by IBM, also referred to as the three 'I's: (i) instrumented, to the capability of capturing real-time data through the use of tools such as sensors and meters, (ii) interconnected, the ability of integrating the data on a platform so that various city elements can communicate, and lastly (iii) intelligent, the integration of analytical and modelling tools as a foundation of decision-making (Harrison, Eckman, Hamilton, Hartswick & Kalagnama, 2010). The most common practice is to analyse smart cities by three main aspects; technology, human resources and governance (Meijer & Bolivar, 2016). From the technology stand, smart technologies are the starting point of cities and provide the fundamental infrastructure allowing integration of diverse city elements (Castelnovo, Misuraca & Savoldelli, 2016; Walravens, 2012). Whereas the human stand concentrates on the role of people in smart cities, arguing that human capital accounts as the main driver for urban growth (Lombardi, Giordano, Farouh, & Yousef, 2012). Lastly, governance emphasizes the widespread collaboration in the city, highlighting the importance of linking various actors in the city with knowledge and research centres to create 'innovation hubs' and developing productive interactions within networks (Kourtit, Nijkamp & Arribas, 2012). In short, the three key aspects of smart cities are to be contextual, collective and collaborative (Figure 1). This triangle emphasizes the existence of collaborations amongst stakeholders to serve the overarching purpose of the smart city by using the information flow (Walravens, Breuer & Ballon, 2014).

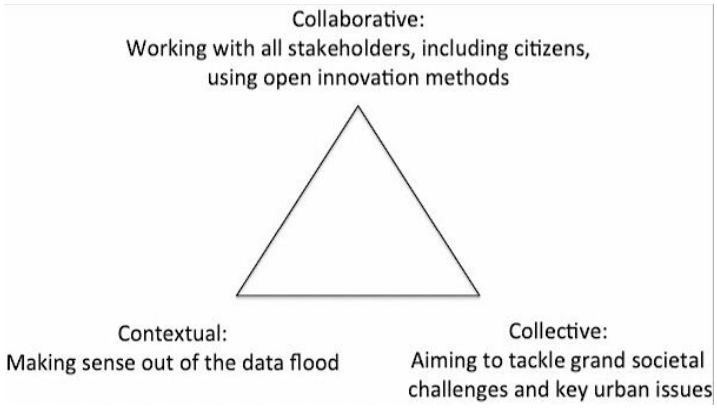

Figure 1 Smart city triangle

2.1.3 Objectives

To achieve a smart city is never a standalone goal, but rather a means to an undefined end. It should be referred to as a "modus operandi", referring to the process of development of the city and the witness of growth of the smartness of the city (The Government Summit, 2015). In the literature, it is common to find that the main objectives of smart city initiatives are sustainable development, economic growth and a better quality of life for citizens (Albino et al., 2015; Meijer & Bolivar, 2016). Similarly, Lee, Hancock & Hu (2014) defined that the aim of smart cities is to 'create a better, more sustainable city, increasing the quality of life for its citizens,

making their environment more comfortable to live in and secure the overall economic prospects'. In order to lead the desired transformation four types of changes are identified to implement within the strategy: technological, social, policy and industrial change (Schaffers et al., 2013). These smart city objectives could be linked to the overarching 3 P's, creating a positive impact on (i) planet, through sustainable development and reducing CO_2 emissions, (ii) profit, such as cost reduction, reputation and improved urban planning, and (iii) people, by improving quality of life, safety and employment (Slob & Woestenburg, 2017).

2.1.4 Performance

The performance of smart cities, also referred to as 'smartness', is assessed using various metrics. Most cities apply the six pillars of smart city development. These pillars are smart economy, smart mobility, smart environment, smart people, smart living and smart governance (Lee et al, 2014; TGS, 2015). A city is considered to be a 'smart city' when performing well in all six dimensions, building on the combination of endowments and activities of independent and aware citizens (Giffinger & Gurdum, 2010). In addition to performing on these pillars, other studies stress the importance of social and human capital as a measurement for smartness of the city (TGS, 2015). The smartness of the city is hereby defined as 'the city's ability to attract human capital and to mobilize this human capital in collaborations between the various actors through the use of information and communication technologies' (Meijer & Bolivar, 2016). Manville (2014) argues that the transformation to a smart city is more than the sum of smart city projects but requires a clear vision, relevant stakeholder involvement and efficient and effective processes.

2.2 Smart city ecosystems

2.2.1 Definition

The cities and urban areas of tomorrow are evolving into complex ecosystems, consisting of various stakeholders with specific needs and demands regarding domains such as healthcare, energy, safety and public services (Nam & Pardo, 2011). The term ecosystem refers to 'a system involving the interactions between a community of living organisms and its non-living environment'. It can also be applied to cities where it describes how citizens work together with non-living components of the city as a system (Schaffers et al., 2013; Slob & Woestenburg, 2017). Smart cities embody the concept of an ecosystem, as they combine the physical technological components to improve the living experience of the city, such as quality of life. In short, the smart city ecosystem is the interaction between the smart elements of living, governance, economy and people (TGS, 2015).

As the landscape of cities changes and cities transform in complex ecosystems, local governments are pressured to adjust their governance structure accordingly. In fact, governing the innovation ecosystem requires a different kind of organizational set-up. Local governments are often perceived as managers of the ecosystem, balancing services to satisfy citizens' needs as well as coordinating and facilitating activities of companies within the area (Visjnic et al., 2016). Moreover, local government takes a critical role in ensuring the long-term sustainability of smart city collaborations. The alignment of potentially conflicting objectives of stakeholders should be achieved through the formulation of a clear vision and strategy (Castelnovo et al., 2016). Section 2.4 will further elaborate on the governance of smart ecosystems.

2.2.2 Innovation systems

Smart city ecosystems are often described as innovation systems, hereby emphasizing the key role of innovations of the successful transformation into a smart city (Ojasalo, 2015). Innovation systems is the entire body impacting the way innovations are conceived, including technologies, regulatory and policy frameworks, stakeholders across various levels (Edelstam, 2016). Technologies play a central role in the creation of innovations in cities, hence innovation systems are also called technological innovation systems (TIS). Wieczorek and Hekkert (2012) have identified four structural dimensions of TIS, respectively actors, institutions, interactions and infrastructure impacting the performance of the innovation system. Subsequently, unsuccessful innovations can be linked back to these dimensions. In fact, structural problems have many root causes. They can be created by the absence of relevant actors, the lack of competence or willingness to collaborate of the actors or lack of vision and strategy of the ecosystem. Issues related to interactions are created because of a lack of communication. Conversely, lock-in problems, network problems and infrastructural problems are created by a platform that is not equipped to innovate. These structural problems may cause an unsuccessful outcome of smart city initiatives and should thus be managed and avoided.

2.2.3 Private-public collaboration

When describing private-public collaboration in smart city ecosystems, literature often refers to the triple helix model. This model addresses the university-industry-government relationship driving economic development and innovation in a knowledge society (TGS, 2015). The triple helix model emphasizes the need for a balanced interaction between the three main stakeholder groups to achieve the collaborative power to reach the common interest. This model is comprehensive because the different functions each stakeholder group has in the ecosystem. Private companies provide the link to the market, governments secure political support and facilitate partnering of companies and finally universities create and validate knowledge.

Consequently, this model causes both short term results and long-term system change. In recent years, the engagement of the civic sector embodied by organizations and civil society in city collaborations has received more attention (Edelstam, 2016). Some researchers go beyond and add a fourth agent, media-based and culture-based public and civil society, to the model, therefore creating the quadruple helix model. However, the precise definition and role of this fourth agent is not widely agreed upon and thus the triple helix model is used to define the private-public collaboration in smart cities (Leydesdorff & Deakin, 2011).

2.3 Urban data platforms

2.3.1 Definition

The interaction of smart city ecosystems is facilitated by the instalment of urban platforms, these are multi-sided platforms with data, communication tools and control possibilities. A brief review at literature reveals that the interpretation of such platforms in urban context is incoherent, they may refer to a virtual or physical space, management approach or a network of actors (Ojasalo, 2015). In this section the concept of platforms will be explained and the diverse implementations of platforms in urban context discussed, resulting in a working definition for this paper.

2.3.2 Functionality of platforms

A platform is any physical, technological or social base on which sociotechnical processes are built (Anttiroiko, Valkama & Bailey, 2013). Platforms facilitate the interactions between at least two distinct groups, which are dependent on each other and seek interaction, typically the demand and supply side. This property is also referred to as the multi-sidedness of platforms (Edelstam, 2016). Typically, a platform includes physical components, tools and regulations to facilitate the development and a set of technical standards to ensure and support interoperability (Ojasalo, 2015). Though platforms come in many varieties and forms, they all have a similar structure consisting of four main types of actors as shown in Figure 2: (i) owners of platforms generally control their intellectual property and must make decisions on who is allowed access and control what is allowed on the

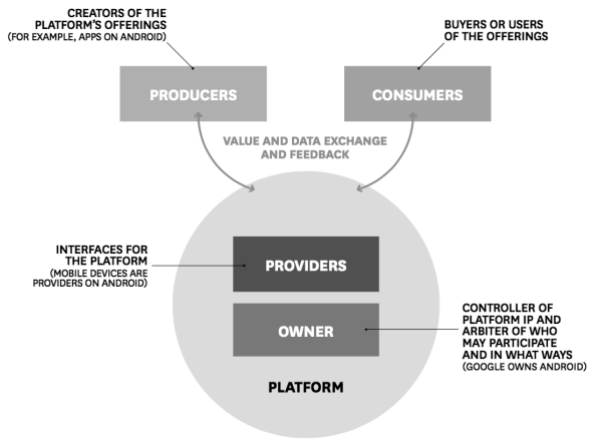

Figure 2 Platform roles

platform, (ii) providers of platforms create and serve as the interface with users, (iii) producers deliver their offerings to the platform and (iv) consumers use those offerings. The platform can generate more value as the consumers and producers swap between roles, for example a user of Uber can both take the rider and the driver role depending on the circumstances (Van Alstyne, Parker & Choudary, 2016).

A concept closely related to the existence of platforms are network effects; the degree to which an additional user makes the platform more valuable to the existing users. A distinction is often made between same-side and cross-side effects. An additional user can either increase the value of the platform for users on the same side or increase the value for the opposite users (Tiwana, 2013). In addition to network effects, Lee, Kim, Noh & Lee. (2010) have distinguished four other areas where platforms contribute to the performance of their users: (i) complementarity, referring to products or services which strengthen one another, (ii) connectivity, referring to the ease of interaction within the network, (iii) innovation ability, referring to occurrence of new ideas within the network and (iv) efficiency, referring to the increased interoperability with other actors offered by the platform.

2.3.3 Platforms in urban context

In the context of smart cities, platforms facilitate the interactions between the different stakeholders in the smart city ecosystem and function as the fundamental infrastructure for collaboration (Ojasalo, 2015). As literature does not provide a coherent definition on platforms in smart city context, this section will provide an overview of the most common terms. Table 1 reports some of the different definitions and meanings of "platforms in smart cities".

First, "innovation platforms" highlights the central role of innovativeness in the smart city ecosystem, similarly to "innovation ecosystems". In this regard, innovation platforms serve as the intermediary for communication and interaction to create innovations of economic and sustainable value. According to Walravens et al. (2014), the purpose of innovation platforms is to accelerate innovations while tackling city problems for local government. Likewise, Ojasalo (2015) argues that the platform enables private parties to turn problems and needs of a city into profitable business. Innovation platforms are often described as being a 'concept', 'way' or an 'approach', they do not necessarily refer to a physical collaborative infrastructure but rather a collaborative environment (Ojasalo, 2015; Slob & Woestenburg, 2017).

Whereas other studies build on this view by adding the ICT aspect to the innovation platform referred to as 'technological innovation platforms', other researchers emphasize the importance

of citizen participation in the urban context. "Participation platforms" function as crowdsourcing and co-creating platforms to foster city innovations (Manville, 2014). Similarly, "policy platforms" aim to involve stakeholders through the platform, emphasizing the dimension of governance (Anttiroiko et al., 2013).

The terms "urban platform" and "urban data platform" are also used by various literature sources. An important distinction from the innovation platforms is that urban (data) platforms incorporate the aspect of data sharing in their meaning. Edelstam (2016) describes urban platforms as a physical space, focussed on handling the data stream derived from the implementations of recent technologies. Other studies emphasize the role of data by referring to the platform as an "urban data platform".

Type of platform	References	Definition
Innovation platform	Manville, 2014	"Innovation platforms, also called participation platforms, referring to something in which governments, businesses and citizens can **communicate and work together**, and track the evolution of the city. They are typically **driven by local municipalities** on behalf of platform users."
	Ojasalo, 2015	"Innovation platform is defined as an approach that **systematically facilitates external actors' innovation** with purpose to develop **solutions to platform owners'** problems and needs. The purpose of the platform is to make companies and third sector organizations to innovate more effective and efficient services for the city's use."
	Edelstam, 2016	"The innovation platform concept can be seen as a **many-sided market creation process** where today there is no market to the solutions needed. No one has yet formulated the needs in a way that has made it possible to come up with solutions."
	Walravens et al., 2014	"The platform is the intermediary, the **enabler of interaction and collaboration** of multiple actors who have corresponding interests or needs."
	Slob & Woestenburg, 2017	"Innovation platforms were seen as a way of gathering relevant stakeholders to promote urban innovation. The ambition of the platforms have been to develop structures and methods for working with enhancing the ability to **support development and innovation** in close collaboration between public, private and academia."
Technological innovation platform	Edelstam, 2016	"Technological innovation platforms can be described as a two-sided platform where typically one big industrial player designs the platform and opens it up for others to innovate on. In a city context, the platform might be described as a **multi-sided organisational setup where the sides are changing as the other sides develop**, and the different parts can innovate with/against the other stakeholders' sides. There are many partners taking part in both developing the rules and playing the game."

Urban platform	Edelstam, 2016	"These are ICT-based platforms for **handling the flow, aggregation and analysis of data** that comes with new technology. They can be beneficial for cities to establish as a **tool for increased understanding and management** of many parts of city operations. They can also be a means to open city data for other stakeholders in order to create innovative solutions."
	Romualdo-Suzuki, 2016	"An urban platform is an **organization of people and systems**, which has accepted the responsibility to **preserve city data** and make it available for all the stakeholders of smart cities."
Urban data platform	Oosterhout et al., 2018	"An urban data platform exploits modern digital technologies to **bring together (integrate) data flows** within and across city systems and make data resources accessible to participants in the cities' ecosystem."
Policy platform	Anttiroiko et al., 2013	"A policy platform is not only a tool for managing information but also in a wider sense a framework within which to involve key stakeholders in **governance processes and to seek solutions** to complex social problems. It makes it possible to extend the collaborative dimension of governance in the form of co-design, co-creation, and co-production."
Participation Platform	Manville, 2014	"An urban platform with **main focus on the participation of citizens**. Examples of these type of platform are open data strategies and platforms, crowdsourcing and co-creation platforms, and other forms of citizen participation and ideation."

Table 1 Platform definitions

In this paper, the term 'smart city ecosystems' refers to the broad concept of the smart city community, described as the interaction between the smart elements of living, governance, economy and people (The Government Summit, 2015). The term 'urban data platforms' is specifically used to address the physical infrastructure in the smart city ecosystem, integrating the generated data and information flows within the system and thus facilitating data sharing between stakeholders (Edelstam, 2016). All stakeholders of the smart city ecosystem get access to the platform with its data, resources, communication and control possibilities to develop innovative applications (Ojasalo & Tähtinen, 2016). As shown in Figure 3, applications interact with the urban platform through interfaces and all elements share the same infrastructure to ensure integration (Tiwana, 2013).

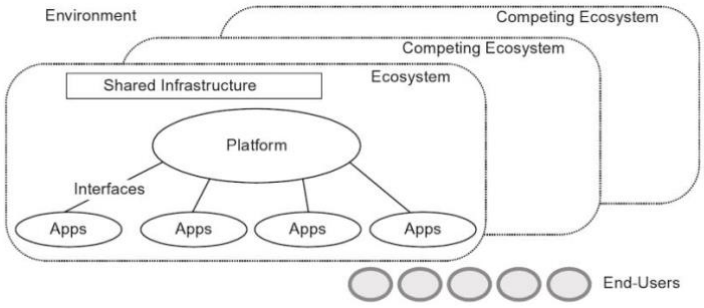

Figure 3 Urban platforms

2.3.4 Urban data platforms

Urban data platforms evolve around the activity of sharing data with other stakeholders to develop solutions for city development (Edelstam, 2016). Urban data platforms are perceived as the game-changing power for cities. They collect and process large volumes of data which enables cities to improve their strategic decision-making (Romualdo-Suzuki, 2016). Apart from providing the infrastructure for data sharing purposes, urban data platforms contribute to the softer topics of collaboration, such as enhancing information flows, increasing transparency, the ability to use open public data sets and a better sense of internal efficiency (EIP-SCC, 2016). Maximum benefits for the smart city ecosystem will be obtained when all stakeholders adopt the data platform and pro-actively and continuously share knowledge, experiences and solutions within the community (Romualdo-Suzuki, 2016).

