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The Role of Multi-Stakeholder Collaboration in Building Trust in Urban Data Platforms

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The Role of Multi-Stakeholder Collaboration in Building Trust in Urban Data Platforms

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RUGGEDISED

Preface

Acknowledgement

I would like to use this opportunity and sincerely thank everyone who has guided and supported me throughout this research.

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Secondly, I would like to thank all participants of the case study for their time and contributions. Besides the academic value, these interviews gave me exciting insights into the way Urban Data Platforms are developed in different cities.

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Executive Summary

Technology is finding its way into cities around the world and offers new, intelligent ways of dealing with urban complexity. In many of these cities, the establishment of an Urban Data Platform represents a central building block on the way to becoming 'smarter' as a city (EIP-SCC, 2017). While several European cities have already implemented an Urban Data Platform and made it available to the city's ecosystem, a recent study shows that user adoption of these platforms is rather low (Van Oosterhout et al., 2020). Further, the same study reveals that trust in the platform by platform users and collaboration between the platform owner and other stakeholders represent important factors, which not only affect the development of these platforms but also their adoption (Van Oosterhout et al., 2020). Building upon these insights, this study explores the relationship between multi-stakeholder collaboration in the development of Urban Data Platforms and trust in Urban Data Platforms.

Due to the scarcity of available literature in the field of Urban Data Platforms, this study follows an exploratory research approach. As a starting point, conceptual constructs and propositions are derived from the academic literature on platform ecosystems, Smart City ecosystems and inter-organizational networks, setting the direction of this research. The analysis process consists of two stages. First, secondary data from two recent studies in the field of Urban Data Platforms are used to verify the conceptual constructs and establish relationships between these constructs. Second, case studies with three cities in Europe, namely Hamburg, Cologne and Vienna, are conducted to understand the underlying dynamics of how the involvement of different stakeholders influences the level of trust in Urban Data Platforms. The empirical results of these analyses are reflected in a comprehensive conceptual model that provides a sound basis for future research. The main findings of this study are:

First, through regular collaboration with the private and academic sectors, the municipality – as the platform owner – can increase the overall level of trust in the Urban Data Platform. Regularity is crucial here, as it signals continuity and the seriousness of the platform owner, which is well perceived by the platform users. Second, public trust in the government has emerged in the case studies as a new factor that substantially determines how citizens perceive the trustworthiness of an Urban Data Platform. If citizens are generally satisfied with developments in their city and trust their local government, this benefits acceptance and trust in the Urban Data Platform. Including citizens in the development of the platform represents

one way of increasing public trust in the government. Third, the municipality – as the platform owner – can actively enhance its platform-related capabilities by collaborating with specific stakeholders. These include a) the private sector, which provides technical expertise, b) the academic sector, which contributes strategic and governance advice, c) citizens, who add new service ideas and platform requirements, and d) platform owners from other Smart Cities, who provide best practices for developing an Urban Data Platform. Fourth, joint urban data projects between the public and private sectors can increase mutual trust between these parties. This in turn facilitates and strengthens further collaboration between these parties. Fifth, collaboration between the municipality – as the owner of the platform – and the academic sector is perceived as most beneficial at an early exploration and planning stage. In contrast, collaboration between the municipality and the private sector is perceived as most beneficial in later stages, when the platform is being implemented. Sixth, platforms users tend to evaluate three different aspects in terms of their trustworthiness, which collectively represent the overall level of trust in an Urban Data Platform. These include a) trust in the security of the platform, b) trust in the data quality, and c) trust in the governance of the platform owner.

Academically, this study bridges the gap between two concepts that have been little explored in the field of Urban Data Platforms, and outlines why and how these concepts are related. Furthermore, the conceptual model brings forth a number of new hypotheses that serve as a basis for future research. Managerially, the findings provide municipalities – as the owners of the platforms – with guidance on how trust in an Urban Data Platform can be increased by involving different stakeholders in the development of the platform. Given the positive relationship of trust in the Urban Data Platform and platform adoption indicated in earlier studies (RUGGEDISED, 2018; Van Oosterhout et al., 2020), this study might offer advice that could eventually contribute to an increased adoption of these platforms.

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1. Introduction

This is an exploratory study on the concepts of *multi-stakeholder collaboration in the development of Urban Data Platforms* and *trust in Urban Data Platforms*. In this study the relation between these two concepts is explored and a new conceptual model is generated. Section 1.1 outlines the motivation to conduct research in this field. In section 1.2 the prevailing problem is discussed which leads to the research question of this study in section 1.3. Then, section 1.4 elaborates on the theoretical and practical relevance of this study, and lastly, section 1.5 outlines the structure of this paper.

1.1. Motivation

More than half of the world's population lives in urban areas today (United Nations, 2019). The process of urbanization, in which people are shifting from rural areas to more urban areas, is expected to continue in the coming decades (United Nations, 2019). The rapid growth of the urban population in cities inevitably gives rise to all kinds of new challenges, ranging from areas such as public infrastructure to air pollution and waste management. Alongside this trend, globalization and emerging technologies create new opportunities for industries and cities to develop new digital services and business models (Weill & Woerner, 2015). More and more cities around the world are using modern technologies to create smarter ways of dealing with urban complexities and ensuring livable conditions. These cities are referred to as *Smart Cities*. Popular examples of cities transforming themselves into Smart Cities include Barcelona, Copenhagen and Paris (Ballesté et al., 2013). Despite various definitions of the term Smart City, it can generally be stated that a Smart City uses information and communication technologies (ICT) to improve the quality of life within an urban area (Giffinger & Gudrun, 2010).

The development of a Smart City usually involves a number of different stakeholders, which contribute, for example, knowledge, resources or technology. To deal with the complexity of today's urban life, governments and municipalities often turn to external sources and enter into collaborative partnerships with businesses, NGOs, or universities (Schütz et al., 2019). In addition, citizens are also often included in the design of new Smart City concepts in order to integrate a societal perspective (Borkowska & Osborne, 2018). These forms of collaboration provide a vehicle for cities to address emerging challenges and co-create new Smart City services (Edler & Georghiou, 2007).

A central step in becoming smarter as a city is the development of a city-wide *Urban Data Platform*. An Urban Data Platform is intended to integrate data from all urban systems and make it accessible to stakeholders within the ecosystem of a city (EIP-SCC, 2017). By considering data as a resource which can be turned into societal value, establishing an Urban Data Platform provides a source for innovation, community building and new Smart City services (EIP-SCC, 2017). However, a recent study on the state-of-the-art of Urban Data Platforms in European Cities reveals that the usage of these platforms by citizens and businesses is currently rather low (Van Oosterhout et al., 2020). Further, this study reveals that collaboration between different stakeholders and trust in the platform represent factors, impacting the development and adoption of these platforms (Van Oosterhout et al., 2020). As the stakeholders involved in the development of these platforms often become platform users themselves once the platform is launched, it can be assumed that stakeholder involvement in the development process will have a positive impact on the future trust of platform users in the platform. Based on this assumption and the insights of the study by Van Oosterhout et al. (2020), this research aims at further exploring the concepts of multi-stakeholder collaboration in the development of Urban Data Platforms and trust in Urban Data Platforms. The findings of this study contribute to the RUGGEDISED project, an EU-financed Smart City project held in Rotterdam and five other European Cities.

1.2. Problem Statement

The performance of an Urban Data Platform can be measured by the number of data users, the number of downloaded datasets, the number of service applications or the number of data providers on the platform (Van Oosterhout et al., 2020). In short, the number of actors adopting a platform plays a significant role in the success of an Urban Data Platform. While the mechanisms of general platform ecosystems and their success factors have been intensively studied (Tiwana, 2013), Urban Data Platforms represent a fairly new academic research field. Yet, available literature in both areas point to the importance of 'trust in the platform' by its users, as this influences their willingness to interact on a platform and to use the offered services (Ceric, 2018; Cohen et al., 2014; Das, 2018; Lee et al., 2017). In addition, recent studies within the scope of RUGGEDISED indicate a positive relationship between the level of trust in a platform and the adoption of a platform by platform users (RUGGEDISED, 2018). Finding ways to increase trust levels in Urban Data Platforms might therefore be a lever to eventually increase the adoption of these platforms.

Based on the responses from 66 Smart Cities in Europe, the before mentioned study by Van Oosterhout et al. (2020) reveals that 'Triple Helix collaboration' is considered by platform owners as the second most important factor in accelerating the development of an Urban Data Platform (out of 16 factors to choose from). While the importance of collaboration between government, industry and university, which form the so-called Triple Helix, is acknowledged in the creation of innovation ecosystems (Etzkowitz, 2008; Leydesdorff & Deakin, 2011), the role of Triple Helix collaboration in the context of Urban Data Platforms has so far received little attention by researchers. Recent Smart City literature and practical examples further suggest to include citizens as a fourth helix in the development of Smart Cities (Borkowska & Osborne, 2018). Therefore, this research on multi-stakeholder collaboration in the field of Urban Data Platforms takes into account all four stakeholders in order to obtain a complete picture and a thorough understanding of the subject.

1.3. Research Question

The main purpose of this study is to investigate the role of two important concepts within the field of Urban Data Platforms: *multi-stakeholder collaboration in the development of Urban Data Platforms* and *trust in Urban Data Platforms*. By adopting an exploratory research approach, the study seeks to explore and analyze the relationship between these two central concepts. Ultimately, a new conceptual model is generated which provides insights in an under researched area. The following main research question determines the direction of this research:

Which factors of multi-stakeholder collaboration in the development of Urban Data Platforms influence the level of trust in Urban Data Platforms?

In order to provide deeper insights into each of these concepts and to answer the main research question of this study, several sub-research questions are formulated:

i. How and why do these factors of multi-stakeholder collaboration influence the overall level of trust in Urban Data Platforms?
ii. In which trust components can the overall level of trust in an Urban Data Platform be decomposed?
iii. At which stages in the development of Urban Data Platforms is multi-stakeholder collaboration particularly beneficial?

When investigating these two concepts, it is important to note that stakeholders involved in the development of an Urban Data Platform, such as the municipality, private companies or citizens, may become users of the platform themselves, after the platform has been implemented. In fact, many stakeholders in an Urban Data Platform ecosystem take on both roles, once an Urban Data Platform is initially launched and accessible. To scale the platform and add new services to it, collaboration often continues. Furthermore, trust in the platform by platform users becomes particularly relevant after the platform is implemented. Nevertheless, public trust in ongoing urban data projects and mutual trust between the actors involved in earlier development stages might affect the future trust of platform users in the platform. These aspects are taken into account and are carefully examined in the course of this study.

1.4. Relevance

Platform and platform ecosystem have become prevalent terms in the business world over the past decades. At the same time, both subjects have received considerable attention in academic research (Lee et al., 2017; Tiwana, 2013), making them a well-researched field today. However, given the relevance of platforms and their broad applicability in society, different types of platforms can be observed, which differ, for example, in terms of purpose, business model or number of actors. Urban Data Platforms represent a rather new type of platform in the world of platforms. Since an Urban Data Platform is widely regarded as a central building block in the development of Smart Cities, more and more cities are implementing such a platform in their own city (EIP-SCC, 2017). Consequently, the attention of academic researchers has also turned to this topic in recent years. This is further accelerated by the fact that universities are often involved in Smart City research projects, as is the case with the RUGGEDISED project, and that these projects are frequently funded by larger organizations such as the European Union (RUGGEDISED, 2018).

While first studies point out the importance of collaboration between different organizations in the implementation of these platforms (RUGGEDISED, 2018; Van Oosterhout et al., 2020), there is lack of research further explaining the role of multi-stakeholder collaboration in the field of Urban Data Platforms. Furthermore, the level of trust users place in these platforms seems to have a substantial impact on the adoption of these platforms (RUGGEDISED, 2018). Since the stakeholders involved in the development of an Urban Data Platform in some way represent the various future user groups of the platform, or will become users themselves at

some point, a link between stakeholder engagement and trust in the platform is assumed. By investigating the role of these two concepts as well as the relation between them, this study contributes to the academic literature and offers new insights in this field.

Apart from that, this study addresses a practical problem that many of the Smart Cities in Europe currently face. Despite having an operational Urban Data Platform in place, user adoption of these platforms is often rather low (Van Oosterhout et al., 2020). Given the presumed link between trust in an Urban Data Platform and platform adoption (RUGGEDISED, 2018), a better understanding of how multi-stakeholder collaboration in the development of Urban Data Platforms affects trust in these platforms by platform users might help to eventually increase platform adoption. Therefore, the results of this study provide valuable insights for platform owners and stakeholders involved in the development of an Urban Data Platform.

Lastly, being conducted by a master student of Erasmus University of Rotterdam in collaboration with the municipality of Rotterdam, the findings of this study contribute to the Smart City project of Rotterdam as well as to the research project RUGGEDISED.

1.5. Outline

In the next chapter relevant literature regarding the central concepts of this study is reviewed. Chapter 3 elaborates on the conceptual framework that serves as a basis for the subsequent steps in this study. In chapter 4 the methodology that is used to collect and analyze data to answer the research question is explained. Chapter 5 and 6 analyze the data and present the results as well as the final conceptual model of this study. This is followed in chapter 7 by a discussion of the results, linking them to existing literature. Lastly, chapter 8 answers the research question and outlines the recommendations and limitations of this study.