Similarly to basic platforms, users of urban data platforms can be distinguished by their roles: data providers, service providers, platform providers and end-users, consisting of both public and private parties and the general public. Depending on the circumstances a stakeholder takes a role and this also impacts the level of access one has to certain data sources (Romualdo-Suzuki, 2016). In most cases, the city owns or at least controls the platform provided by an external company (Ojasalo, 2015). As local governments are often bound to traditional internal structures and regulations, opening up the platform for other parties usually contributes to addressing city needs and increases innovativeness of the ecosystem (Edelstam, 2016).

Many cities are facing issues with the development, implementation and working with the platform. Trust in the platform is a key component for the development. Stakeholders are often hesitant in adopting the platform. Discussions arise on the level of openness, interoperability and integration of the platform, as well as measures to standardize the data. In addition, issues concerned with privacy, security and data ownership occur (Edelstam, 2016; Romualdo-Suzuki, 2016). In order to accelerate the development and adoption of the urban data platforms, several European initiatives have been designed to provide guidance. As an example, the European Innovation Partnership of Smart Cities and Communities (EIP-SCC) breaks the development of urban data platform down to five sub-goals. To exploit the value of city data, the city should: (i) provide in a harmonised way, (ii) manage city data in a safe and intelligent matter, (iii) orchestrate city data in a market place, (iv) offer city data in an accessible manner and (v) provide value-added services (Romualdo-Suzuki, 2016). Furthermore, cities and institutions are co-creating open standards and city architectures to accelerate the development and adoption of urban data platforms. Lastly, the platform standards also contribute to the interoperability between cities which increases the perceived value for its users (Manville, 2014).

2.3.5 City data

The extent to which the urban data platform is adopted by the stakeholders is highly dependent on the characteristics of the data available on the platform. Several challenges are associated with city data on urban platforms, in particular the availability, quality, ownership and governance, valuation and monetisation of the data (EIP-SCC, 2016). Data on the platform differs highly in characteristics, it may be static, near-real time or in the future, real time, descriptive or operational (Romualdo-Suzuki, 2016). City data can either be produced and held by a governmental or public party, a private party or citizens. There are four distinct types of data; (i) open data, made available without any restrictions for usage, (ii) private data and (iii) commercial data, both requiring permission in order to be used and (iv) sensor data, owned by citizens, private and public parties. Sensory data is presented in different levels of quality as the sensors and devices have different features and settings (Romualdo-Suzuki, 2016). The value of the data, both financial and beyond, receives more attention these days with the increase of city data generated through sensors and devices in cities. Many of the smart city projects are currently funded by external organisations, therefore the development of a business models for data sharing have not been a priority (EIP-SCC, 2016).

2.4 Smart city governance

2.4.1 Definition

As established in previous sections, with the rise of smart cities comes the need for an innovative and IT-based form of governance, also ‘smart city governance’(Meijer & Bolivar, 2013). In the smart city literature, the activity of governance is twofold; facilitating citizen participation (Caragliu et al., 2011; Lombardi et al., 2011) and stimulating stakeholder collaboration (Edelstam, 2016; Nam & Pardo, 2011). Smart city governance evolves around using technologies to increase governments efficiency and effectiveness and actively engaging and collaborating with stakeholders (Slob & Woestenburg, 2017). Meijer and Bolivar (2016) define smart governance as the practice of ‘crafting new forms of human collaboration through the use of ICTs to obtain better outcomes and more open governance processes’. In this view, local governments are the ‘enablers of interaction and collaboration of multiple actors who have corresponding interests or needs’ (Walravens et al., 2014).

The aim of local government agents should no longer be to solve the city problems on its own but should rather focus on ameliorating the capacity of the ecosystem to tackle problems and improve city circumstances as a whole (Landry, 2006). Important hereby is to encapsulate collaboration, cooperation, partnership, citizen involvement and participation in the

governance (Coe, Paquet, & Roy, 2001). Due to the complexity of the ecosystem with high heterogeneity of stakeholders and conflicting objectives, smart governance must be involved in developing a shared vision and strategy with the stakeholders (Visjnic et al., 2016). Similarly, Schaffers et al. (2013) argues that the challenge for cities lays in developing cooperative environment built on sustainable private-public partnerships in the ecosystem. Hence, the management should concentrate on facilitating partnerships, stimulating information flows and providing open access to resources made available to users and developers. To conclude, smart governance can be defined as 'the definition and implementation of the policies that aim to make cities smarter, which requires aligning incentives of various stakeholders' (Nam & Pardo, 2011).

2.4.2 Local government in smart city ecosystem

Within the rise of city ecosystems, city administrations need to find a balance between traditional hierarchical governance mechanisms and the demand for more authority among the stakeholders (Edelstam, 2016; Span et al., 2012). Governance could be described as the means used to stimulate, support, influence or in other ways "manage" the interactions between different stakeholders (Edelstam, 2016). In academic literature, smart cities are governed in various ways, either in a top-down or a bottom-up approach. Ideally, top-down planning and bottom-up initiatives are complementary to each other so that vision, strategy and policies are clear, but business and societal improvements are authorized (EIP-SCC, 2016; Schaffers et al., 2013). Adopting the role of commissioner is an example of a top-down approach, whereas the role of facilitator or co-producer provides power to the bottom of the ecosystem (Span et al., 2012).

Three basic models of governance have been identified by Edelstam (2016); (i) hierarchic governance, a top-down approach based on regulations and control, (ii) market governance, a bottom-up approach based on transactions and efficiency of the interactions with enterprises, and (iii) network governance, a bottom-up approach based on cooperation between all stakeholders. Similarly, Visjnic et al. (2016) described three types of ecosystems based on the position the directive organization takes. The main types for city ecosystems are 'extended enterprises' where the city acts as the central authority and coordinates activities from the role of 'integrator'. Cities may also act as a 'platform hub' exclusively controlling the context and not the outcome of projects, so that the ecosystem functions as a 'platform market'. Due to the multi-disciplinary and complex character of smart cities, a third type of ecosystem arises. In 'ecosystems-of-ecosystems' the local government acts as an 'orchestrator', balancing the roles of integrator and platform hub to manage conflicting goals of stakeholders (Visjnic et al., 2016).

However, the question remains what local government can or should do to encourage desirable sharing while regulating undesired outcomes. Studies have shown that the main reason for failure of smart city projects is the lack of synergy and heterogenicity between stakeholders, resulting from the absence of common goals (Almirall, Wareham, Ratti, Conesa & Bria, 2016, Span et al., 2012). As a result, Manville et al. (2016) emphasizes the responsibility for local government to develop and maintain a shared vision to enhance the success of the smart city projects. Moreover, Schaffers et al. (2013) and Walravens et al. (2014) require the development of a set of agreements and principles for collaboration in order to drive all actors in the same direction, pursuing the desirable outcome and producing a co-created value to the citizens. Lastly, Span et al. (2012) argues that actions for local government include the alignment of stakeholder products and services to ensure the fulfilment of the ultimate smart city goal together with monitoring the projects through regular analyses and evaluations.

Essentially, the responsibility of the local government can be seen as a combination of being the coordinator, funder and regulator of the ecosystem. The local government functions as a coordinator by actively bringing different stakeholders and interests together to a platform and stimulating new collaborations through new initiatives. It acts as a funder taking responsibility in funding companies to develop and test new products and providing an infrastructure for initiatives. Lastly, the local government acts as a regulator supporting open sharing by formulating and monitoring regulations and putting common standards in place (Centre for Cities, 2014).

2.5 Ruggedised

Ruggedised is a smart city project bringing together three lighthouse cities (Rotterdam, Glasgow and Umeå) and three fellow cities (Brno, Gdansk and Parma) to test, implement and accelerate the smart city model across Europe. The project receives funding from the European Union's Horizon 2020 Research and Innovation program. The aim of the Ruggedised project is to develop and combine ICT, mobility and energy solutions designing smart, resilient cities with the aim to realize public interests at the intersection of ICT, mobility and energy in an urban environment (Romualdo-Suzuki, 2016; "About Ruggedised", 2018).

In Rotterdam, various private and public stakeholders are currently working on 13 projects linked to the area of the Heart of South. In order to use all data coming from various sources, Rotterdam is developing a datahub, also named an urban data platform, and a 3D visualization platform (Slob & Woestenburg., 2017). The data platform is provided by a private company, KPN, and the task of the management and ownership of the platform is currently shared with the local government. Other stakeholders can perform the role of data provider, data user, app

developer and app user on the data platform (Slob & Woestenburg, 2017). Partners of Ruggedised are currently facing challenges related to the development and implementation of and foremost the collaboration over the urban data platform. The question has been raised how collaboration between stakeholders can be fostered and accelerated.

3 Pre-conceptual framework

This study aims to develop a theory and model on the willingness to collaborate in smart city ecosystems from a business stakeholder perspective. Moreover, it aims at identifying the potential role for local government in smart city ecosystems. An analysis of the academic literature revealed several influencing factors. To validate the importance and relevance of each factor, four exploratory expert interviews were held. This lead to the final formulation of eight constructs which will further be assessed. In this section, the dependent variable and eight theoretical constructs will be described followed by the formulation of propositions. In addition, as stakeholder roles on the platform are expected to influence the vision of stakeholders, another proposition is formulated. To conclude, a pre-conceptual framework will be proposed.

3.1 Dependent variable

The dependent variable in this study is the willingness of business stakeholders to collaborate in smart city ecosystems. A higher willingness to collaborate assumingly leads to an increased level of activity in the ecosystem, which can result in more successful collaborations. An important determination of the collaboration is the extent to which the urban data platform is adopted by the stakeholders. A high level of adoption reflects the readiness of stakeholders to share data with others and implicitly displays a higher overall willingness to collaborate.

3.2 Propositions

3.2.1 Theoretical constructs

The theoretical constructs are derived from various literature sources on smart city collaboration, platform adoption and smart governance. These are discussed in the previous chapter. In addition to literature sources, four exploratory open interviews were held with experts on smart city collaboration to verify the relevance and coherence of the constructs. In total eight independent variables were extracted as factors expected to influence the willingness to collaborate and adopt the urban data platform. These independent variables were the following: integrated vision, perceived outcome, trust, platform standardization, data monetisation, data quality, clear platform governance and innovation enabling conditions. The following table includes each variable with additional descriptions and relevant literature sources to support the selected factors resulting in eight propositions.

Factor	Description	References
(1) Integrated vision	The extent to which the overall goals and vision of the smart city ecosystem is considered and understood by the business stakeholders. An integrated vision shared amongst all participants is seen as a key factor to realize a smart city.	Castelnovo et al., 2016; Romualdo-Suzuki, 2016; Edelstam, 2016; Slob & Woestenburg, 2017; Bolivar, 2015
	Proposition 1: An integrated vision amongst business stakeholders leads to higher willingness to collaborate in the smart city ecosystem.	
(2) Perceived outcome	The prospected benefits for the organisation considered when participating in the urban data platforms, making it meaningful to allocate time and resources in a collaborative effort. Some of the potential values for a company could be: - New market opportunities and complementary businesses (interaction between products or services that provide more value together than separately) - Reputation and image (participation may contribute to innovative and sustainable image for the company) - Staying ahead of competition and peer pressure (when competing businesses join in similar initiatives may increase influence willingness to participate)	Edelstam, 2016; Lee et al, 2010; 2014; Wieczorek & Hekkert, 2012
	Proposition 2: A concrete view of the perceived outcomes for the organisation leads to higher willingness to collaborate in the smart city ecosystem.	
(3) Trust	The perceived level of openness, transparency and trustworthiness amongst the stakeholders participating in the urban data platform.	Edelstam, 2016; Oosterhout et al., 2018;
	Proposition 3: A higher level of trust amongst stakeholders leads to higher willingness to collaborate in the smart city ecosystem.	
(4) Platform standardization	The extent to which the platform has a standardized format and integrated data sources, allowing for efficient collaboration, replication and scalability. It also impacts the openness of the platform and the perceived security and transparency of the platform.	Edelstam, 2016; Slob & Woestenburg, 2017
	Proposition 4: A higher level of platform integration and standardization leads to higher willingness to collaborate in the smart city ecosystem.	
(5) Data monetisation	The extent to which new business models are set up in order to capitalize economic value from sharing data on the platform.	EIP-SCC, 2016
	Proposition 5: An existing vision on the monetisation of data leads to higher willingness to collaborate in the smart city ecosystem.	

(6) Data quality	The characteristics of the data sources in the urban data platform. Data quality, volume and speed of the data influence the usability and valuation of the sources. **Proposition 6: A higher quality of data leads to higher willingness to collaborate in the smart city ecosystem.**	EIP-SCC, 2016; Slob & Woestenburg, 2017
(7) Clear governance	Data usage refers to the ownership and governance of data is a challenge in urban data platforms and unclear regulations and agreements could affect the willingness to share data. **Proposition 7: Clear governance rules on data ownership and data use leads to higher willingness to collaborate in the smart city ecosystem.**	EIP-SCC, 2016; Wieczorek & Hekkert, 2012
(8) Enabling innovation conditions	The overall ability for stakeholders to take initiatives and co-create projects using the urban data platform. An open and stimulating environment may push the co-creation of projects, especially openness can expedite innovation and lead to more value. Some enabling factors may include: - Triple Helix (collaboration among local governments, research institutes, universities and businesses) - Open attitude and cross-silo mentality of local government - Knowledge sharing (willingness of stakeholders to share knowledge, skills, resources, best practices and strategies) - Engagement of citizens **Proposition 8: The presence of innovation enabling conditions leads to higher willingness to collaborate in the smart city ecosystem.**	Bolivar, 2015; Centre for Cities, 2014; Lee et al., 2010; Schaffers et al., 2013; Wieczorek & Hekkert, 2012

Table 2 Theoretical constructs

3.2.2 Role on urban data platform

In addition to the eight propositions, the role of the stakeholder on the platform will be taken into consideration. This study assumes that the platform role of the business stakeholder has a moderating effect on the factors of the platform. This is so because the role on the platform determines the perceived value of participation on the platform. In this regard, stakeholders can either publish data for the platform as a data provider or develop solutions with available data as a data user (Van Alstyne et al., 2016).

Proposition 9: The perception of influencing factors depends on the role of business stakeholder on the urban data platform.

3.3 Pre-conceptual framework

Following the nine propositions, a pre-conceptual framework was developed. The model, consisting of the theoretical constructs and the moderating factor of the stakeholder role, will serve as a basis for this study.

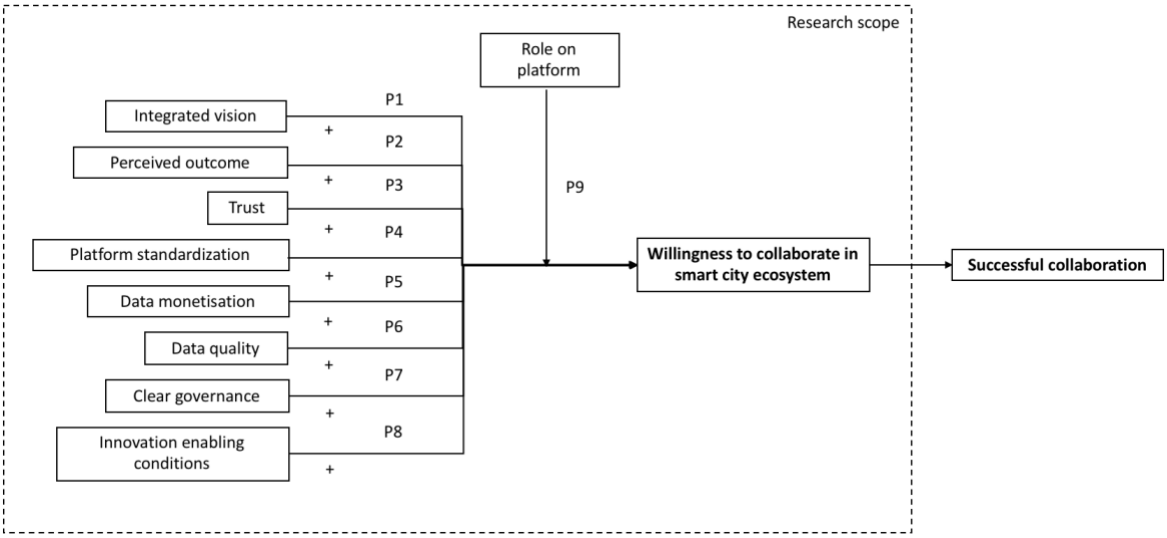

Figure 4 Pre-conceptual framework

4 Methodology

This exploratory study focuses on developing a theory around collaboration in smart city ecosystems. Hence, it aims at formulating directives to the local government to foster collaboration. In order to establish a theory and conceptual framework consisting of the main drivers influencing smart city collaboration, relevant constructs will be identified and the expectations towards the local government are defined. This section will elaborate on the decision for the grounded theory methodology and will discuss the respective research techniques used. This part will be followed by a detailed description of the interviewee selection, data collection and data analysis process, as well as a discussion on the validity and reliability of the research.