2. Literature Review

This chapter examines the main concepts of Urban Data Platforms, multi-stakeholder collaboration and trust within the academic literature. Given the novelty of Urban Data Platforms, relevant literature on platform ecosystems and Smart City ecosystems is assessed in order to gain insights into the topic of platforms. The theoretical concepts reviewed in this chapter form the basis for the development of the initial conceptual model in chapter 3.

2.1. Urban Data Platforms

The first section discusses the concept of Urban Data Platforms, including its actors and objectives. Further, the different development stages as well as performance measurements of Urban Data Platforms are described. Due to the scarcity of academic literature on these platforms, insights from recent studies within the scope of RUGGEDISED are used in this section.

2.1.1. Concept, Actors and Objectives

Before examining the characteristics of Urban Data Platforms, it is helpful to briefly illustrate the concepts of platforms and platform ecosystems first, as Urban Data Platforms represent a particular type of such platforms. *Platforms* can be defined as an interface which facilitates the exchange of goods or services between different providers and consumers (Rochet & Tirole, 2003). Value is created by facilitating the interaction between different individuals, businesses or organizations. While platforms determine the way how interaction takes place and value is created, *platform ecosystems* can be seen as the entirety of actors participating on the platform to create value for one another in some way (Tiwana, 2013). *Platform users* in these ecosystems can be divided into *producers*, who supply the platform with input such as data or services, and *consumers*, who derive value from consuming the data or services provided on the platform (Tiwana, 2013).

Moving over to the platform of focus in this study, an *Urban Data Platform* represents a platform, which collects and integrates city-related data from various sources and makes it accessible to different actors within a city ecosystem (EIP-SCC, 2017). This way stakeholders from different sectors are brought together, including government, public sector, private sector,

businesses, NGOs, universities or citizens (EIP-SCC, 2017). A conceptualization of the ecosystem of an Urban Data Platform by Van Oosterhout et al. (2020) is displayed in Figure 1, including potential platform users and data streams on each side of the platform. The figure shows that the platform itself builds the center of the ecosystem, collecting data from various sources and providing it to a range of different actors in the city ecosystem. In the lower part of the figure, data sources and data providers are displayed, which represent the providers of the platform according to Tiwana (2013), whereas the upper part depicts data users, which represent the consumer side. As one side almost mirrors the other, it becomes clear that actors can take over both roles in the ecosystem of an Urban Data Platform. Additionally, data can be gathered from open data sources or from IoT sensors across the city, measuring, for example, the current traffic flow on the streets or the waste level in public bins (EIP-SCC, 2017; RUGGEDISED, 2018).

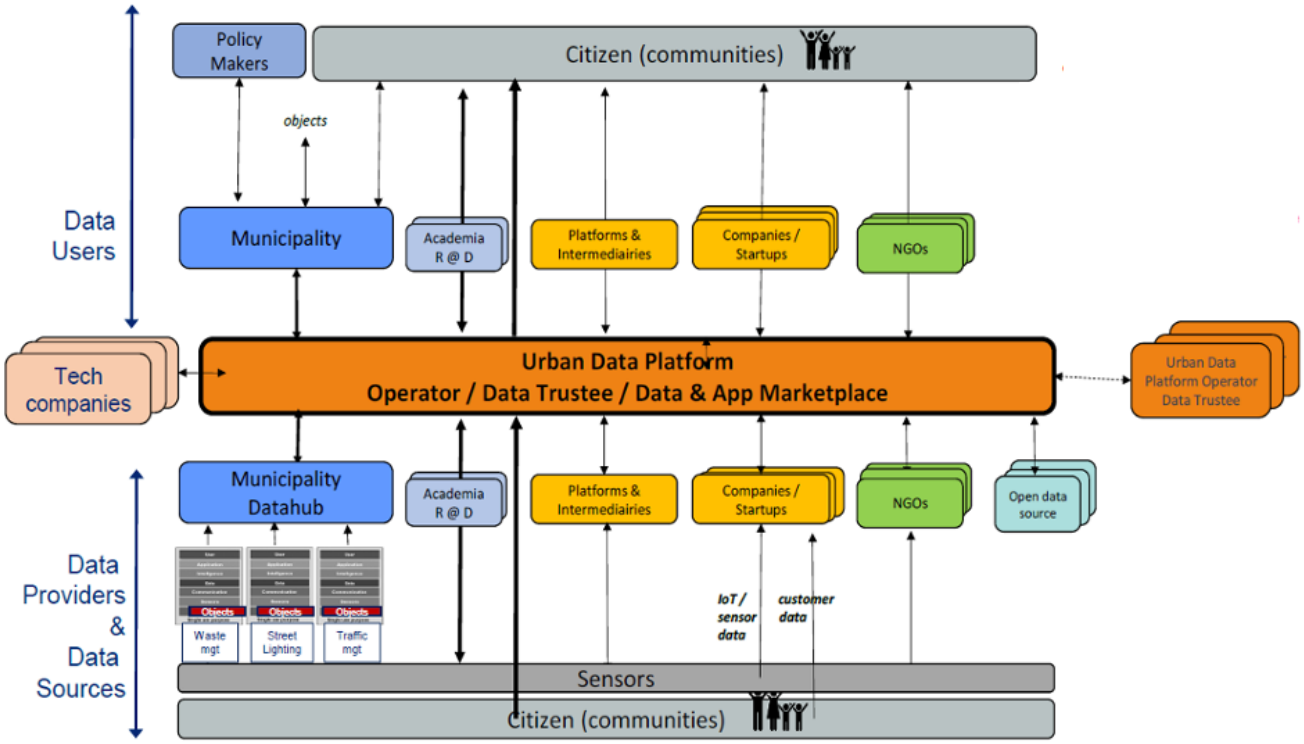

Figure 1: Conceptualization of an Urban Data Platform ecosystem (Source: Van Oosterhout et al., 2020)

The role of the owner of an Urban Data Platform can be performed by different actors and differs across Smart Cities in Europe (Van Oosterhout et al., 2020). Based on the responses of

66 Smart Cities in Europe, which all engage in developing an Urban Data Platform, the study by Van Oosterhout et al. (2020) shows that the municipality owns the platform in 66% of the cases, followed by public-private partnerships (18%), and private companies (10%). While the platform owner has the legal control over the technology and intellectual property of the platform, platform managers maintain, run and develop the platform according to the guidelines of the platform owner. However, in most cases these roles are carried out by the same actor (Van Oosterhout et al., 2020). Besides facilitating the exchange of data and information across different actors in cities, a central aspect of Urban Data Platforms is the development of applications by data users, such as app developers or businesses (EIP-SCC, 2017). Although these applications are not part of the platform itself, they provide value to participating actors in the ecosystem. Thus, Urban Data Platforms are similar to *software-based platforms*, which Tiwana (2013) describes as the base for platform ecosystems and applications to be developed.

The objectives and possible applications of Urban Data Platforms are manifold and depend strongly on the objectives of the respective platform owner and the vision of the Smart City (EIP-SCC, 2017; Nam & Pardo, 2011). For example, municipalities can leverage data in the platform to monitor and analyze activities within the city and improve processes and public services accordingly (Hashem et al., 2016). App developers or private companies might use data to develop new urban applications which can be offered to the public (Visnjic et al., 2016). Citizens could make use of Urban Data Platforms by accessing (real-time) information on traffic, public services or events (Nam & Pardo, 2011). While non-confidential data is often made publicly available to the whole ecosystem, also called open data, sensitive data is usually restricted to certain groups such as the government or businesses, for example on project basis (Zygiaris, 2013). By defining what type of data is shared on the platform and which actors have access to it, platform owners strategically guide the direction and objectives of the platform.

Ultimately, Urban Data Platforms represent an important building block that enables cities to transform itself and become "smarter" as a city (EIP-SCC, 2017). Similar to software-based platforms described by Tiwana (2013), establishing an Urban Data Platform unlocks new opportunities for innovation and offers new ways to build ecosystems in cities (EIP-SCC, 2017; Hashem et al., 2016; Visnjic et al., 2016).

2.1.2. Development Stages

Cities differ in terms of geographic location, number of inhabitants or cultural challenges, resulting in different Smart City visions and Urban Data Platform designs. Thus, a universal approach in developing an Urban Data Platform does hardly exist. Due to the scarcity of literature on Urban Data Platforms, the maturity stages of Smart Cities are first outlined before discussing the development stages of Urban Data Platforms as used in a recent study.

The model of IDC's Smart City MaturityScape by Clarke (2017) illustrates the different stages of maturity of a Smart City. As cities take on the challenge of developing a Smart City ecosystem, the author argues that cities go through common stages as they mature as Smart Cities. The developed framework describes the different stages regarding goals and outcomes. The five stages, of which each stage builds on the previous stage, are:

- *Ad Hoc:* Planning and coordination is done, first pilots are carried out and proof of concept is demonstrated.
- *Opportunistic:* Stakeholders are included and collaboration across different organizations begins.
- *Repeatable:* Recurring projects take place across multiple organizations.
- *Managed:* Technology and data assets are in place, standards emerge and new services are developed.
- *Optimized:* Citywide platform is in place, providing innovation and continuous improvement.

While the IDC's model also considers the establishment of a city-wide platform in its later stages, the research team of the study by Van Oosterhout et al. (2020) explicitly focuses on the development stages of Urban Data Platforms. The authors differentiate between the following five stages:

- *Exploring:* Investigating possibilities.
- *Planning:* Getting stakeholders on board and designing the Urban Data Platform.
- *Building:* Actual constructing the digital manifestation of the platform.
- *Implementing:* Making the platform available to data users.
- *Operational:* Onboarding of first wave of participants and further development.

Both the maturity stages of a Smart City and the development stages of an Urban Data Platform follow a similar pattern. After defining the vision and scope at the beginning, additional stakeholders are included early on. This is followed by the development of the underlying technical infrastructure as well as the creation of new services which are offered to end-users. Ultimately, in both cases a platform is established which serves as a central source for further development and innovation in Smart Cities.

2.1.3. Performance

As outlined earlier, Urban Data Platforms represent a particular type of platform, connecting data providers with data users in cities. Thus, literature on performance measurements of multi-sided platforms can also be applied in the case of Urban Data Platforms. In platform theory, it is commonly acknowledged that the value of a platform increases with the number of its actors, as this increases the likelihood of an interaction between actors (Eisenmann et al., 2006; Tiwana, 2013). This means that the platform's value to actors on one side strongly depends on the number of actors on the other side (Eisenmann et al., 2006). This phenomenon is called network effects and can be observed in nearly all multi-sided platforms (Eisenmann et al., 2006). While further performance metrics are discussed in the literature like profitability, platform evolution, plasticity or stickiness, the number of actors and the number of transactions on a platform remain the key measurements for platform performance (Eisenmann et al., 2006; Tiwana, 2013).

Looking at Urban Data Platforms and taking into account their different development stages, it can be concluded that the key performance metrics of platforms also apply to Urban Data Platforms, once a first version of the platform is implemented and accessible by users. In this case, any actor in a city ecosystem that either provides data to the platform or uses data from the platform can become a user of the platform. Additionally, data from sensors placed across the city fulfill a similar role as other data providers as they share data on the platform. Following the logic of the platform theory of Eisenmann et al. (2006) and Tiwana (2013), this means that the higher the number of data providers on the platform, the more attractive the Urban Data Platform becomes for data users, such as application developers, and vice versa.

2.2. Multi-Stakeholder Collaboration

This section examines the concepts of multi-stakeholder collaboration using various literature sources. First, the concept of collaboration between multiple stakeholders is defined. Second, the Triple Helix and Quadruple Helix models are explained and their application in Smart Cities is discussed. Lastly, theory on inter-organizational networks is reviewed, providing further insights regarding the collaboration between multiple organizations.

2.2.1. Definition of Multi-Stakeholder Collaboration

Partnerships and co-evolution between different parties have a thousand-year-old history. For example, in ancient Greece and Rome politicians already drew inspiration from philosophers and the Church, seeking to include external advice into their policy making. Today, partnerships between different stakeholders and collaborative arrangements are concluded, for example, to address societal problems or achieve strategic corporate goals (Berger et. al, 2004; Sloan, 2009). While the value of partnerships between different stakeholders is widely recognized, they inherit a range of difficulties that can significantly affect the outcome (Tomlinson, 2005). As a consequence, partnerships often fall short of expectations or even fail if not managed thoughtfully (Bryson et al., 2006; Eden & Huxham, 2001). The level of trust between the various stakeholders is hereby one of the central aspects in the literature, often described as the key to success in partnerships (Bryson et al., 2006; Tomlinson, 2005).