4.1 Research design

With technology playing an essential role in our daily lives, more and more cities are now experimenting with the implementations of technology in city operations. The emerging trend of smart cities has implications for the status quo of cities. More specifically, it has implications for the co-creation and data sharing of ecosystems. The rise in demand for these smart city ecosystems, built around a particular type of urban data platform, together with the implications for public-private collaborations is currently not explained in academic theory. Therefore, by doing an in-depth case study on the Ruggedised example in Rotterdam, this study provides insights on the drivers that foster collaboration in smart city ecosystems. The goal of this study is twofold. It examines the factors that influence the willingness to collaborate of business stakeholders. It also assesses the role local government can take to foster the collaboration. Eventually, an answer will be formulated to the aforementioned research question: '*Which factors drive business stakeholders to collaborate in smart city ecosystems and how could local government facilitate this collaboration?'*

The research design includes a literature review and determines a strategy for validating the theoretical constructs in order to understand how the willingness to collaborate of business stakeholders in smart city ecosystems can be influenced. For the purpose of developing a theory on this broad topic, the grounded theory approach is most appropriate (Bryant & Charmaz, 2007; Flick, 2009). The grounded theory method has strict yet flexible guidelines, initiating an open and exploratory process. This gradually leads to the development of a grounded theory based on actual data. It is a qualitative and inductive research method, that studies various individual cases and finds patterns to develop constructs (Glaser, Strauss & Strutzel, 1967). Important in grounded theory is that the data collection and data analysis proceed

simultaneously (Flick, 2014). Although the grounded theory methodology is not linked to a research method for the collection of data, the use of a method of observing nature is preferred. Interviews are most appropriate when little is known on the topic of the study and deeper insight of individuals are required, as in this case (Gill, Stewart, Treasure & Chadwick, 2008). The interview methodology is based on repeated field contacts and allows the researcher to adapt the collection process according to the needs and questions resulting from the analysis so far (Corbin & Strauss, 2013). The sample size of grounded theory is determined by the level of saturation of each category and concept rather than the need for demographic representativeness (Corbin & Strauss, 1990). An initial theoretical model is derived from the data and is continuously checked and refined with new data through a constant comparative method. As the incidents are consistently compared to other concepts for similarities and differences, greater precision can be obtained (Corbin & Strauss, 2013; Glaser et al., 1967).

To define the factors affecting the willingness to collaborate, this study is divided into two phases. In the first phase, the initial findings and constructs from literature are validated during exploratory interviews with four experts from the field. This round of interviews will be less structured than the second phase of interviews due to their open nature. The second phase of the study concentrates on the smart city project Ruggedised. The aim is to get a deeper understanding of each construct, identify relations and find gaps for local government to fill. Eventually, a theoretical model is developed. This model describes critical factors for effective and collaborative smart city ecosystems. Moreover, the model will be used to formulate recommendations for local government on how to facilitate collaborations.

4.1.1 Level of analysis

As the implementations of technologies is spreading across the globe and more and more cities are experimenting with smart city initiatives, the possibilities for research are enormous. Therefore, the level of analysis for this study is limited down to the smart city projects in the Netherlands, particularly the stakeholders of Ruggedised in the city of Rotterdam.

4.1.2 Unit of analysis

In this study, the unit of analysis refers to the extent to which business stakeholders are willing to collaborate within the smart city ecosystem to realize smart city projects. An important aspect of collaboration in the smart city context is sharing data over a type of urban data platform. Being one of the main working points for the Ruggedised project, this topic deserves extra attention in this study. Additionally, this study aims to formulate roles for local

government to foster collaborations. The data is gathered through two rounds of interviews with various stakeholders of smart city ecosystems.

4.2 Data collection

Data were primarily gathered through 12 semi-structured interviews during the period of March to May 2017. Interviews were conducted in Dutch and preferably face-to-face, in some cases Skype was chosen as an alternative. As grounded theory aims to develop a new theory, the questions at the beginning of the study tend to be open ended. As the research moves along the questions will gradually get more focused, refined and detailed (Corbin & Strauss, 2013). The first expert interviews were conducted without a clear structure and predefined questions, whereas the semi-structured interviews for the second phase of this study were performed according to an interview protocol (see Appendix A) consisting of a topic lists as guidance throughout the interview without restricting the interviewer to the pre-defined topics. All interviews have been recorded and transcribed. Similar to other qualitative approaches, the data for grounded theory can come from multiple sources. In addition to interviews and observations, company websites, institutional reports and papers are used to gain knowledge on the topics of interest (Corbin & Strauss, 1990). In grounded theory, the practice of data collection and data analysis are highly interrelated. The first bits of collected data initiate the beginning of the data analysis (Glaser et al., 1967). In this section the process of gathering the data will be further described.

4.2.1 Interviewee selection

The interviewees selected for this study are all stakeholders linked to smart city projects in the Netherlands, specifically Ruggedised. In order to get a complete understanding of factors influencing collaboration in smart city ecosystems and hereby the adoption of urban data platforms, the sample of this study must include at least one player of each partner of the Ruggedised case. Different to most research types, the size of the sample is not dependent on complete ‘demographic representativeness’ but is rather determined by the ‘theoretical saturation’. Theoretical saturation refers to the point, at which collecting additional data about a theoretical category reveals no new properties or theoretical insights about the emerging grounded theory (Bryant & Charmaz, 2007). Interviewees are not seen as a single case but rather as a representative of a group (Flick, 2009).

4.2.2 First phase of interviews

During the first phase of the study, interviews with experts are conducted. Flick (2009) has identified several reasons for the use of expert interviews. For this study, expert interviews are used for further orientation and exploration in the smart city field. Also, reconstructing the knowledge of various experts contributes the development of a new theory. The previous knowledge on the willingness to collaborate in ecosystems and specifically the adoption of urban data platforms is limited. For this reason are the interviews in this phase of an open and explorative nature. Open and unstructured interviews protect an open-minded approach, allowing the expert to bring other concepts and thoughts into the conversation (Flick, 2014; Gill et al., 2008).

The interviews were opened with a short introduction of this study, followed by a question on the interviewees current position and involvements on smart cities. The experts were then asked to elaborate on the necessities to foster collaboration in smart city ecosystems. Some questions on more specific theoretical constructs were kept aside and used in case the interview required additional push or change in direction. The outcomes of these interviews combined with insights of the literature review resulted in the validation of several theoretical concepts (Flick, 2009).

In total four experts with varying backgrounds and fields of expertise were selected. Amongst other projects, most of the experts were involved in the Talking Traffic project, a public-private collaboration between the Ministry of Infrastructure and Water Management, local government authorities and various operating companies ("Talking Traffic", 2018). This smart mobility operation has been successfully implemented and can be perceived as an exemplary case for smart city collaborations. The table below depicts the selected experts for this phase.

#	Type of organisation	Position	Field of expertise	Interview
E1	Telecommunications Company (KPN N.V.)	Business Builder Smart Mobility	Smart solutions building; Talking Traffic Case	Face-to-face 1 hour
E2	Telecommunications Company (KPN N.V.)	Product Owner KPN Data Services Hub	Data analytics; technical knowledge data services hub	Skype 45 minutes
E3	City of Rotterdam	Smart City Project Planner	Smart city projects in Rotterdam	Face-to-face 1 hour
E4	Telecommunications Company (KPN N.V.)	Managing Director Finance, Retail and Services	Strategy; Talking Traffic Case	Skype 1 hour

Table 3 First round interviewees

4.2.3 Second phase of interviews

Following upon the first phase of interviews, a second round of semi-structured interviews is conducted. The second phase of the interviews serves to gain deeper understanding of each construct, establish relations and identify gaps for local government to fulfil.

The semi-structured interview technique is a method to reconstruct a subjective theory, referring to the complex stock of knowledge on the topic. This method contributes to the inductive development of the theory reassembling knowledge of the interviewees (Flick, 2009). In this case, the starting point of the second phase of interviews are the propositions derived from literature and expert interviews. During the semi-structured interviews, the content of the subjective theory is redefined as the interviewer asks open and confrontational questions (Flick, 2014). First, open questions are being asked to examine the basic knowledge of the interviewee on a specific topic. Eventually, the interviewer directs the questions to answer predefined hypothesis based on literature, previous expert interviews and the researcher's presumptions (Flick, 2009). This semi-structured format allows for further investigation, whilst maintaining a clear structure across the interviews (Gill et al., 2008).

For this round, the stakeholders of the ecosystem of Ruggedised in Rotterdam are selected. Ruggedised will serve as an exemplary case to obtain an in-depth understanding of factors driving collaboration. As this study focusses on the business perspective on collaborative influencers, the interviewees are selected from the current private partners of the ecosystem. To ensure completeness, at least one representative was interviewed per business stakeholder (Flick, 2009). In addition, two external players are interviewed as they could provide additional insight on the urban data platform. In order to take the potential difference between platform roles into consideration, the stakeholders have been asked to identify themselves with either the role of data user (DU), data provider (DP) or platform provider (PP). These roles are not exhaustive and a stakeholder can have multiple roles simultaneously. The table lists the interviewees with their current role(s) on the platform, organisation and position, as well as the context of the interview. In case of multiple roles, the dominant role is underlined.

#	Role on platform	Type of organisation	Position	Interview
S1	DU&DP	Public Transportation Company (RET N.V.)	Senior Advisor Business Development	Face-to-face 45 minutes
S2	DU&DP	City of Rotterdam	Product Manager Digitale Stad	Face-to-face 1 hour 15 min

S3	DP&PP	Telecommunications Company (KPN N.V.)	Account Director	Skype 45 minutes
S4	DU (&DP)	3D City Operations Model Developer (Future Insight B.V.)	Founder & CCO	Face-to-face 1 hour 15 min
S5	Potential DU&DP	Construction-services Company (Heijmans N.V.)	Project Manager	Face-to-face 1 hour
S6	DU&DP	Energy Supplier (Eneco Holding N.V.)	Project- & Tender Manager	Face-to-face 1 hour 30 min
S7	(Consultant)	International Standards Organization (Open Geospatial Consortium, Inc.)	General Manager OGC Europe	Skype 45 minutes
S8	(Consultant/DP)	Data Platform Developer (Civity)	Managing Director	Skype 1 hour

Table 4 Second phase interviewees

4.3 Data analysis

In order to analyse the collected interviews, the data analysis was performed according to the coding stages thoroughly described by Flick (2009). Previous to the data analysis, each interview was recorded and transcribed. Notes were taken alongside the interview as a clarification tool. According to grounded theory, data first needs to be applied to multiple coding methods before the development of a theory (Corbin & Strauss, 2013). For this study, all stages of the coding process were executed in ATLAS.ti. Essentially, the analysis of the data is performed by comparing occurring incidents and naming phenomena with the same conceptual labels resulting in basic concepts for the developing theory. Writing memos is seen as an integral part of practicing a grounded theory methodology, because it helps to keep track of all categories, properties, relationships and conceptual ideas. This method allows to quickly organize and incorporate information and contributes to making the analysis more explicit and transparent for the involved parties (Corbin & Strauss, 1990; 2013). Flick (2009) describes the procedure of coding extensively, hence this book lies at the foundation of this section.

4.3.1 Coding

The central process of grounded theory research is coding the data. Coding is the practice of taking raw data and raising it to a conceptual level in order to build upon a theory. The process of coding is more than paraphrasing or basic noting down of the occurring concepts, it should be seen as data-mining. Coding requires interaction with data by using different techniques, such as asking questions about data and making comparisons, which results in the derivation

of concepts which later can be developed into concepts for the new theory (Corbin & Strauss, 2013). This practice allows researchers to scrutinize and dissect the data and critically reviewing assumptions arising of the data (Flick, 2014). The aim of coding is twofold: to develop an understanding of the field of study and to identify an elemental structure, principle, process, or core category (Corbin & Strauss, 2013). In the grounded theory, coding starts immediately after gathering data and remains during the entire research process as a continuous interaction between data collection and coding (Flick, 2009). There are three types of coding in the grounded theory to be used: open, axial and selective coding (Corbin & Strauss, 1990). These types should neither be seen as temporarily disconnected nor as clearly distinguished procedures, but simply as different ways of handling the text between which researchers switch regularly (Flick, 2009). The results of this coding process are provided in section 5.

4.3.2 Open coding

The first step of coding aims at expressing the raw data in the form of concepts. Open coding is defined as the process of interpretation by breaking data analytically. This process helps the researcher gain new insights on the topic (Flick, 2014). Data is first segmented and expressions are classified in order to attach annotations and concepts to them. By doing so, sometimes dozens of codes arise from the open coding process (Corbin & Strauss, 1990). The next step is to categorize the codes around similar phenomena relevant to the research topic. These categories are then linked back to the codes, which now are more abstract than before. These codes either come from social science literature or are taken from interviewee's expressions. The degree of detail in the coding process depends on the research question, it can vary from coding line by line to only one code per paragraph. The result of open coding should be a list of codes and categories linked to the raw text, together with the code notes included to explain and define the content (Flick, 2009).

4.3.3 Axial coding

After some substantive categories have been identified during the process of open coding, the researcher starts with axial coding. This is a more formal coding method to identify how concepts are related to their initial subcategories (Flick, 2014). The researcher will verify the relationships and categories by moving back and forth between inductive and deductive thinking. Inductive thinking refers to the creation of theories by developing concepts, categories and relations from the text. Deductive thinking refers to testing these constructs against the text. In axial coding, the categories with the highest relevance for the research questions are selected and linked to as many passages from the text as possible (Flick, 2009).

4.3.4 Selective coding

The third step, selective coding can be seen as the continuation of axial coding at an even higher level of abstraction. This step focusses on the main concepts and codes and elaborates on the integration of the model (Flick, 2009). Selective coding involves the selection of a category which encapsulates the most frequent and relevant concepts. Then more data on this concept is gathered (Flick, 2014). The purpose of selective coding is determining a central category together with its subcategories answering the research question. At the point where theoretical saturation is reached, a new theory is formulated and checked again against the data. However, the researcher will be able to re-access the same source texts and codes from open coding to develop a new grounded theory on a different issue (Flick, 2009).

4.3.5 Quality of research

In order to assess the quality of the research design, Yin (2013) has identified four major aspects any type of research must consider carefully: construct validity, internal validity, external validity, and reliability. Appendix B provides a table that is based on the table used by Yin to validate the quality of case studies. Only applicable guidelines for this specific study are included.

According to Yin (2013), construct validity tests whether the correct instruments were deployed for measuring the concepts of the study. This type of validity is ensured by the usage of multiple sources, also referred to as triangulation, and developing a chain of evidence, allowing for a confirmation of the data. Internal validity assesses the truthfulness of the established causal relationships between the concepts. By building on existing theories and finding patterns in different interviews internal validity can be obtained. Thirdly, external validity refers to the generalizability of the established relationships in the study. By linking other research and academic theory to the found relationships a fit can be found between the new and existing knowledge. Lastly, reliability is a measure to establish the extent to which the study is error and bias free. It indicates whether the study would have resulted in similar results over time and across items. This study consulted a case study protocol and used a database to ensure reliability.

5 Result analysis

In this section the results of the interviews will be presented and interpreted. First, the main findings of the expert interviews are discussed, serving as a basis for this study. Then, the findings from the second phase of interviews are discussed with their data structures and underpinned with quotations derived from the transcribed interviews.

5.1 Findings expert interviews

In order to validate the pre-conceptual framework and develop deeper knowledge on the topic of this study, four expert interviews have been conducted previous to the case study research. The experts were chosen based on expertise and experience. They were involved in public-private collaborations to develop smart city projects which included data sharing on an urban platform. Three of the experts interviewed hold high-level positions at one of the biggest telecommunications companies of the Netherlands and participate in smart city collaborations on a regular basis. The other interviewee works for the local government of Rotterdam as a project planner, facilitating smart city collaborations for the municipality both internally and externally. Each expert is represented by a shorthand, respectively EB (Edwin Bussem), DG (Dennis Groot), RW (Roel Willemsen) and FV (Frank Vieveen).