Due to the relevance of partnerships today, there exists a large body of academic literature in this field including various terms from ‘cross-sector partnerships’ to ‘collaborative groups’ (Bryson et al., 2006, Tomlinson, 2005). Yet, the type of stakeholders, the form of relationships and the envisioned goals often determine which definition is used (Sloan & Oliver, 2013). In a study on cooperation between organizations of the private, public, and not-for-profit sector, the authors use the term ‘multi-stakeholder partnerships’ and describe it as *“arrangements in which organizations from diverse sectors (private, public, and not-for-profit) commit to work together”* (Sloan & Oliver, 2013, p. 1837). While this definition would also apply for the three stakeholders ‘government’, ‘industry’ and ‘university’ in this study, it does not adequately represent the role of the fourth stakeholder, the ‘citizens’. Citizens cannot be assigned to an organization, as each citizen acts individually and usually does not commit itself to longer-term arrangement in his or her role as a citizen (Yang & Callahan, 2007). Instead, citizens often

engage in individual Smart City initiatives offered by the government, such as co-creation workshops (Bakici et al., 2013). Alternative terms in the academic literature that describe this type of relationship are ‘collaboration’ and ‘cooperation’. While collaboration is seen as the direct participation of two or more actors with a concrete goal, cooperation is a more formal or informal agreement to exchange information (Polenske, 2004). Taking these criteria into account, the term *multi-stakeholder collaboration* seems to reflect most accurately the circumstances examined in this study and is therefore used in this paper.

2.2.2. Triple Helix Model

The Triple Helix model describes the triadic relationship between government, industry and university. Since its first appearance in the 1990s (Etzkowitz & Leydesdorff, 1995), it has received a lot of attention by society and academic scholars. While the model is applied in different fields today, its initial idea is based on stimulating innovation which in turn leads to economic development and growth (Etzkowitz & Leydesdorff, 1995). The formation of Triple Helix collaboration represents a shift from a mostly industry-government dyad in the industrial society to a triadic relationship in the knowledge society (Etzkowitz, 2008). The thesis of Triple Helix states that the full potential in a knowledge society, which deeply relies on production, transfer and application of knowledge, can only be exploited by giving university a more prominent role (Etzkowitz, 2008). Over time, the Triple Helix model has evolved and has been applied by scholars in different contexts (Almeida, 2005; Carayannis & Campbell, 2009), leading to a significant body of theoretical literature. Yet, the triad between government, industry and university, as displayed in Figure 2, remains at its core.

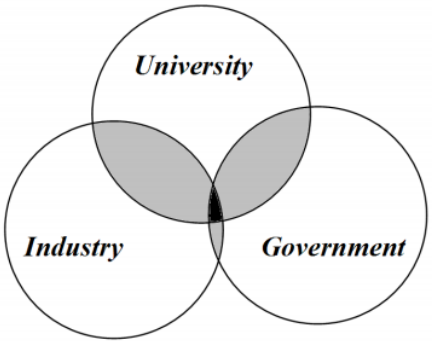

Figure 2: Triple Helix model (Source: Smith & Leydesdorff, 2012)

Besides a shift towards a knowledge society in many parts of the world, the increasing complexity of modern time challenges leads to the formation of Triple Helix collaborations in different fields. Challenges that are jointly addressed by government, industry and university can be of very different nature, ranging from economic or technological to social or cultural (Nyman, 2015). The unifying force between all of them is the common belief by the stakeholders, that goals either cannot be achieved individually or can be achieved more efficiently together (Smith & Leydesdorff, 2012).

Synergies of collaboration between these parties can be explained by the fact that government, industry and university take different roles in society, therefore each exhibiting expertise in a different field (Etzkowitz, 2008). Traditionally, the government primarily takes on a regulatory role in society (Smith & Leydesdorff, 2012). Besides providing public services to the public, the government can define policies which directly influence universities or businesses (Etzkowitz, 2008). This includes, for example, providing funds to certain research fields at universities or regulating certain markets (Etzkowitz, 2008). Industries, however, are primarily driven by the commercialization of knowledge and making profits (Smith & Leydesdorff, 2012). The transfer of knowledge and skilled people between industry and university is seen as a key aspect in the process of innovation and progress of an industry (Etzkowitz, 2008; Smith & Leydesdorff, 2012). Universities and other higher education institutes allow governments and industries to extract valuable information and knowledge which may lead to an improvement in their internal efficiency and effectiveness (Cunningham & Link, 2015; Etzkowitz, 2008). For companies, universities are often the main partner for generating insights in unknown fields due to its unique scientific methods and approaches (Etzkowitz, 2016). As relationships within the Triple Helix evolve over time, boundaries of the traditional roles of the actors may blur, leading to the emergence of intermediaries and new hybrid organizations (Etzkowitz, 2008; Smith & Leydesdorff, 2012).

In essence, the Triple Helix model suggests that the value of the triadic relationship primarily lays in the production, sharing and use of knowledge, leading to the creation of new ideas and innovation (Etzkowitz, 2016; Etzkowitz & Leydesdorff, 1995). By tapping into different fields of expertise, Triple Helix collaboration can be seen as a major source of entrepreneurial activity which bears the potential to ultimately foster economic growth of a region (Etzkowitz, 2008). Nevertheless, the practice reveals that difficulties in Triple Helix collaboration can emerge as in all forms of collaboration. This can be caused, for example, by power imbalances, lack of

openness, opportunistic behavior or an unappropriated distribution of risk (Saad, 2004). Additionally, the clash of different cultures and procedures often imposes a particular challenge for institutions building a Triple Helix (Saad, 2004).

Moving over to Triple Helix collaboration in Smart Cities, several academic studies view Smart Cities as knowledge-based innovation systems where the Triple Helix concept can be applied. One of the inventors of the Triple Helix, Leydesdorff, demonstrates together with another researcher how these three stakeholders can benefit from each other in the context of cities (Leydesdorff & Deakin, 2011). Considering cities as densities of networks including different dynamics, the authors argue that universities would provide intellectual capital, while industries create wealth and governments form the rules of Smart Cities. Joint interaction among these groups can enable the production and exploitation of knowledge which facilitates the creation of Smart Cities (Leydesdorff & Deakin, 2011). Others suggest that within the Triple Helix, universities and governments should focus on the production of knowledge, whereas industries and universities should primarily deal with the creation of innovation (Lombardi et al., 2012). In their study on the dimensions of Smart Cities, Nam and Pardo (2011) describe stakeholder collaboration as an essential part of the governance of Smart Cities, which is necessary to successfully build Smart Cities. While cities can take different approaches, such as top down or bottom up, the inclusion of different stakeholders into Smart City projects leads to the creation of valuable synergies. This becomes apparent, for example, in the faster progress of projects or in better informed and trained people involved in the projects (Nam & Pardo, 2011).

2.2.3. Quadruple Helix Model

Building on the Triple Helix model outlined in the previous section, several recent studies suggest adding a fourth component to this model: society. By adding society, which includes all civil individuals or citizens, to the triad of government, industry and university, a so-called Quadruple Helix is created (Figure 3).

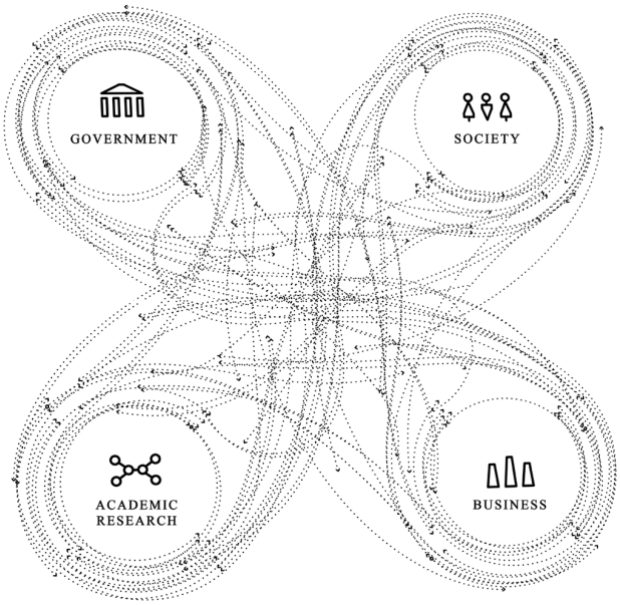

Figure 3: Quadruple Helix Model (Source: Schütz et al., 2019)

The Quadruple Helix model was first conceptualized by Carayannis and Campbell in 2009 as an attempt to overcome limitations of the Triple Helix model. It was claimed that innovation and newly created services, developed under the Triple Helix model, often failed to match the demands and needs of society (Carayannis & Campbell, 2009). In addition, without including a societal perspective into innovation processes, new solutions were often largely technology focused, thereby lacking to benefit the public in the longer term (Borkowska & Osborne, 2018). Thus, by including society in research and development projects from an early stage, the Quadruple Helix model aims to bridge this gap, leading to more desired, citizen-centric innovation (Carayannis & Campbell, 2009). Besides taking the public's need into account, Edler and Georghiou (2007) point out that the inclusion of citizens provides access to a very broad and diverse pool of knowledge. This can generate new ideas, produce better decisions and, as a consequence, improve the quality of innovation (Edler & Georghiou, 2007).

Besides the positive aspects of citizen engagement, the Quadruple Helix model also comes with a number of new challenges. Evaluating new forms of interaction within Quadruple Helix innovation systems, Schütz et al. (2019) point out two particular key challenges. First, defining the functional role of citizens within the collaboration in terms of goals and contribution presents an obstacle. Compared to government, industry and university, where the functional roles are quite clear, citizens may pursue very different goals and exhibit a different degree of technological, political or sustainable understanding. In fact, innovation projects often include

the implementation of new technologies or changes of existing operational processes. Since not all citizens can be experts in these fields, the large number of different interests, perceptions and opinions can become a barrier in communication and decision-making (Schütz et al., 2019). Second, designing participatory formats in which citizens can effectively communicate their perspectives and contribute their skills often proves to be difficult (Schütz et al., 2019). The complexity of knowledge transfer in Quadruple Helix ecosystems is also acknowledged by Miller et al. (2016), who claim that the effectiveness of this type of collaboration depends on several factors which are difficult to control, such as knowledge characteristics, power relationships or network characteristics.

Meanwhile, citizen inclusion, which is more commonly referred to as citizen engagement or public participation, is not an entirely new concept. Especially with regard to public trust in authorities or political systems, public participation has been an intensively researched subject in the past (Wang & Van Wart, 2007). The assumption is that involving the public into government-related activities enhances public trust in authorities. Yet, while there seems to be a convergence among researchers that public participation does increase public trust, Wang and Van Wart (2007) argue that this belief is based on a set of assumptions which might not be fulfilled in every situation. The results of their own study suggest that public participation increases public trust in two cases: first, when services are developed as an outcome that reflect the public's needs and second, when public officials demonstrate ethical behaviors and integrity throughout the process of participation (Wang & Van Wart, 2007).

In the field of Smart Cities, scholars and practitioners highlight the need to include a societal perspective in the development of Smart Cities (Giffinger et al., 2007; Meijer & Bolivar, 2015). In order to develop truly user-centric Smart City services, citizen engagement is described as a crucial factor along the different development steps (Giffinger & Gudrun, 2010). In addition, Borkowska and Osborne (2018) suggest that by giving citizens a voice in the design of new services, greater acceptance of these services could be achieved once they are implemented. In essence, it is argued that the perspectives of all stakeholders of the future services should be taken into account to unlock the full value of Smart Cities (Anthopoulos & Fitsilis, 2010).

The practice shows that today a number of Smart Cities across Europe follow the Quadruple Helix approach in developing new Smart City services. A prominent example for that is the city of Barcelona. The city has undertaken several steps in the last 20 years to transform itself into

a leading Smart City and is especially known for its living labs across the city (Bakici et al., 2013). For example, the 22@Barcelona district project, which started around the year 2000, represents a community space where government, businesses, knowledge institutions and citizens can come together to experiment and develop new innovative products and services for the city (Bakici et al., 2013). In this way the city can effectively test new concepts as pilot projects in a real-life environment and with low risk. Pilots range from creating more sustainable living concepts to new mobility solutions including sensors and other modern technologies (Bakici et al., 2013). Another city in Europe which established a living lab in their city is Glasgow (Borkowska & Osborne, 2018). While the government is the owner of the project, all stakeholders, such as businesses, knowledge institutions or citizens are expected to take the initiative and jointly develop new services for the public (Borkowska & Osborne, 2018).

2.2.4. Inter-Organizational Networks

In the academic literature, stakeholder collaboration is often associated with inter-organizational networks. In its simplest form, networks are enduring relationships within or between organizations, groups, and individuals (Weber & Khademian, 2008). Inter-organizational networks, in contrast, can be defined as groups of three or more organizations, sharing information, resources and capabilities to achieve a common goal (Bryson et. al, 2006; Provan et al., 2007). As this applies to the collaboration of three of the stakeholders discussed in this study, namely government, industry and university, the literature on inter-organizational networks is reviewed in the following.

Given the ubiquity of inter-organizational networks in society, a large number of literature strains exist within this field. Depending on structure, relationships and goals, inter-organizational networks can be subdivided into policy networks, governance networks and collaborative networks (Isett et al., 2011). While the first two networks primarily focus on organizations within the public sector, collaborative networks also include organizations from different sectors which work together to provide a public good or value (Isett et al., 2011). The rationale behind forming networks, and inter-organizational networks in particular, is the advantage of bundling resources, knowledge and capabilities to effectively address complex issues and challenges (Bryson et al., 2006; Weber & Khademian, 2008). By joining such

networks, actors seek to achieve some goal which they could not achieve independently (Provan & Kenis, 2008).