The four experts were asked to share their perspective on collaboration in smart cities and factors driving the adoption of the urban data platform specifically, a key aspect of smart city collaboration. During the interview, successful projects realizations were discussed touching upon positive drivers of collaboration, as well as failed collaborations and constraints for optimal collaboration. The interviews have contributed to this study on several aspects. First, by the end of the fourth interview, all constructs previously derived from academic literature were confirmed. Second, the level of trust in the smart city ecosystem was repeatedly emphasized during the interviews. For this reason, trust is included as a separated proposition in the pre-conceptual framework instead of being implicit in other constructs. Furthermore, The experts established the inherent relationship between the adoption of the urban data platform and collaboration in smart city ecosystems in general. Furthermore, the experts indicated several pain points for collaboration in smart cities which were further assessed during the second phase of interviews. Finally, in addition to the validation of the pre-conceptual framework, the interviews provided further information on the extensive, complex and novel topic. This background knowledge served as a foundation for the continuation of the study. In order to support the findings of this study, some quotes of the expert interviews will be included in the subsequent sections.

5.2 Influencing factors

5.2.1 Data analysis

As a result of the first step of the coding process, open coding, in total 73 codes were obtained. Examples of open codes are 'Building connections so that one plus one equals three' and 'Looking further than single purpose solutions'. In-vivo codes were also created to develop increased understanding, as well as code notes to explain and define the content of the codes. Axial coding was performed to find relationships between concepts and develop higher-order themes, for example the specifications of 'Complementary business' and 'Solve specific use case'. Finally, a higher level of abstraction was reached through selective coding. The main categories influencing the willingness to collaborate were aggregated, resulting in the final eight constructs. These were integrated vision, perceived outcome, trust, platform standardization, data quality, clear governance and innovation enabling factors, of which some are specifically related to urban data platform. In addition, special attention was given to the comments related to the role and responsibilities for the local government. These serve as a ground for recommendations towards the local government. The following sections will elaborate on the findings from the interviews through data structures consisting of the main categories and concepts of the constructs, supported by relevant quotes from the expert interviews. A list of all codes, an example of the code report and a coded interview from Atlas.ti and all original quotes are included in in Appendix C-E. Each expert is represented by a shorthand, respectively VG (Virgil Grot), RvdH (Roland van der Heijden), RvR (Roland van Ravenstein), RK (Rick Klooster), MK (Maarten Kokshoorn), JF (Jasper Feuth), BdL (Bart de Lathouwer) and AH (Arjen Hof).

5.2.2 Integrated vision

The influencing effect of the integrated vision on the willingness to collaborate is often mentioned during the interviews. This concept refers to a formulated vision on the collective overarching goal shared by all stakeholders. It is mentioned by both data users and data providers on the platform. Most interviewees argue that this vision plays an integral part in the collaborative process. Vision should be formulated with the *'goal to answer the initial question to serve the city'*[1] (EB) and drives the ecosystem *'to achieve the bigger picture'* [2] (VG). Moreover, an integrated vision helps to envision the *'potential advantages collaboration holds for partners'* [3] (RvdH) and drives organizations to work at a faster pace with an increased sense of urgency [4] (JF). Most interviewees recognize that the main goal of the smart city ecosystem is to *'share data with each other'* [5] (JF), but also state that the vision is *'gradually being shaped by all parties*' [6] (VG) and is therefore not yet finalized.

Some interviewees mention that an integrated vision encourages collaborations because of a better understanding. When stakeholders *'truly believe in the future smart city ecosystems'* they are more willing to collaborate, *'regardless of what the short-term outcome is'* [7] (EB). The concept of a smart vision differs amongst interviewees. Some argue that the vision should concentrate on the main overarching goal of smart cities, which *'cannot be broken down to individual benefits for organizations'* [8] (VG). However, others emphasize the existence of individual needs and objectives and state that *'you also have to deal with individual goals and align them.'* [9] (JF). In this regard, the integrated vision should arise from common grounds of the individual objectives of organisations. The role for the government lays in *'coordinating the different perspectives, motivations and ideas'* [10] (RK) and *'aligning individual incentives with an overall goal'* [11] (RvR).

Figure 5 summarizes interview responses related to integrated vision.

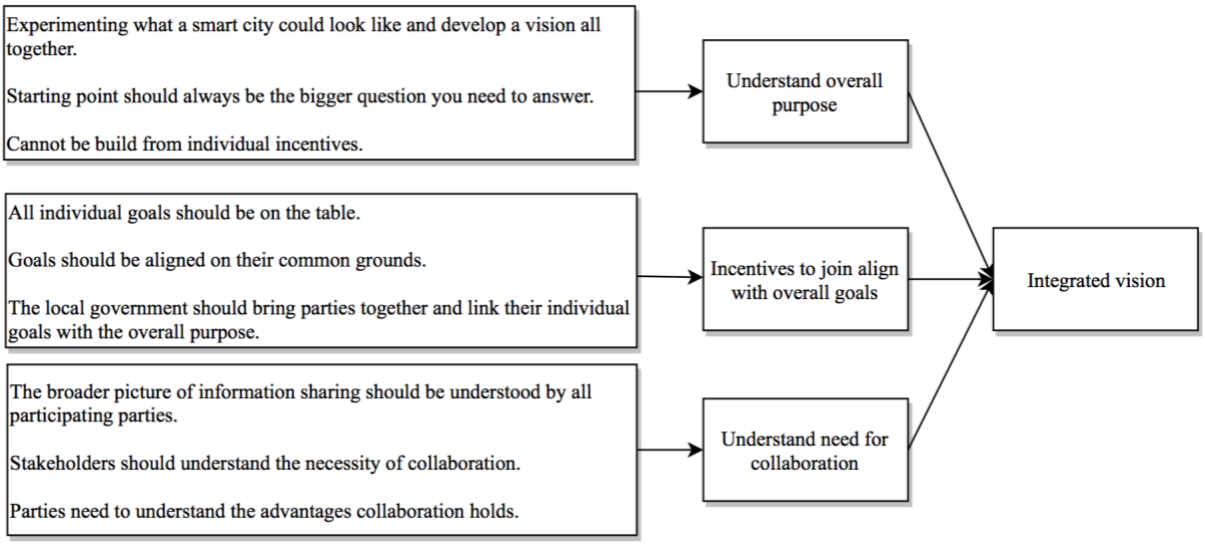

Figure 5 Data structure integrated vision

5.2.3 Perceived outcomes

Perceived outcomes refer to the individual desired outcomes of stakeholders when participating in the smart city ecosystems. Various interviewees stated the importance of being aware of the different incentives and perspectives on smart city collaboration within the ecosystem, so that common grounds can be identified stimulating the willingness to collaborate [12] (DG). In addition, other stakeholders claim that individual goals need to be outspoken.

Three main objectives for stakeholders to join the smart city ecosystem were derived from the interviews; to solve a specific use case, the prospect of financial benefits and arising business. First, many stakeholders recognized that the initial reason to join Ruggedised was somehow related an existing project such as the implementation of electrical bus logistics (VG) or in addition to the existing public-private collaboration in the Heart of South (MK). In this regard, the main driver for collaboration from a business stakeholder perspective is to derive business. In some cases a specific business case is a minimum requirement to participate. Moreover, the platform provider has mentioned to specifically develop use cases '*to demonstrate the advantages of smart city collaborations'* [13] and hereby stimulating the adoption of the urban data platform.

Secondly, stakeholders mention the prospective of financial benefits for the urban data platform. Financial impact is even said to be the main aspect of desired outcomes and the foundation for collaboration; '*to know that the collaboration is financially attractive for all parties'* [14] (VG). In particular the more traditional companies are said to emphasize the need of earning money, as they were described as *'sitting on their data waiting for it to become clear what financial benefits can be obtained'* [15] (RvR). However, as Ruggedised currently receives funding from Horizon 2020, interviewees emphasize that the prospect of financial benefits is mostly long-term oriented. *'At this point it is too soon to have a clear idea on how to earn money on the urban data platform'* [16] (VG). To conclude, data providers mentioned the financial outcomes more often, referring to the opportunity to derive cash from sharing data. *'The reason parties publish their data on the platform is because they know that cash will flow in a later stage'* [17] (BdL).

Lastly, the fact that increased data sharing and collaborations may lead to new business opportunities also mentioned, mostly by data users. The benefit of smart city collaborations is said building connections so that '*parties will look further than their single use purposes and build connections so that one plus one equals three'* [18] (RvdH) Furthermore, the possibility of scaling the solutions to other markets, to gain knowledge and obtain advantages over competitors were reasons to collaborate in the system.

Figure 6 summarizes interview responses related to perceived outcomes.

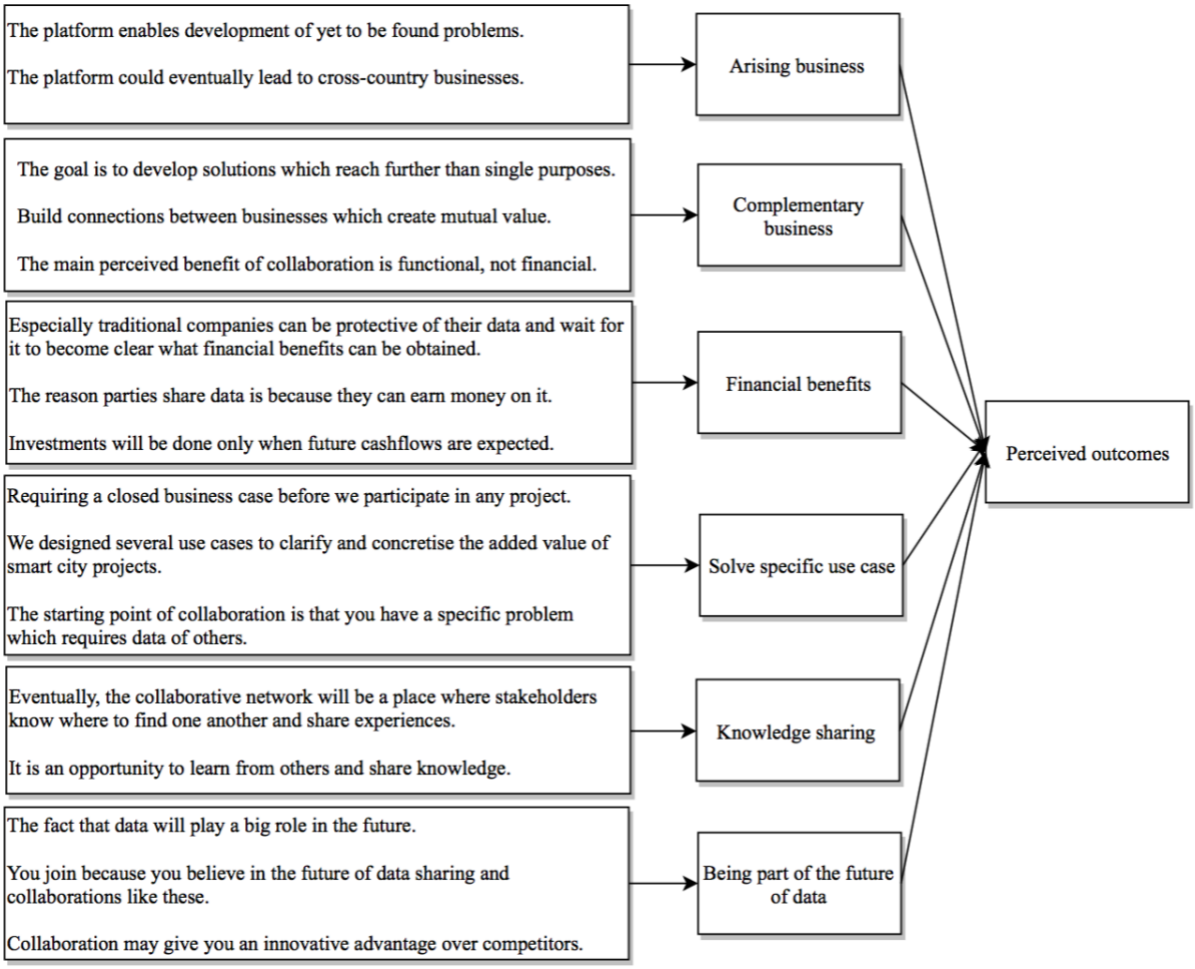

Figure 6 Data structure perceived outcomes

5.2.4 Trust

Without an exception trust is mentioned as an essential aspect and driver of collaboration in smart city ecosystems. Supposedly, without a sense of trust the stakeholder ecosystem will be unable to deliver successful projects as *'collaboration between people, machines and computers only work because the people who use them agree with each other'* [19] (BdL). The dimension of trust can be divided into a general sense of trust amongst stakeholders and trust in the longevity of the urban data platform.

Trust in partners of the ecosystem strongly relates to the transparency of the objectives of others to collaborate, as discussed in earlier sections. On this topic, some stakeholders stated that *'as long as the incentives are on the table, it doesn't really matter how or what parties want'* [20](RK) indicating that trust is the fundamental aspect of any type of collaboration. However, during the interviews it became clear that in the Ruggedised ecosystem *'true incentives to collaborate are still a taboo'* [21] (RK). It is said that here lays a role for local government to drive the conversation in unveiling individual agenda's.

On the other hand, stakeholders mentioned the trust in the platform provider, particularly in *'what happens to the data when you publish it, we are not that far yet'* [22] (VG). Data users emphasized the need for a trustworthy provider and platform in particular, as *'for the development of a product on external data, it is crucial that the platform can ensure the availability of that data the next week'* [23] (BdL). Considering the novelty and fragility of the current urban data platform, the platform provider is urged to ensure longevity of the platform to stimulate collaborations.

Figure 7 summarizes interview responses related to trust.

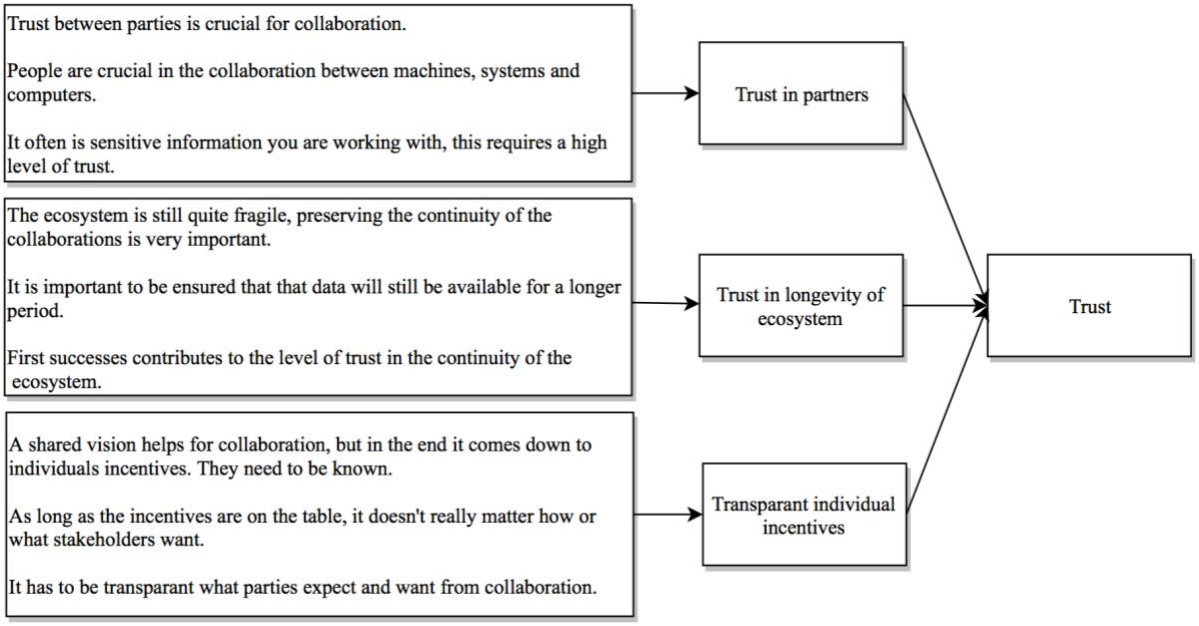

Figure 7 Data structure trust

5.2.5 Platform standardization

As established in previous sections, the urban data platform holds many implications for the willingness to share data and thus collaboration in the smart city ecosystem. From the interviews arose several preferences for the implementation of such a platform, the most common factors are brought together in this dimension. The platform standardization is rather a minimum requirement for the urban data platform, interviewees expect a certain level in order to consider participating on it. Platform standardization is indirectly influencing the willingness of stakeholders to collaborate in the smart city ecosystem.