The benefits of forming inter-organizational networks are manifold. As already discussed in earlier literature strains, knowledge exchange is seen as an essential factor, facilitating learning and capacity building across organizations (Bryson et al., 2006; Huxham & Vangen, 2005; Weber & Khademian, 2008). Furthermore, different resources, such as labor, technology or expertise, may be held by individual organizations that can be leveraged among collaborative networks (Huxham & Vangen, 2005). In fact, the possibility to access specific resources is an important factor in networks, allowing to overcome resource shortages and complement skills (Bryson et al., 2006). Another advantage of collaboration in inter-organizational networks is the creation of structures that promote diversity, openness and innovation (Keast et al., 2004). Similarly as discussed in the Triple Helix literature, inter-organizational networks can create an environment of shared risk and accountability, fostering creativity and the curiosity for advancements among people (Huxham & Vangen, 2005).

Nevertheless, the literature also highlights the inherent difficulties in the management and governance of inter-organizational networks (Bryson et al., 2006; Huxham & Vangen, 2005; Provan & Lemaire, 2012). In some cases, especially when being from different sectors, collaboration of institutions can create more new problems than it solves existing ones (Bryson et al., 2006). Before entering a collaborative network, it is therefore essential to analyze if the added benefits will outweigh the challenges and limitations (Provan & Lemaire, 2012). While some literature suggests that inter-organizational networks are often a reactive answer on failed attempts by individual entities or other governance structures (Keast et al., 2004; Isett et al., 2011), others describe the establishment of networks more as an proactive approach to solve complex problems (Provan and Lemaire, 2012).

To create effective networks and reap the benefits of it, relationships between individuals of different organizations first must be established. Goal consensus, a clear vision, prior relationship experience and high proximity are seen as factors which positively contribute to the development of strong ties between the individuals (Provan and Lemaire, 2012). Other positive factors are homophily in terms of sector, size or reputation across the organizations, whereas heterophily in terms of capabilities and resources positively adds to the network (Provan and Lemaire, 2012). Another variable, which is often mentioned in the literature and

highly affects network effectiveness, is trust between the individuals (Provan et al., 2007). Due to the focus of this study and the complexity of trust, the concept of trust is discussed separately in the following chapter.

2.3. Trust

The last chapter of the literature review fits the concept of trust into the scope of this study. First, a definition of trust is presented. This is followed by a review of relevant literature with respect to trust in platform ecosystems and trust in Smart City ecosystems. Lastly, light is shed on the role of mutual trust between organizations.

2.3.1. Definition of Trust

Trust is commonly regarded as the willingness to be vulnerable, as a belief in another party's integrity or competence (Rousseau et al., 1998). This leads to situations where the trustor places trust in the trustee, thereby having confidence in the good will of the other party (Ring & Van de Ven, 1994). Despite differences in the definitions of trust in the various scientific fields, it is widely acknowledged that only individuals can take the role of the trustor (Janowicz & Noorderhaven, 2006). Trustees, however, can be individuals, organizations or specific objects, like hardware or software (Janowicz & Noorderhaven, 2006). Hence, in the context of Urban Data Platforms and throughout this study, data providers and data users are seen as trustors, who place trust in an Urban Data Platform. The Urban Data Platform represents the trustee in this constellation.

2.3.2. Trust in Platform Ecosystems

Despite the numerous studies in the field of platform ecosystems, there are only a limited number of studies that investigated the role of trust in relation with platforms. As one of the few, Hurni and Huber (2014) examined the interplay of power and trust in a study on platform ecosystems in the enterprise application software industry. Based on the platform model by Tiwana et. al (2010), the authors describe the interaction between platform vendors, which represent the platform owner, and complement vendors, which represent the platform providers, as forms of inter-organizational cooperation. Instead of complement vendors simply accessing

the platform and providing their complementary products on the platform, efforts must be undertaken by both sides to establish a relationship. Only by taking joint actions, platform providers can be included into the platform ecosystem. Similar as in general inter-organizational relationships, the findings of their study suggest that trust between platform owners and complement vendors is of major importance for establishing relationships and for platform ecosystems to succeed (Hurni & Huber, 2014). Other studies support these findings, stating that trust is in fact a prerequisite for platform ecosystems to attract new users and eventually to survive in the market (Choudary et al. 2016; Schreieck et al, 2016). Using data from a consumer-to-consumer (C2C) e-commerce platform in China, Chen et al. (2009) assessed the role of mutual trust among consumers on such a platform. The results suggest that information exchange and emotional interaction both lead to an increase in mutual trust among the users. Furthermore, the analysis reveals that mutual trust among users on the C2C platform increases trust and loyalty of the platform users in the platform provider (Chen et al., 2009).

The collection, storage and usage of data is of central importance in many platform ecosystems, making data governance a key issue for practitioners of platform ecosystems (Tiwana, 2013). Building upon the work of Tiwana, Lee et al. (2017) analyzed the role of different data governance factors in four existing platform ecosystems. Among other results, the authors argue that the knowledge of who owns the data on a platform and who has access to it are essential aspects and affect the level of trust users place in a platform (Lee et al., 2017). Further, trust is seen as a prerequisite especially when interactions between two parties involve the sharing of data (Lee et al., 2017). This view is consistent with the results of an earlier study by Hart and Saunders (1997), who focused on the adoption of electronical data exchange between organizations. The authors argue that trust is an essential component in establishing new relationships between these partners. When no transactional history between two parties exists, sharing data involves a certain degree of vulnerability. In such situations, trust can help to increase the probability of sharing data and engage in new arrangements (Hart & Saunders, 1997). Several studies from the e-commerce literature draw a similar picture. To share their private information on an e-commerce platform, such as product preferences or reviews, users must have a certain level of trust in the platform (Belanger et al., 2002; Chellappa & Sin, 2005).

The results of the studies above indicate that trustees in platform ecosystems, in other words the individuals, organizations or objects that are placed trust in, can be divided into two categories: the technical infrastructure of a platform and the owner of the platform. In their

study on platform ecosystems, Lee et al. (2017) highlight the importance of data security on platforms as it directly affects the level of trust and the willingness of users to share data. In e-commerce, the perceived privacy and security of shared information is similarly considered as the central aspects by users when it comes to sharing data on a platform (Belanger et al., 2002; Chellappa & Sin, 2005). Consequently, the level of trust users place in the security of a platform significantly determines the users attitude towards data sharing and participation (Belanger et al., 2002; Chellappa & Sin, 2005). The same behavior can be observed in B2B e-commerce. In a study investigating the role of trust in establishing new relationships on B2B e-commerce platforms, Sultan and Mooraj (2001) concluded that the infrastructure of the platform affects the perceived trustworthiness of the partner. The factors that influence the level of trust in the platform include the security and privacy standards of data transaction and storage, as well as the type of implemented systems and technologies (Sultan & Mooraj, 2001). Apart from the technical aspects of a platform, the second category in which trust is placed by the platform users is the owner of the platform. Demonstrating a high competence in the corresponding domain increases the credibility of an organization and thus the confidence in this party (Hart & Saunders, 1997). Also when establishing new partnerships, domain knowledge of an organization strongly influences the level of trust between the potential partners, facilitating the building of new partnerships (Sultan & Mooraj, 2001). While trust first must be established and evolves over time, Sultan and Mooraj (2001) point out that trustworthiness can be improved and signaled by the platform owner by leveraging existing partnerships and affiliates (Sultan & Mooraj, 2001).