Platform standards were the most prevalent factor reflecting the need that *'a minimal platform structure should be build, giving both directions and freedom to everyone for sharing.'* [24] (BdL). The goal of the platform must be to *' develop a generic platform with standardized data'* [25] (RvdH) with the perspective to '*become a federation of systems'* [26] (AH). This so-called cross-platform integration is an important factor to both players on the urban data platform. *'For data providers open standards are essential'* (RvdH) so that data can be published to the platform in an effortless and efficient manner which lowers barriers to adopt the platform. *'For data users it is very time consuming if data requirements vary per city'* [27] (RvdH). Open standards will allow data users to build one solution which is replicable to various cities and will thus become economically viable.

Other aspects of platform standardization include the level of trust in the security of the platform, *'finding a balance between high level of security and freedom to innovate'* [28] (VG), as well as trust in the provider of the platform. In order to be willing to share data stakeholders demand clarification on what happens to their data. Finally, in order to come up with new business solutions from the data, it is required that data is available and foremost accessible. This will encourage data users to explore the possibilities on the platform and potentially derive new businesses.

Figure 8 summarizes interview responses related to platform standardization.

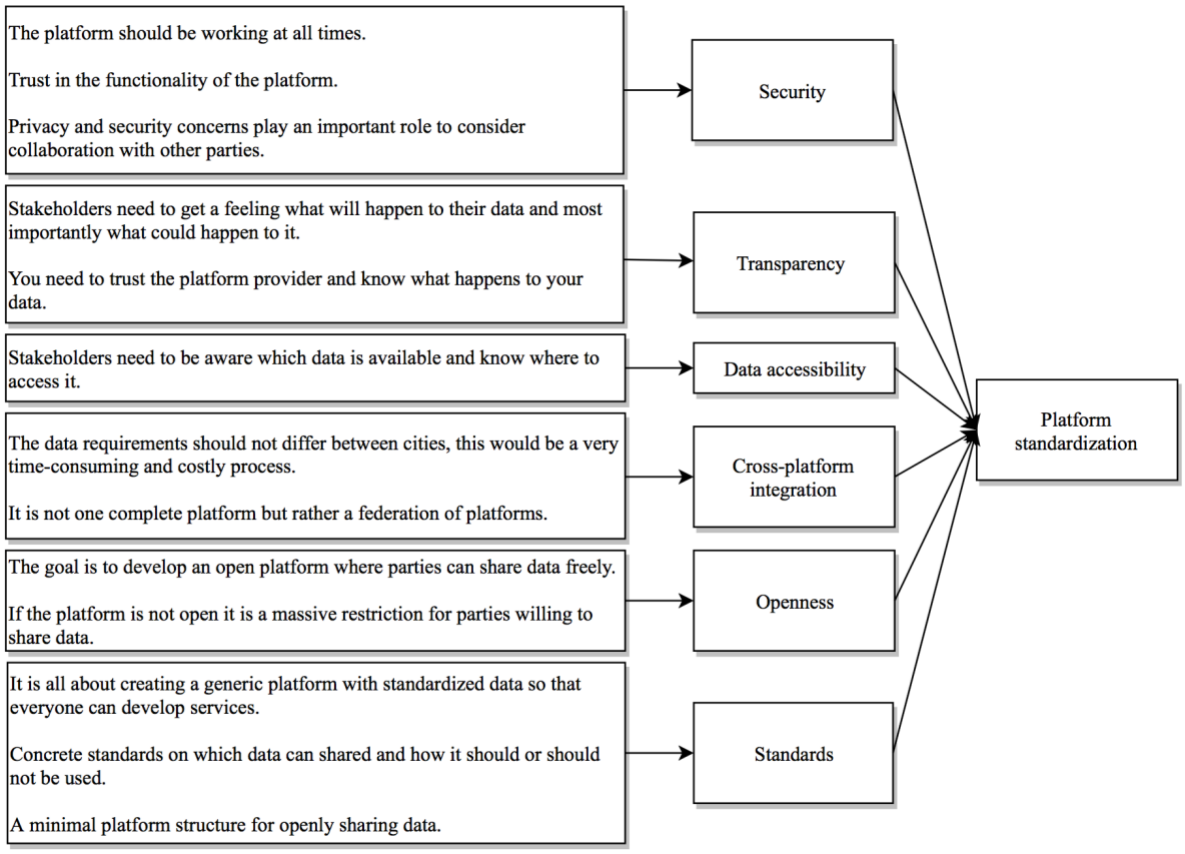

Figure 8 Data structure platform standardization

5.2.6 Data quality

Interviewees often referred to the quality of the data available on the urban data platform as a driver for collaboration. Data quality is a dimension closely related to the standardization of the platform, discussed in the previous section and a hot topic in the current development phase of platform. The concepts linked to the data quality mostly reflect the usability and specifically the preferred data format. *'Quality of data is a broad concept, but at least standards should be formulated on the scope and format of data'* [29] (AH). Platform users are said to be more willing to collaborate over the platform when the quality of the data is perceived high.

The usability of data plays an important role for the adoption of the urban platform. *'Still a big proportion of the public data sources are old and messy'* [30] (RvR), which is said to have negative effects on the willingness to collaborate. These public data sources are *'often not*

worth a lot' [31] (RK) and limits the extent that parties may want to participate on the platform. Data users state the preference for real-time data sources as *'the goal is to eventually develop an infrastructure for real-time data only'* [32] (RW). Although data providers understand and agree with the need for data standards, these standards can also be perceived as a constraint to publish data; '*it depends how much work it is to deliver the data in the expected format, especially if we don't know what we get out of it'* [33] (MK). The concept of data quality was valued more by interviewees identifying with the data user role. For this group of stakeholders the format and usability of data has a great impact on the possibilities for the creation of solutions.

Figure 9 summarizes interview responses related to data quality on the urban data platform.

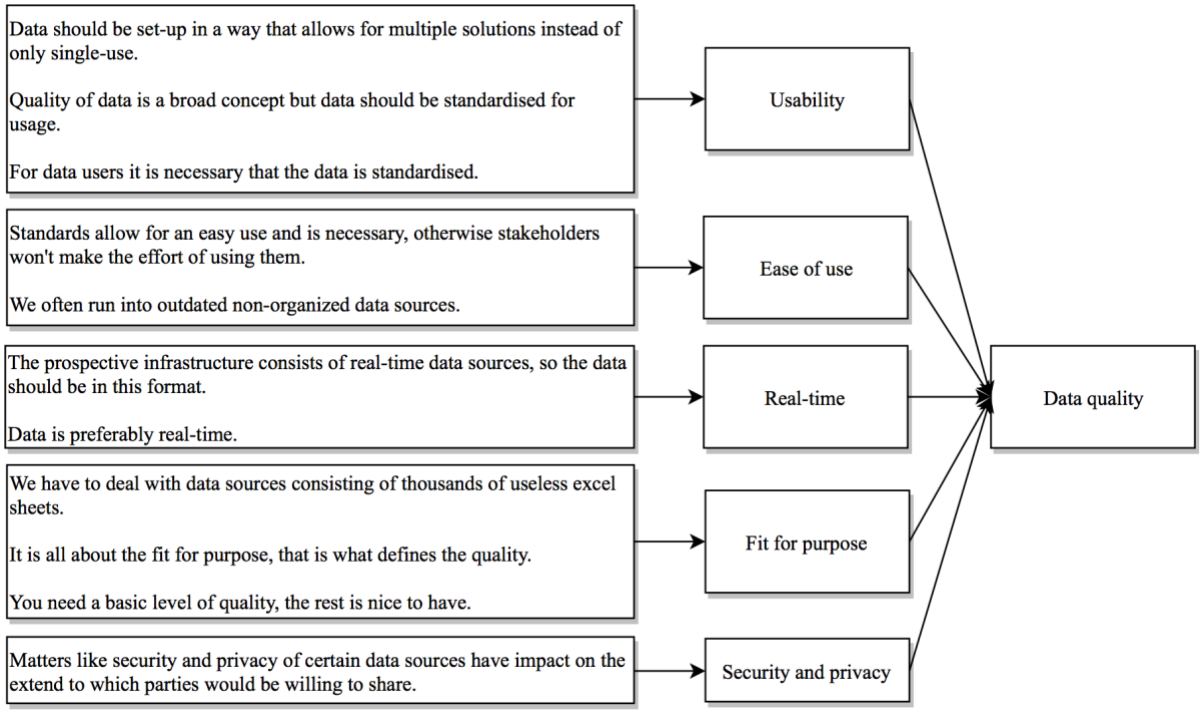

Figure 9 Data structure data quality

5.2.7 Clear platform governance

Both data users and data providers mentioned the necessity of clear governance as a driving factor for collaboration on the urban data platform. Clear platform governance is concerned with the regulatory aspects of the urban data platform, such as collaborative agreements, clarified role division, platform conditions and a sense of ownership for data providers.

Contractual agreements are often required to establish grounds for data sharing and allow for sustainable and long-term collaborations. Some interviewees are of the opinion that *'you need contracts to pin down specific tasks, costs and benefits'* [34] (MK) in order to create a similar level of pressure and motivation to contribute across all stakeholders. Whereas others emphasize that trust can serve as a basis; *'a common will to collaborate and vision lowers the need for strict contractual agreements'* [35] (BdL). In this regard, contracts are only required *'to support and verify the agreements based on trust'* [36] (AH). Various interviewees state that *'monitoring collaboration too strictly might lead to distrust in the ecosystem'* [37] (BdL) and should therefore be avoided.

Another driver for adoption of the urban data platform is the clear distribution of roles on the platform so '*that it becomes clear which stakeholder has which expertise'* [38] (RW). Clarification of platform roles would contribute to transparency and trust on the driving the collaborative power in ecosystems. In order to establish platform roles, stakeholders rely on the initiative-taking party, often the local government, to *'take a clear stand and let other parties pitch what they will contribute from which role'* [39] (DG).

Platform conditions and restrictions are also mentioned by interviewees, demanding clear governance rules for the platform to supervise collaborations between stakeholders. These conditions both refer to platform conditions to collaborate as well as the possibility to create conditions as a data provider; '*You will have to create an environment where you can decide for yourself to which parties you will share data on which conditions'*[40] (RvdH), lowering the barrier for data providers and thus enforcing the adoption of the data platform. This sense of ownership also stimulates new parties to collaborate since '*the fact that you maintain control protects from the occurrence of a lock-in'* [41] (RW). Although the platform provider claims to allocate ownership to the data providers by offering them *'a private space on the platform with full control on accessibility of the data'* [42] (RvR), other stakeholders seem unaware of the possibilities stating they want to know what happens to their provided data on the platform [43] (MK).

Figure 10 summarizes interview responses related to clear data governance.

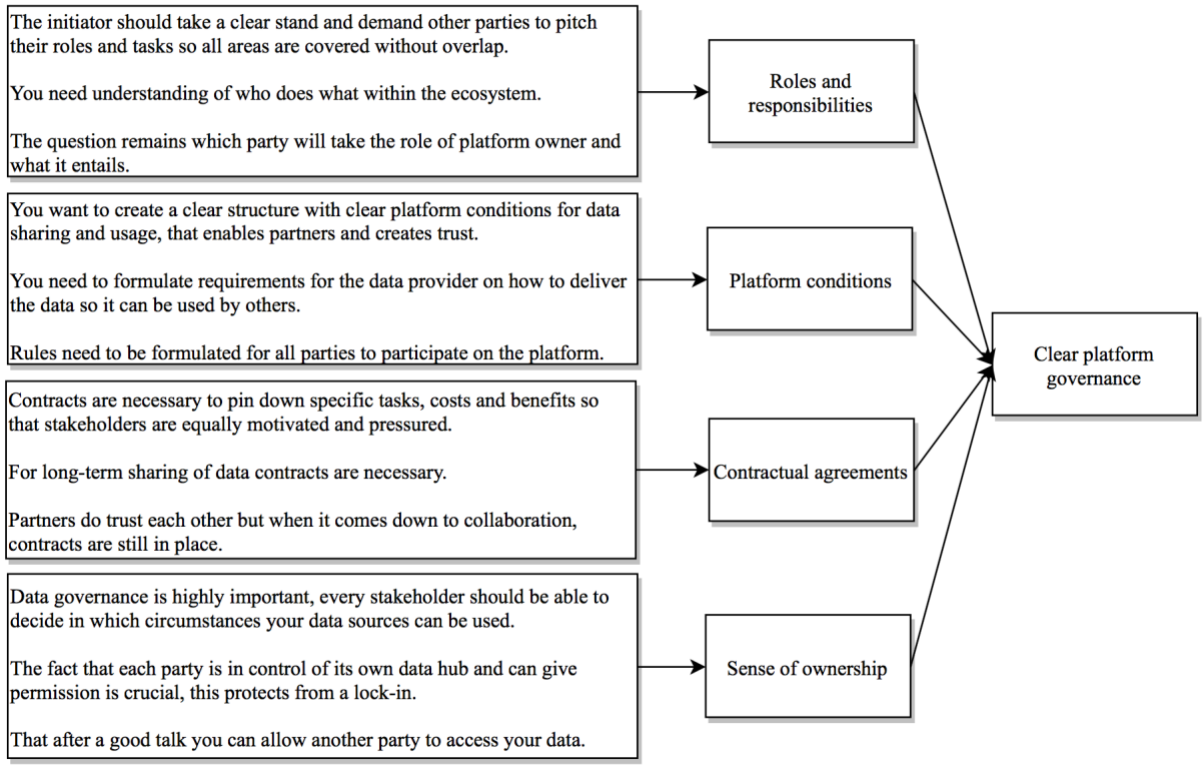

Figure 10 Data structure clear platform governance

5.2.8 Innovation enabling conditions

Lastly, several concepts were derived from the interviews referred to as innovation enabling conditions. The presence of these conditions have a stimulating and accelerating effect on innovations driving the willingness to collaborate. First, success stories on previous collaborations illustrate the beneficiary outcomes smart city collaborations and create a feeling of trust, potentially stimulating the willingness to collaborate since *'people know what to expect and will follow'* [44] (RvR). One driver of the production of these success stories, is the feeling of a risk-free environment as it lowers the barriers to collaborate for stakeholders. *'The crux is the funding from Europe which allows us to experiment in a small group and start collaborating without a massive risk'* [45] (EB). As mentioned, the financial aspects matters a lot for business stakeholders, thus funding appeared crucial in this initial phase of smart city project *'if an investment cannot directly be translated into money, you need to give them a push to get started'* [46] (VG). Lastly, general enthusiasm for collaboration and willingness to share knowledge, experiences and data are mentioned to facilitate collaboration, as well as an open process which allows parties to innovate together.

Figure 11 summarizes interview responses related to innovation enabling conditions.

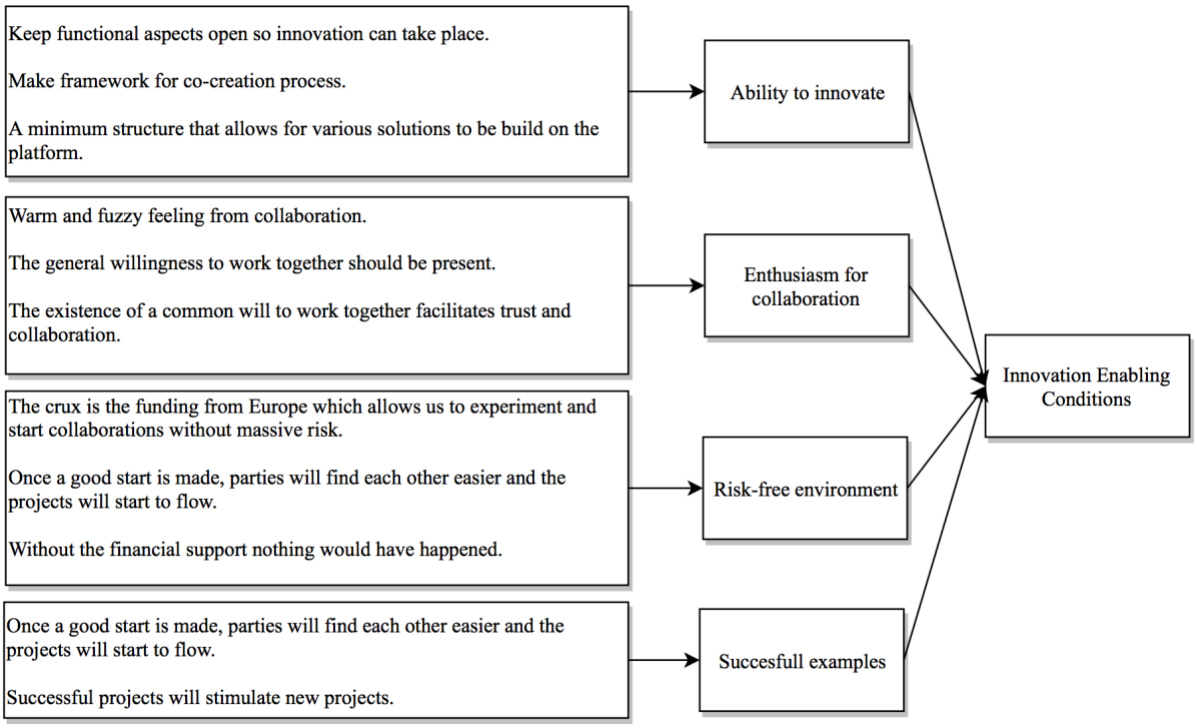

Figure 11 Data structure innovation enabling condition

5.3 Additional findings

5.3.1 Constraining factors

This study has demonstrated that various factors may influence the willingness of business stakeholders to collaborate in smart city ecosystems. Table 5 depicts the constraining factors that were identified during the interviews together with their frequency of occurrence. These additional findings will be discussed below.

Constraint	Frequency of occurrence
Unclear reason to share data	8
Juridical complications	6
Level of urgency and priority	6
Excessive amount of public data	5
Unclear smart city vision	5

Conditions before willing to share data	4
Fear of slow process	4
Technical capacity local government	4
Little understanding of the platform	3
Technical ability to deliver data	1

Table 5 Additional findings

The main constraint for collaboration in smart city ecosystems mentioned by the interviewees is the unclear reason to do so. Many of the stakeholders recognized the lack of understanding of the advantages of information sharing as a constraint for adopting of the platform. '*Because of the lack of knowledge on the functionality and benefits of data sharing, the smart city projects receive low priority from business stakeholders'* [47] (VG). A low level of priority is also mentioned as a cause for limited willingness to collaborate. When some stakeholders in the ecosystem are less driven to contribute than others, the jointly level of collaboration will suffer. Additionally, the lack of the feeling of urgency is mentioned stating that *'the current ecosystem is not bounded by results'* [48] (BdL), referring to the funding Ruggedised is currently receiving from Horizon 2020. A potential reason for the absence of the sense of urgency and priority is are the *'undefined responsibilities between stakeholders and unclear financial goals'* [49] (JF).

On a higher level, juridical complications are mentioned as a potential constraint for the willingness to collaborate. European regulations are mentioned to have a restricting effect on the pursuing of collaborations, as well as the laws on tendering [50] (JF). In addition, the fact that *'stakeholders now have a shared responsibility towards Horizion 2020'* is said to not only limit the overall contribution of each partner, but also '*causes difficulties for the juridical departments of the involved stakeholders'* (JF). This could potentially withhold stakeholders to participate in collaborations.

To conclude, some other constraints for collaboration reflect the implicit conditions stakeholders may hold before collaborating on the platform, such as a predefined business model for data sharing or applying self-defined APIs. Also, technical knowledge and capability to deliver usable data sources of the local government has been mentioned as a constraint. *'The excessive amounts of outdated Excel sheets of public data'* [51] (RK) require commitment and energy from the stakeholders before the data can be used, which may increase the barrier to adopt the platform in the first place.

5.3.2 Critical factors for the adoption of urban data platform

In order to get an overview of the critical factors for the adoption of the urban data platform, the interviewees were asked to answer the question 'What is the main driver for business stakeholders to adopt the urban data platform?'. Table 6 summarizes the responses of all interviewees.

Interviewee	Answers
VG	- To predefine the **individual expected outcomes** - Write **terms of agreement** down so they can be monitored[52]
RvdH	- Create an environment of **trust** - Enable stakeholders to decide on which **conditions** to share data and with whom[53]
RvR	- You join because you believe in the **broader vision** of the smart city ecosystem - The stakeholder needs to **understand the added value** of sharing information for the city and themselves [54]
RK	- The most important thing is to take **all objectives of stakeholders** into account, each party has its own agenda - Create **trust** between stakeholders[55]
MK	- Being **open and transparent** on the expectations and objectives[56]
JF	- It must be **financially attractive** and technically achievable for companies to participate[57]
BdL	- The findability and **accessibility of the data** on the platform. Knowing which data sources can be found where on the platform[58]
AH	- It is important that the open standards match so a **reference framework** for cities can be developed[59]

Table 6 Main requirements for platform adoption

Concluding from the table, the critical factors influencing the adoption of urban data platforms can hardly brought back to one main driver. Instead, the responses to the question encapsulate all findings discussed in the sections above. Each interviewee has a different perception of the needs for the urban data platform, highlighting technical as well as collaborative aspects of collaboration. Trust amongst stakeholders can be established as the most prevalent factor, especially when the coherence with a clear vision and transparent objectives is taken into account. However, the heterogenicity of the responses indicate the multi-disciplinary and complex character of the adoption of the urban data platform.

5.3.3 Role of government

As a final question interviewees were asked to determine the role for local government in the smart city ecosystem. In the literature review three distinct roles for local government were described, either a funder, coordinator or regulator. The table below lists an overview of responses is given by the stakeholders. In short, as the project of Ruggedised is currently funded an external party, the role of funder was hardly mentioned. However, the role of regulator and coordinator were both equally referred to. The role of coordinator was mentioned most frequently, followed by the role of regulator. In fact, interviewees mentioned that all roles usually go hand in hand in real life city collaborations.

Coordinator	Regulator	Funder
Coordinate individual goals (VG)	Create framework of rules (VG)	Organize funding process (VG)
Preserve overall goal (RvR)	Develop rules for collaboration (JF)	Provide funding if there is no external funding (MK)
Motivating and managing different stakeholder objectives (RK)	Preserve main values of ecosystem (BdL)	
Coordinating activities (MK)		
Create sense of urgency (JF)		
Create buzz about smart cities (BdL)		

Table 7 Role for local government

6 Discussions

In the following section, the predefined propositions will be discussed as well as the additional findings and new hypotheses will be derived. Consequently, the revised conceptual framework will be presented and explained.

6.1 Reflection on findings

6.1.1 Proposition 1: Integrated vision

P1: An integrated vision amongst business stakeholders leads to higher willingness to collaborate in the smart city ecosystem.

Concluding from this study, the existence of an integrated vision amongst stakeholders has a positive influence on the willingness to collaborate. An integrated vision helps to shape the overall collaboration process, driving the ecosystem as a whole towards the same direction at an increased level of productivity. It also contributes to the understanding of the benefits of public-private collaborations, which contribute to the willingness of stakeholders to participate in the smart city projects. There are various perceptions of the content of the vision, it should combine the overall purpose of the smart city project with the common grounds derived from the stakeholder objectives. The critical reflection the proposition thus leads to the following hypothesis:

Hypothesis 1: An integrated vision has a positive influence on the willingness to collaborate in the smart city ecosystem.

6.1.2 Proposition 2: Perceived outcomes

P2: A concrete view of the perceived outcomes for the organisation leads to higher willingness to collaborate in the smart city ecosystem.

Closely related to the existence of a shared vision, the formulation of perceived outcomes of the individual stakeholders also have a positive influence on the willingness to collaborate. As mentioned in the previous section, established common grounds of stakeholders objectives contribute to an integrated vision. This is said to enhance the willingness to collaborate.

Further, it is agreed upon by the interviewees that once there is a mutual understanding of expectations and objectives, the willingness to collaborate increases. The main objectives for business stakeholders to join the smart city project are all related to the rise of business opportunities. Some of the stakeholders joined to solve specific use cases, whereas other stakeholders hold financial expectations towards the sharing of data in the urban data platform. Additionally, the perceived added value of public-private collaboration may also influence the willingness to collaborate, such as sharing knowledge and being involved in the future of such collaborative ecosystems. The critical reflection the proposition thus leads to the following hypothesis:

Hypothesis 2: A concrete view of the perceived outcomes for the organisation has a positive influence on the willingness to collaborate in the smart city ecosystem.

6.1.3 Proposition 3: Trust

P3: A high level of trust amongst stakeholders leads to higher willingness to collaborate in the smart city ecosystem.

The positive influence of trust amongst stakeholders on the willingness to collaborate is established in each interview. It is said that a basic level of trust is expected when collaborating in a similar smart city ecosystem, but the level of trust can be enhanced by transparency and openness of stakeholders incentives. First, an environment must be created where stakeholders are open about their incentives to collaborate. Openness enhances a mutual understanding between stakeholders and allows conflicting objectives to be managed. In particular for sharing data, the stakeholders require a high level of trust in order publish data on the urban data platform and thus collaborate in the smart city ecosystem. The critical reflection the proposition thus leads to the following hypothesis:

Hypothesis 3: Trust amongst stakeholders has a positive influence on the willingness to collaborate in the smart city ecosystem.

6.1.4 Proposition 4: Platform standardization

P4: A higher level of platform integration and standardization leads to higher willingness to collaborate in the smart city ecosystem.

Concerning the urban data platform in smart city ecosystems, the level of integration and standardization has a positive influence on the willingness to collaborate. Standardization can be obtained through open standards which define aspects of data on the platform and allow for integration with other platforms. Cross-platform integration allows for multiple use of data sources and replication of developed services, which potentially leads to new business cases for stakeholders. Open standards also contribute to the overall level of trust in the platform, as well as security and transparency of the platform. The critical reflection the proposition thus leads to the following hypothesis:

Hypothesis 4: The level of platform integration and standardization has a positive influence on the willingness to collaborate in the smart city ecosystem.

6.1.5 Proposition 5: Data monetisation

P5: An existing vision on the monetisation of data leads to higher willingness to collaborate in the smart city ecosystem.

Interviewees have not mentioned the existence of an existent business model on sharing data on the urban platform. Though the financial benefits of smart city collaborations certainly impacts the willingness to collaborate, the current view on monetising data has lacked. Interviewees have mostly mentioned selling their data in the long-term perspective, referring to potential financial benefits at a later stage. A reason for this might be the funding Ruggedised currently receives. Therefore, the necessity for business stakeholders to pre-determine a business model on their data is to a limited extend. There is thus no proof that the vision of data monetisation leads to a higher willingness of business stakeholders to collaborate. However, the aspect of data monetisation is implicitly included in the perceived financial benefits described in proposition 2.

6.1.6 Proposition 6: Data quality

P6: A higher quality of data leads to higher willingness to collaborate in the smart city ecosystem.

The willingness to adopt the urban data platform and thus collaborate in the smart city ecosystem is positively influenced by a higher quality of the data. The quality of the data affects the usability of the data and the platform. Data users have expressed the preference for real-time data, whereas data providers mentioned that the ability to deliver the data might work as a constraint. The better the characteristics of the available data match expectations of data users, the lower the barrier to create solutions on the urban data platform. The critical reflection the proposition thus leads to the following hypothesis:

Hypothesis 5: The quality of data has a positive influence on the willingness to collaborate in the smart city ecosystem.

6.1.7 Proposition 7: Clear platform governance

P7: Clear governance rules on data ownership and data use leads to higher willingness to collaborate in the smart city ecosystem.

Clear platform governance has been expressed to be a positive influence on the willingness to collaborate in the smart city ecosystem. Given the fact that collaborations over the platform often encounter working with sensitive information, the demand for open standards and regulations has been established. By enabling the data provider to make its own decisions and conditions on data sharing, a sense of ownership is created which encourages data sharing. Furthermore, the existence of clear conditions for collaboration and the consistent use of contracts between stakeholders to define the terms of collaboration have are expected to facilitate the adoption of the urban data platform and thus enhance collaboration. The critical reflection the proposition thus leads to the following hypothesis:

Hypothesis 6: Clear governance rules on data ownership and data use have a positive influence on the willingness to collaborate in the smart city ecosystem.

6.1.8 Proposition 8: Innovation enabling conditions

P8: The presence of innovation enabling conditions leads to higher willingness to collaborate in the smart city ecosystem.

The presence of some factors have been identified to have a positive influence on the willingness to collaborate of business stakeholders, referred to as innovation enabling conditions. The existence of an experimental environment with financial support drives collaboration amongst stakeholders. It limits the necessity of early-stage investments as well as the overall individual risk to participate. Further, as soon as the projects start to take off and collaborations prove to be fruitful, it is expected that other parties will join and the overall willingness to collaborate increases. Lastly, the presence of intrinsic enthusiasm to work in collaborative projects and to share knowledge is mentioned as a driver for collaboration. These factors are expected to gain more influence over time. The critical reflection the proposition thus leads to the following hypothesis:

Hypothesis 7: The presence of innovation enabling conditions has a positive influence on the willingness to collaborate in the smart city ecosystem.

6.1.9 Proposition 9: Role on platform

Proposition 9: The perception of influencing factors depends on the role of business stakeholder on the urban data platform.

The influence of the stakeholder role on the urban data platform has been assessed. On the urban data platform of Ruggedised, most stakeholders are both a data provider as a data user. For the purpose of answering this proposition, the interviewees were asked to identify themselves with the most representable role. An overview per interviewee can be found in Table 4 in section 4.2.3. By assessing the responses according to their platform role, a slight moderating effect became apparent.

The table below presents the difference in perception of the relevant findings of this study.

Proposition	Data user	Data provider
Integrated vison	All stakeholders share data	Understanding of benefits of collaboration
Perceived outcomes	Arising business opportunities	Future cashflows from sharing data on platform
Trust	Trust in longevity and continuity of the urban data platform Trust that the data will be available anytime	Trust in security of the urban data platform
Platform standardization	Open standards to create replicable solutions Data accessibility and findability	Ease of publishing data on the urban data platform Prevent from lock-in
Data quality	Real-time and up-to-date data sources to develop solutions	Open standards match data type of organization
Clear governance	Contractual agreements which define roles and responsibilities	Ownership of data and in control of who may access Clear conditions to participate on the platform

Table 8 Perceptions per role on platform

Concluding from the table, there exists a tendency of different perspectives from the stakeholder platform roles. When it comes to the influencing factors of willingness to collaborate, the data users generally focus on the usability of the data and the interoperability of the platform, as well as strong contracts to define the terms of agreements and divide the responsibilities in the project. On the other hand, platform providers emphasize the need for an easy to use platform and clear governance on the platform, enabling data ownership and liberty to set own conditions for data access. However, these findings only indicate a slight preference as most stakeholders are or aspire to execute both roles on the urban data platform.

6.1.10 Constraining factors

Throughout the interviews several constraining factors were identified, which will be called contextual constraints. These constraints were mentioned as having an unwanted effect on the willingness of business stakeholders to collaborate in smart city ecosystems. The constraints can be subcategorized into two main categories, namely the constraints which can be linked back to previously defined factors and other constraining factors.

First, some constraints which are mentioned are the result from a lacking driver of the ecosystem. These constraints will be mentioned as they give deeper insights in the necessity of the drivers, but can easily be managed by the local government. The first conclusion which can be drawn is the need of a better understanding of the smart city ecosystem and the urban data platform. The unclear reason to share data was mentioned frequently by interviewees, reflecting the need for additional explanation on the urban data platform. To illustrate, although the platform provider says it allows stakeholders to maintain control over their own data and monitor the level of access, interviewees have repeatedly expressed the need of this feature. Related to the unclear reason to share data is the perceived unclear vision of the local government. A lack of vision may result in a lower level of trust amongst stakeholders and thus negatively affecting the willingness to collaborate. Lastly, the excessive amount of public data, often outdated and not real-time, reflects in usability of data on the platform, which was previously discussed. Local government should invest in improving the quality of the data sources.

Second, some constraints have been identified which are independent from other influencers of collaboration. Stakeholders mentioned the occurrence of juridical complications, caused by the undefined shared responsibility and reliability in the ecosystem and information sharing processes. Also, with the General Data Protection Regulation (GDPR) is expected to complicate collaboration. It was also mentioned that some stakeholders value and prioritize Ruggedised considerably less than other stakeholders. This is said to have a limiting effect on the overall output, lower trust amongst stakeholders and thereby negatively influencing the willingness of other stakeholders to collaborate. Fear of a slow process is also mentioned as a constraining factor, this relates to the low level of commitment participating parties may give. As some stakeholders perceive collaboration as an ineffective and slow process, the willingness to collaborate may decrease.

To conclude, some inherent practices of stakeholders may complicate collaborations such as predetermined business models on data sharing or the use of self-developed APIs. The potential inflexible attitude of stakeholders is said to negatively impact the willingness to collaborate of the ecosystem as a whole. The local government should actively monitor the identified constraints and limit their impacts. The critical reflection the proposition thus leads to the following hypothesis:

Hypothesis 8: The presence of contextual constraints has a negative influence on the willingness to collaborate in the smart city ecosystem.

6.1.11 Role of local government

Previously, three main roles for local government were derived from academic literature, namely the funder, coordinator and regulator of the ecosystem. Concluding from the findings, there is not one particular role set out for the local government but government should perform them simultaneously. The role of funder was least mentioned by interviewees, this can be explained by the fact that Ruggedised is now funded by the Horizon 2020 program. There is however a task for local government to take the lead in organizing the funding as the initiative taker for the smart city project in general. Many interviewees mentioned the need for a manager of the system, referring to the roles of regulator and coordinator. Business stakeholders have established the need for an coordinating partner, stimulating collaborations on a continuous level and bringing together the different stakeholder perspectives and objectives. Also bringing new stakeholders to the table by creating a buzz. Further, some regulations and conditions need to be set in place in order for stakeholders to trust both the platform and each other. As a regulator the local government is expected to lead the development and monitor the outcomes.

6.2 Revised conceptual framework

In order to bring the reflections on the propositions and additional findings together, the table below summarizes the newly derived hypotheses.

Hypotheses
H1: An integrated vision amongst business stakeholders has a positive influence on the willingness to collaborate in the smart city ecosystem.
H2: A concrete view of the perceived outcomes for the organisation has a positive influence on the willingness to collaborate in the smart city ecosystem.
H3: Trust amongst stakeholders has a positive influence on the willingness to collaborate in the smart city ecosystem.
H4: The level of platform integration and standardization has a positive influence on the willingness to collaborate in the smart city ecosystem.
H5: The quality of data has a positive influence on the willingness to collaborate in the smart city ecosystem.
H6: Clear governance rules on data ownership and data use have a positive influence on the willingness to collaborate in the smart city ecosystem.
H7: The presence of innovation enabling conditions has a positive influence on the willingness to collaborate in the smart city ecosystem.

H8: The presence of contextual constraints has a negative influence on the willingness to collaborate in the smart city ecosystem.

Table 9 Hypotheses

From these hypotheses on the predefined propositions and additional findings a revised framework can be developed, presented in Figure 12. The purpose of this model is to support the local government and stakeholders to build, integrate and foremost sustain the smart city ecosystem along with the urban data platform. The model visualizes the effects of several constructs on the willingness of business stakeholders to collaborate. Some of the constructs relate strongly to the smart ecosystem, whereas others focus on the adoption of the urban data platform. The hypotheses can thus be categorized into ecosystem drivers and platform adoption drivers. As can be seen in Figure 12, there is a correlation between drivers of the ecosystem and the drivers of the adoption of the urban data platform. It can be said that in a high level of trust, integrated vision and existent perceived outcomes for stakeholders not only has a positive influence on the willingness to collaborate, but also the willingness to adopt the urban data platform.

Apart from the ecosystem drivers and drivers to adopt the platform, other influencers of the willingness to adopt exist. The presence of innovation enabling conditions has an accelerating effect on the overall collaborative power of smart city ecosystems, affecting the ecosystem and the platform collaboration. Contextual constraints however have a negative moderating influencing on the willingness of business stakeholders to collaborate.

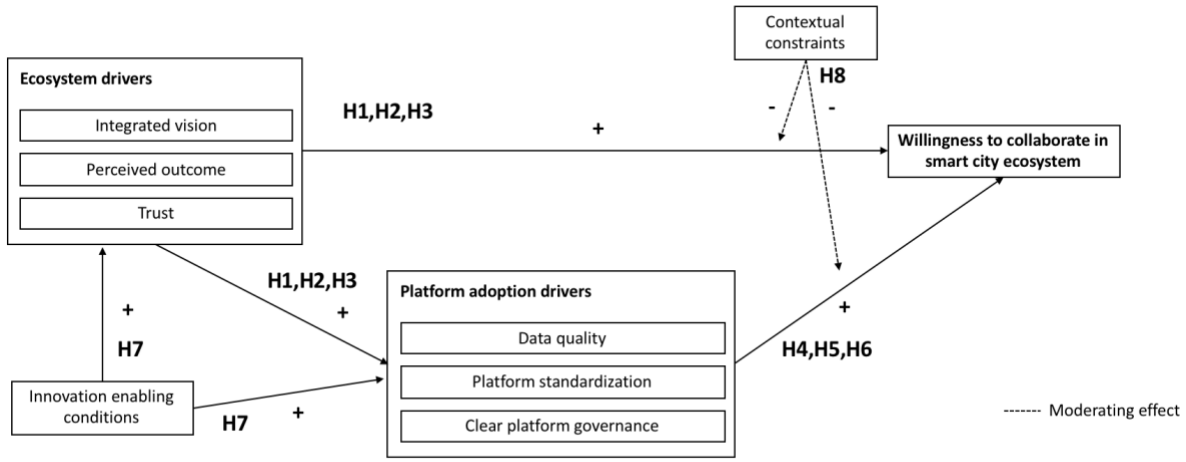

Figure 12 Conceptual framework

7 Conclusions

This section will provide an answer to the research question and sub-questions defined in the introduction. Then, the limitations, recommendations and implications for this study will be discussed, as well as recommendations for future research.

7.1 Conclusion

Over the last years, various researchers have studied the aspects of smart city collaboration and hereby the changing role of local government. However, considering the novelty and broad character of the topic, more research is needed (Edelstam, 2016; Nam & Pardo, 2011). This study has investigated the drivers behind the level of collaboration in the smart city ecosystem. It assessed which factors influence collaboration from the perspective of business stakeholders and formulated actions for local government to stimulate these. In previous research, the importance of collaboration for the performance of ecosystems was established. However, only limited research has examined the factors which influence the willingness of these stakeholders to collaborate. Consequently, an exploratory study was most suitable to answer the broad research question. A case study was performed on the Ruggedised project in Rotterdam, one of the cities from the smart city project funded under the European Union's Horizon 2020 programme. In order to answer the central research question, three sub-questions are formulated to support the main question.

Sub-question 1: What do business stakeholders perceive as key drivers for collaboration in smart city ecosystem?

The empirical findings have identified the three key drivers of collaboration in smart city ecosystems, namely the level of trust, perceived outcomes and integrated vision. These interrelated factors positively influence the willingness of business stakeholders to collaborate. The willingness to collaborate is highly affected by the level of trust, mutual understandings need to be in place in order for stakeholders to participate. Since roles and responsibilities of collaborations are often not precisely defined, the collaboration with sensitive data requires a high level of trust in the ecosystem. In addition to trust, the openness and transparency on individual objectives and the existence of an overarching purpose contribute to the overall drive work together.

Sub-question 2: What do business stakeholders perceive as key drivers for adopting the urban data platform?

After the analyses of the empirical findings, it can be concluded that there are three key drivers behind the adoption of the urban data platform, respectively quality of data, standardization of the platform and clear platform governance. Trust in the data platform is the key. Particularly the formulation of platform roles and responsibilities and existence of platform conditions enhance the overall trust in the platform, which leads to higher willingness to adopt the platform. Furthermore, a high level of stakeholder trust, perceived outcomes and integrated vision encourages the adoption of the platform.

Sub-question 3: Which role is expected from local government to facilitate collaborations in smart city ecosystems?

The empirical findings have established two dimensions for the local government in facilitating collaborations. Their responsibility lies essentially in creating innovation enabling conditions and elimination of contextual constraints. Choosing from the three identified roles for local government, the role of coordinator best encapsulates the responsibilities for local government. It mainly involves aligning stakeholders objectives, orchestrating collaborations and stimulating new smart city initiatives in the ecosystem. However, business stakeholders also expect the role of regulator in leading the development of clear platform conditions and regulations.

In addition to the influencing factors described above, some conditions were found. The presence of innovation enabling conditions stimulates the overall willingness to collaborate, whereas contextual constraints have a negative impact.

To conclude, this study has found that the main influencer of the willingness to collaborate of stakeholders is the level of trust. In the experimental setting of smart city ecosystems, stakeholders require openness and transparency from others. A high level of trust will stimulate stakeholders to commit to projects and invest in collaborations, which will lead to the successful realization of smart cities.

7.2 Recommendations for local government

In order for the local government to facilitate collaborations in the smart city ecosystem, several recommendations are formulated based on the findings of this study. The governance of smart cities is twofold. Local government should trigger the innovation enabling conditions, which lead to the stimulation of smart city collaborations. Also, local government should minimize the effect of contextual constraints, since these factors hinder collaborations.

In general, local government should concentrate on establishing a high level of trust in the ecosystem, both referring to stakeholder trust as to trust in the urban data platform. By establishing a high level of trust in the ecosystem, stakeholders are expected to have a higher motivation to contribute and develop new projects. Furthermore, a higher level of trust in the urban data platform will increase data sharing over the platform. Hence, the value of the platform will increase and this will have positive implications for the level of collaboration. The table below specifies the desired actions for local government to foster the willingness of stakeholders to collaborate, categorised in several stages of priority.

First, some actions are formulated to be performed during an ideation session with the current stakeholders. The aim of this session is to improve understanding of collaborations and the urban data platform. By leading the conversation on personal objectives, the local government will make the first steps towards a more transparent and open ecosystem. Subsequently, the short-term recommendations should be implemented, reflecting several follow-up actions to simulate the collaborative environment. The last section of recommendations focuses on the long-term maintenance of the smart city ecosystem.

Ideation session	-	Making individual objectives transparent and visible for all stakeholders in the ecosystem
	-	Establish set of collaborative principles enhancing the overall understanding of collaborations
	-	Divide roles and responsibilities for existing projects
	-	Create a understanding of the functionality of the urban data platform for all stakeholders
Short-term focus	-	Develop a smart city vision which encapsulates the individual objectives
	-	Make benefits of collaborations and data sharing concrete through success stories
	-	Establish set of platform regulations together with stakeholders
	-	Eliminate partners which show inflexibility and unwillingness to collaborate

Long-term focus	-	Monitor the stakeholders concerning regulations on the platform
	-	Drive contribution of each stakeholder to equal speed and volume
	-	Create buzz around smart cities to attract other stakeholders to ensure the continuity of the ecosystem
	-	Promote, sustain and adjust smart city vision according to ecosystem's needs

Table 10 Recommendations for local government

7.3 Limitations

There are several limitations to this study. First, the scope of this research was solely focused on one smart city ecosystem. As this study performed a case study on the smart city project in Rotterdam, as part of the EU Ruggedised project, the generalizability is reduced. There are multiple factors inherent to Ruggedised which may have influenced the outcome of this study. It could be that the stakeholder attitude towards collaboration is influenced by specific traits of the culture of the Netherlands or Rotterdam. Furthermore, the results might have differed if another smart city case was chosen. Cities which are developed according to different frameworks or architecture may provide different results, as well as cities which are in a different phase of development. It is likely that other cases encounter different issues, thus further research could with different smart city cases would increase the generalizability and scope of this study.

Second, several limitations are linked to the sample of interviewees in this study. The interviewees were all previously or currently involved in a smart city ecosystem, not taking the perspective of potential or aspiring stakeholders into account. More importantly, private organizations who reject the idea of smart city collaborations could give useful insights on this topic. Also, even though the grounded theory has no specific requirements for the sample size, one may argue that the theoretical saturation has not been reached. In this study, one individual has been chosen as the representative for the organisation. Further research could expand this sample by taking various interviewees per stakeholder. Lastly, as smart city collaborations are relatively new many of the interviewees referred to the same examples and experiences. Therefore some of the responses might reflect a similar one-sided point of view.

Third, some final limitations are due to the novelty and broad scope of the topic of this study and the applied research method. Given the exploratory characteristic of this study, the findings are rather abstract. The constructs describe a broad aspect of collaboration, but these occur at a relatively high-level. In order to draw more precise conclusions on smart city collaborations, each construct could be assessed individually. Furthermore, there are some limitations related

to the methodology. Interviews are vulnerably to be biased caused by unintentional verbal and non-verbal expressions of the researcher, potentially leading towards a desired outcome. Also other interviewee biases may occur such as emotional satisfaction or altruism influencing the responses. In addition, the responses of the interviewees mostly reflect the attitude towards collaboration instead of actual behaviour. Lastly, the semi-structured interview technique does not have explicit rules on how to interpret the collected data, which could lead to a less objective interpretation of results.

7.4 Implications

The insights from this study lead to several implications. The main value of this study lays in the link between the drivers for collaboration in the ecosystem and the implications for smart city governance to foster interactions between stakeholders. These findings are relevant for both academic and managerial purposes.

To begin with, the study holds several managerial implications. First, the presented conceptual framework could serve as a base for the development and maintenance of smart city ecosystems. The model encapsulates factors which are most prevalent in influencing the willingness of business stakeholders to collaborate. With this knowledge, local government will be able to stimulate favourable circumstances and fight contextual constraints in the ecosystem. In addition, the recommendations for local government include several actions for local government to undertake. These actions are expected to foster collaborations in the ecosystem and facilitate adoption of the urban data platform. At first the local government and other stakeholders might encounter difficulties in implementing the actions, as change often come with resistance at first. Implementing the recommended steps requires commitment and effort from all stakeholders.

Further, this study also holds several academic implications. The presented theoretical framework contributes to the existing academic literature and helps to model the emerging smart city ecosystems. Through conducting interviews this study has identified the main drivers of the willingness to collaborate in the ecosystem. The findings also shed a light on the implications for stakeholders to share data on the urban data platform. Literature on the implementations of urban data platforms is limited, so this study also contributes to this precise field of research.

7.5 Recommendations for further research

Though this study has provided some valuable insights on the willingness to collaborate in smart city ecosystems from a business perspective, some ideas for further research have risen. This study has identified various factors influencing the collaboration in the ecosystem and the adoption of the data platform, as well as provided some recommendations for the role of the local government. First, considering the broad scope of the topic, researchers can further investigate the influencing factors of collaboration. This can be done by doing in-depth research on each construct. In particular the existence of trust was repeatedly emphasized by interviewees, additional studies could determine which factors foster the level of trust and which actions must be undertaken to create and maintain an environment of trust.

Also, the standardization of the platform and open data standards have been identified as an important determinant of platform adoption, researchers could build upon this knowledge and assess which standards are ought optimal for collaborations in the smart city ecosystem. Additionally, some aspects of roles on the urban data platform require clarification, especially concerning ownership and governance. The questions in smart cities are often raised about which stakeholder is in control of the platform. It could be valuable to assess the different perspectives on this matter. Further research could formulate clear strategies for the platform provider and platform manager, the local government, to help the coordination and regulation of the urban data platform.

Moreover, even though this study has shed a light on the perceived importance of each construct, it would be valuable to identify the level of urgency and importance for stakeholders. This could be used for local government to prioritize its actions to facilitate collaboration more effectively. Also, this study provided first order recommendations to foster collaborations, more research is needed to provide further guidance in facilitating collaboration by designing an action plan or formulating concrete actions.

Lastly, in this study some constraints were identified which limit the extent to which stakeholders are able and willing to collaborate. Additional research can elaborate on the root causes for these constraints and determine steps to avoid the occurrence. For example, while this study has established the need from local government to drive stakeholders to an equal level of contribution and speed up the process, further research could elaborate by determining how this could be done.

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Appendix

Appendix A. Interview protocol

According to the interview techniques described by Gill, Stewart, Treasure & Chadwick (2008), the interview protocol was developed. Several recommendations for the interviews were considered during the data collection process:

- An introduction on the study were provided before the interviews took place, giving directions and setting expectations
- All interviews were recorded, transcribed within two days and sent to the interviewee for revision
- Notes were written down during each interview to help interpretation and understanding of certain topics
- Additional documents were consulted to support the given responses

Furthermore, a list of interview questions were defined before the interviews, providing a structure throughout the interviews. The questions are provided below:

Introduction

- Thank you for your time and effort
- Research question and intention of interview
- Permission for recording

Context

- What is your role within the organisation?
- What is your role in the Ruggedised project and what would be your role on the urban data platform? (data provider or data user)

In general

- What is a smart city in your opinion? And an urban data platform?
- Which conditions are necessary for smart city collaboration?
- What is a potential reason not to collaborate or not to share data on the urban data platform?

Specific factors

- What is the shared vision on the Ruggedised project? How important is it to have one?
- To which extend are the perceived outcome of each party outspoken? How important is it this?
- How important is trust between partners? Can this be facilitated? How?
- How important is the existence of a clear business model for collaboration in the ecosystem?
- How does openness of the platform affect collaboration?
- In which ways does standardization and integration of the platform affect collaboration?
- To which extent does the quality of data influence collaboration?
- To which extent do agreements on collaboration and sharing data play a role?
- How would you foster an innovative ecosystem and what could government do to facilitate this?
- To which extent does the open attitude of the local government play a role in collaboration in the ecosystem?
- Which role could local government take (regulator, funder, coördinator)?
- What is the main requirement for business stakeholders to adopt the urban data platform?

Closing

- Are there any additions?
- Do you have useful documents or contacts?
- I will provide you with the transcript
- Thank you for your time

Appendix B. Validity and reliability measure

Test	Literature guidelines	Application in this paper
Construct validity	Multiple sources of evidence	Interviews with multiple stakeholders Additional use of other sources
	Establish a chain of evidence	All data is cross-referenced to the source
Internal validity	Pattern matching	Corresponding findings across interviews strengthens validity Building on theoretical propositions
External validity	Use of academic theory	Fit between data analysis and existing theory
Reliability	Study protocol	An interview protocol is developed (see Appendix A)
	Study database	Each interview is recorded and transcribed and additional notes are taken during the interviews

Table 11 Validity and Reliability

Appendix C. List of codes

Name	Groundedness
/Advice create trust	3
/C Business model on their data	2
/C Business versus technical language	1
/C Conditions before willing to share data	2
/C Data type matches requirements	1
/C Excessive amount of public data	4
/C Fear of slow process	4
/C Juridical complications	6
/C Level of priority	3
/C Limited vision government	2
/C Little understanding of the platform	2
/C No sense of urgence	3
/C Technical ability to deliver data	1
/C Technical capacity local government	4
/C Unclear reason to share data	8
/C Unclear smart city vision	3
/Constraint	0
/E Successful examples	9
/Enabler/nice-to-have	1
/Ideation Session	10
/Main requirement	9
/Quote	2
/R Create buzz around smart cities	3
/R Silo cooperation	2
/Role data provider	6
/Role data provider/local government	5
/Role local government	27
1 Incentives align with overall goal	7
1 Understand need for collaboration	6
1 Understand overall purpose	3
1/ Integrated vision	0
2 Arising business opportunities	5
2 Being part of the future of data	4
2 Complementarity businesses	4
2 Financial benefits	7
2 Gain and share knowledge	3
2 Specific use case	8
2/ Perceived outcome	0
3 Transparant individual incentives	10
3 Trust in longevity of collaboration	4
3 Trust in partners	6
3/ Trust	0
4 Cross-platform integration	10

4 Data accessibility/findability	1
4 Platform openness	2
4 Platform transparency	2
4 Standardization	3
4 Trust in security of platform	3
4/ Platform standardization	0
5 Future business model perspective	4
5/ Data monetisation	1
6 Ease of use	3
6 Fit for purpose	4
6 Real time	2
6 Security/privacy	2
6 Usability	8
6/ Data quality	0
7 Contractual agreements	12
7 Platform conditions	9
7 Platform roles	6
7 Sense of ownership	5
7/ Clear data governance	0
8 Ability to innovate	3
8 Enthusiasm for collaboration	3
8 Risk-free environment	7
8/ Innovation enabling factors	0
Codecision on condition development	1
GDPR	1

Appendix D. Example from code report from Atlas.ti

Innovation ecosystem

4 Codes:

- **8 Ability to innovate**

  Quotations:

  1:15 Qua technologie wil je sommige duidelijke standaarden creëren, maar voor de innovatie is het bevorde…

  1:25 Het is dus goed dat je wel kaders stelt waarbinnen co-creatie plaats kan vinden om de kans op uitvoe…

  7:20 Je moet het platform met zo min mogelijk structuur aanbrengen, zie het zoals lego blokjes. Ze hebben…

- **8 Enthusiasm for collaboration**

  Quotations:

  2:25 Die gelaagdheid om samen te willen werken, moet er wel inzitten

  7:3 warm en fuzzy feeling krijgen van samenwerking in het algemeen

  7:23 Er moet een gezamenlijke wil zijn, die er overigens vaak is. Wanneer er weinig overlap/concurrentie…

- **8 Risk-free environment**

  Quotations:

  1:2 Developing a vision all together and experimenting in small group what a smart city could look like.

  1:21 Wat wel helpt is dat we het op een kleine schaal gaan uitproberen en zo mogelijk wat eerste resultat…

  1:32 bijvoorbeeld het CO2-neutraal maken van een gebouw of verbeteren van het leefklimaat in een gebouw,…

  2:6 Uiteindelijk gaat het erom dat ze de voordelen zien, op welke manier dan ook, dit kan financieel zij…

  6:21 De eerste stap is inzicht op het data delen en vervolgens moeten er euro's tegenoverstaan om dat te…

  7:19 als de funding er niet zou zijn zou er niet veel van de grond komen. De partijen die over een aantal…

Bart: Ja dat is belangrijk. Samenwerking is tussen mensen, die machines en computers staan er alleen omdat de mensen ze gebruiken. Mens moet overeenkomen, zo worden standaarden gemaakt. Er moet een gezamenlijke wil zijn, die er overigens vaak is. Wanneer er weinig overlap/concurrentie is en inzicht over dat ze er samen uitkomen, dan lukt dat zonder heftige contracten. Strenge afspraken eindigen alleen bij advocaten.

7:10 Sam...
3 Trust in partners

7:23 Er...
7 Contractual agreements
8 Enthusiasm for collaboration

Marilou: Niet contractueel dus?

Bart: Tuurlijk moet je basis zaken vastleggen maar je moet niet beginnen met het “streng” monitoren van dit soort zaken. Dit doe je enkel bij wantrouwen of wanneer je een partij niet kent.

7:11 Tuurl...
/ROLE LOCAL GOVERNMENT
7 Contractual agreements

Marilou: Hoe creëer je een omgeving zonder wantrouwen?

Bart: Omdat het een niet-operationele omgeving is kan men vrij experimenteren zonder er zelf veel in te investeringen of een groot risico te lopen. Ik vraag me af hoe dat in operationele omgevingen gaat gaan. Er zit in het Horizon 2020 project nu geen resultaatgebondenheid. In de toekomst, als het zo is als we zeggen, dan gaat het op een gegeven moment wel zo zijn dat we afspraken maken over het datagebruik.

7:25 Er zit in...
/C Level of urgency and priority
7 Contractual agreements

Marilou: Duidelijk! Denk je dat de kwaliteit van de beschikbare data een rol speelt?

Bart: Zeker een basiskwaliteit moet je hebben, alles wat meer is is nice-to-have. Maar initieel gaat het om de fit for purpose, kwalitiet hangt af wat je er ook mee kunt doen.

7:12...
6 Fit for purpose

Marilou: Dus eigenlijk de flexibiliteit wat je met de data kunt doen

Appendix E. List with original quotes

1 Je moet altijd als uitgangspunt nemen wat nou de te beantwoorden vraag is, dat gaat in mijn optiek zo vaak fout.

2 Smart city toepassingen dienen veelal een algemeen belang en zijn niet altijd terug te brengen naar een individueel voordeel.

3 Als je echt wil samenwerken met elkaar wel. Uiteindelijk gaat het erom dat ze de voordelen zien, op welke manier dan ook.

4 Door het delen van de verantwoordelijkheid en de financiële doelen zijn de partijen nog niet genoeg gemotiveerd grote stappen te zetten, iedereen doet nu zijn eigen ding op een rustig tempo zonder echt hard te werken.

[5] We gaan samen data uitwisselen" als grootste doel

6 Instinctief denk ik dat we deze visie nu aan het creëren zijn en op kleine schaal aan het ontdekken zijn hoe zo'n (slimme) stad als Rotterdam eruit zou kunnen zien.

7 je doet dit eigenlijk omdat je gelooft in de toekomst van deze samenwerkingen. Je wilt wel aangehaakt zijn, ook al komt er nu nog niet veel uit.

8 Smart city toepassingen dienen veelal een algemeen belang en zijn niet altijd terug te brengen naar een individueel voordeel. Als je gaat redeneren vanuit alle individuele baten kom je vaak niet verder.

9 Gedeeltelijk, je hebt een gezamenlijk doel maar verder heb je ook individuele belangen. Dat kan financieel zijn maar ook beleidsdoelstellingen of andere belangen. Als het goed is, is er overlap.

10 Coördineren als gemeente is onwijs belangrijk. Iedereen heeft zijn eigen interpretaties, motivaties en verleden maar het combineren van al die begrippen is cruciaal. De grote vraag is hoe je ervoor kunt zorgen dat verschillende mensen met verschillende achtergronden in verschillende projecten met elkaar kunnen samenwerken aan een onderwerp zodat het beter aansluit.

11 Dit doen ze door partijen samen te brengen en vraagstukken neer te leggen.

12 Maar mocht je een duurzame relatie met elkaar willen opbouwen, ga dan ook echt opzoek naar de raakvlakken en doelen.

13 Vanuit KPN hebben we bijvoorbeeld ook concrete use cases bedacht die het de voordelen duidelijk maakte.

14 Als het voor alle partijen financieel aantrekkelijk is.

15 Er zijn nog genoeg partijen, met name in de traditionele business, die zitten nog onwijs op hun data en wachten tot het duidelijk wordt hoe ze geld kunnen verdienen met delen.

16 Het is op dit moment nog zo vroeg dat het me sterk ljikt als je echt van tevoren al weet hoe je er geld aan gaat verdienen.

17 De reden dat de partijen hun data op het platform zetten is dan dat men toch wel weet dat ze er uiteindelijk geld voor kunnen verdienen of iets dergelijks.

18 Het doel is dat partijen uiteindelijk verder kijken dan de eigen single use purposes. We denken dat de crux ligt bij het leggen van verbindingen, 1 en 1 is 3.

19 Vertrouwen is ontzettend belangrijk. Samenwerking is tussen mensen, die machines en computers staan er enkel en alleen omdat de mensen er gebruik van maken.

20 Als partij X zegt dat ze op een bepaald onderdeel geld willen verdienen of hun data enkel met een bepaalde partij willen delen, dan is dat mogelijk zolang de belangen op tafel bekend zijn

21 Belangen zijn nu een taboe. Stel dat je een project wil gaan doen met allerlei informatie, dan is het belangrijk om vooraleer je in zo'n project stapt dat je van elkaar weet wat de eisen zijn.

22 Daarnaast moet je ook vertrouwen hebben in de partij achter het platform en wat er met de data gebeurt. Daar zijn we nog niet, het is onduidelijk wat er met de data gebeurt.

23 Voor een project is het belangrijk om te weten wanneer je een product op data ontwikkelt is dat de data er volgende week ook nog is, is het toekomstvast.

24 Een open platform waar allerlei partijen met elkaar services gaan uitwisselen en waar de data de brandstof is. Het doel is een generiek platform met gestandaardiseerde data waar vervolgens iedereen een service op kan ontwikkelen.

25 Het doel is een generiek platform met gestandaardiseerde data waar vervolgens iedereen een service op kan ontwikkelen.

26 Het eerste wat belangrijk is, is het besef dat er niet 1 platform is. Het wordt een federatie van systemen.

27 Verder is voor het delen van data afspraken over het gebruik van open datastandaarden essentieel.

28 Ten tweede is de balans houden tussen het juridisch dicht timmeren en het openhouden van spelregels lastig.

29 De kwaliteit van data is natuurlijk een breed begrip, het gaat om hetzelfde standaard van gebruik of van ontsluit etc.

30 Er komt veel bij want de gemeente integreert IT componenten in nieuwe projecten, maar we lopen nog vaak tegen rommelige, verouderde databronnen aan.

31 Vroeger ging het over een open data portaal maar dat betrof dan een omgeving met tienduizend Excel bestandjes waar we niks aan hadden. Het draait om de kwaliteit van data

32 Een data infrastructuur die streeft naar real-time data, het wordt dus steeds belangrijker dat je weet wat je met de data wil en dat data real time is wordt ook steeds belangrijker.

33 Het hangt er ook vanaf hoeveel moeite je moet doen om de data te leveren en je er verder ook niet iets aan hebt, dan motiveert me dat niet.

34 Je hebt wel contracten nodig die de verantwoordelijkheden, kosten, baten etc. vastleggen. Als dat niet duidelijk is dan lopen de belangen niet synchroon en dan is het heel moeilijk om dezelfde motivatie en tijdsdruk te krijgen.

35 Er moet een gezamenlijke wil zijn, die er overigens vaak is. Wanneer er weinig overlap/concurrentie is en inzicht over dat ze er samen uitkomen, dan lukt dat zonder heftige contracten.

36 In principe vertrouwt iedereen elkaar maar als er echt wat geregeld moet worden wordt het toch vaak op papier gezet.

37 Tuurlijk moet je basis zaken vastleggen maar je moet niet beginnen met het “streng” monitoren van dit soort zaken. Dit doe je enkel bij wantrouwen of wanneer je een partij niet kent.

38 Ja als het begrip er is van goh wie doet nu welke rol, met betrekking tot verstand van elke partij.

39 Als je gewoon begint vanuit een partij die een duidelijke rol op zich neemt, en vervolgens de andere partijen laat pitchen waarom ze dan wel een andere rol zouden moeten innemen.

40 Het gaat erom dat je een omgeving creëert, die de mogelijkheden en het vertrouwen geeft, om zelf de condities en partijen te bepalen waaronder je data wil gaan delen onder jouw voorwaarden.

41 Het feit dat je altijd zelf controle over je data toegang houdt zorgt ook voor dat je nooit een zogenaamde ‘data lock in’

42 Elke provider krijgt zijn eigen ‘hangar’ waar je zelf aan de knoppen blijft zitten. Data governance is een heel belangrijk stukje, je kunt aangeven in welke omstandigheid iemand jouw data kan gaan gebruiken.

43 Daarnaast moet je ook vertrouwen hebben in de partij achter het platform en wat er met de data gebeurt. Daar zijn we nog niet, het is onduidelijk wat er met de data gebeurt.

44 Dan weten de partijen wat er te halen valt, dan gaan de mogelijkheden meer leven en weten partijen elkaar meer te vinden.

45 Want dat is echt de crux, op dit moment is het echt gefundeerd door Europa. Vervolgens wat je ziet gebeuren is dat het zich organisch gaat ontwikkelen en er komen nu partijen bij die zich willen mengen met nieuwe diensten.

46 maar als je dat belang niet financieel gaat waarderen zullen individuele partijen daar niet zo snel in willen investeren. Dus in die zin kunnen partijen wel een zetje in de rug gebruiken van de gemeente, als funder, omdat de gemeente wel dat algemene belang voor ogen heeft en daarin kan investeren.

47 Bij de partijen nog niet voldoende prioriteit krijgt, dat komt ook voort uit nog onvoldoende kennis over wat een dataplatform zou kunnen betekenen voor de organisatie of de stad.

48 Er zit in het Horizon 2020 project nu geen resultaatgebondenheid.

49 Door het delen van de verantwoordelijkheid en de financiële doelen zijn de partijen nog niet genoeg gemotiveerd grote stappen te zetten, iedereen doet nu zijn eigen ding op een rustig tempo zonder echt hard te werken.

50 De Europese wetgeving kan onwijs belemmerend werken op de samenwerking, zo moet bijvoorbeeld bij een aanbesteding een minimum aantal van 5 partijen gevraagd worden. Dit is onwijs beperkend omdat wij van sommige specifieke taken al perfect weten wie er geschikt is.

51 Vroeger ging het over een open data portaal maar dat betrof dan een omgeving met tienduizend Excel bestandjes waar we niks aan hadden. Het draait om de kwaliteit van data

52 Van tevoren helder krijgen wat de gewenste uitkomst is van het delen van data en commitment ook echt vastleggen zodat je elkaar er ook aan kan houden.

53 Het gaat erom dat je een omgeving creëert, die de mogelijkheden en het vertrouwen geeft, om zelf de condities en partijen te bepalen waaronder je data wil gaan delen onder jouw voorwaarden. Dat is waar het spel zit, langzaamaan dat vertrouwen creëren.

54 De drempels zijn in het begin best hoog, wat gaat ermee gebeuren en hoe dan. Maar de reden om het uiteindelijk te doen is dat je het groter geheel snapt, door met meer informatie meer te bereiken in een project maar ook je eigen organisatie als geheel.

55 Het belangrijkste is dat je de belangen in acht neemt, elke partij is erbij met zijn eigen belang. Als je daar geen oog voor hebt heb je er niks aan.

56 Transparantie en vertrouwen zijn heel belangrijk. Open zijn waarom je dingen doet, met name omdat je verschillende types bedrijven hebt en iedereen dingen op een andere manier doet.

57 Als het voor alle partijen financieel aantrekkelijk is, voor sommige partijen dat het haalbaar is en voor sommige partijen value for money.

58 Weten dat de data er is, het moet vindbaar zijn en beschikbaar zijn. Dat is de hoofd bezorgdheid.

59 Het erg belangrijk dat de standaarden op elkaar aansluiten zodat er ook referentiearchitectuur ontwikkeld kan worden, dus op welke standaarden we gezamenlijk gaan handteren