2.3.3. Trust in Smart City Ecosystems

Similarly as in the platform ecosystem literature before, literature on Smart City ecosystems suggest that the success of Smart Cities strongly depends on the level of trust participants place into the offered services (Nam & Pardo, 2011). For example, while e-government services have become the standard in many larger cities around Europe, citizens must have trust in the privacy and security of their personal data in order to achieve wider adoption (Carter & Belanger, 2005). This view is consistent with several other studies in this field, who argue that citizens need to have a certain level of trust in the security of the IT infrastructure in order to disclose personal information (Anthopoulos & Fitsilis, 2010; Carter & Belanger, 2005; Cohen et al., 2014; Yang & Callahan, 2007).

Apart from providing a secure and reliable IT infrastructure, several studies stress the importance of giving data providers in Smart Cities the power to decide with whom their data is shared and what it is used for, as this directly affects trust (Cao et al., 2017; Cohen et al., 2014). For example, in a study on trustworthy data sharing platforms in Smart Cities, Cao et al. (2017) propose a data usage control model, in which setting the right policies plays a critical role. They argue that platform owners should capture the obligations and constraints that data providers wish to impose on the usage of their data. As different stakeholders may have different views, this can lead to conflicting requirements. Yet, to keep trust levels high, policies have to be constructed and implemented, reflecting the requirements of the respective owners of the data (Cao et al., 2017). The importance of such policies is also supported by a study of Cohen et al. (2014), who investigated the implications of the interplay of policy and trust in Smart Cities. Following the argumentation of Cao et al. (2017), the authors argue that in order to establish trust of service providers in Smart City systems, clear rules regarding the development of Smart City services have to be established. Such policies deliver not only instructions but also define the direction of the future platform, as newly developed systems and services incorporate the set policies. Besides increasing trust on the service provider side, the authors conclude that trusted Smart City policies can lead to the creation of Smart City services, which are also trusted by the service consumers (Cohen et al., 2014).

The privacy of citizens has become an increasingly researched topic in the last decade with the emergence of Smart Cities. On the basis of existing privacy research, Van Zoonen (2016) identifies three dimensions, which influence the privacy concerns of citizens with regard to data collection and use. These include the type of data (personal vs. impersonal), the purpose of the data collection (service vs. surveillance), and the organization collecting and using the data (Van Zoonen, 2016). The relevance of these dimensions among citizens and their relation to trust is reflected in the results of a report about data protection standards and practices by the European Commission (2015). Evaluating data from 27,980 respondents of all member states across the EU, the report reveals that mass data collection by governments, for example to develop new public services, undermines the trust of citizens in governments. This is viewed particularly critical by citizens that do not trust authorities or companies to protect their data. In return, people who trust the data security standards of authorities and businesses do not consider the disclosure of personal information as a serious problem. Moreover, almost 70% of the people are concerned that their data is being used for a different purpose than is was initially

collected for. Lastly, the results show that the level of trust regarding the protection of personal data is the highest in national public authorities (European Commission, 2015).

2.3.4. Trust between Organizations

In the field of inter-organizational networks, trust between organizations has been an intensively researched subject by academic scholars. This is explained by the fact that trust is commonly regarded as a decisive factor which influences the effectiveness of inter-organizational networks and thus impacts the outcome of collaboration (Gulati et al., 2011; Keast et al., 2004; Provan et al., 2007). The presence of trust or mistrust towards other individuals often influences the behavior of the trustor within the partnership (Calanni et al., 2014; Gulati et al., 2011). For example, Calanni et al. (2014) show that the extent to which individuals exchange information with individuals of other organizations can be affected by the existing level of trust. Apart from that, trust is often seen not only as a prerequisite to form inter-organizational networks, but especially to create and sustain effective collaboration over time (Gulati et al., 2011; Vangen & Huxham, 2003). The inherent difficulty of trust is that it cannot be simply created overnight. As Provan et al. (2007) argue, trust has to be developed by the individual organizations and should be regularly reviewed as trust levels usually evolve over time. Therefore, building a trusting relationship can be a resource and time intensive process, requiring organizations to carefully choose which organizations they want to collaborate with (Provan et al., 2007). Selecting partners on the basis of a positive prior relationship can be a strategy that minimizes risks and saves time (Bryson et al., 2006).

Trust levels at an organizational level are difficult to measure, therefore, the quality of relationships between individuals is often used as an indicator for the level of trust between organizations (Milward et al., 2010). If individuals of different organizations perceive the quality of their relationships as high, then the level of trust between these organizations can also be seen as high (Milward et al., 2010). However, a difficulty often arising using this approach is that the quality of relationships is not only determined by the personal relationship of the individuals, but is also influenced by the visions and interests of their organizations (Provan et al., 2007).

3. Conceptual Framework

This chapter illustrates the dependent variable and the theoretical constructs of this study, which are derived from the academic literature. Subsequently, the initial conceptual model of this study is presented.

3.1. Dependent Variable

Reviewing the academic literature on platform ecosystems reveals that trust takes a central role in all types of platforms, for example in software platforms, social media platforms or e-commerce platforms (Belanger et al., 2002; Hurni & Huber, 2014; Lee et al., 2017). In particular, the level of trust actors place in a platform affects their willingness to provide services or to share data on it (Belanger et al., 2002; Hurni & Huber, 2014). Literature on Smart City ecosystems underlines the importance of trust in such ecosystems, as it affects, for example, citizen engagement in Smart City initiatives or the adoption of new 'smart' services (Carter & Belanger, 2005; Cohen et al., 2014). Results of previous years Master students of Erasmus University Rotterdam, who conducted research within the scope of RUGGEDISED, further indicate that trust in Urban Data Platforms plays an important role when it comes to citizen engagement (Ceric, 2018), and the willingness of businesses to collaborate in Smart City ecosystems (Das, 2018). Taking these insights from different fields together, it can be presumed that trust in a platform affects the number of users and usage of a certain platform, which according to Tiwana significantly determines the performance of a platform (2013). This is in line with findings from recent studies within the scope of RUGGEDISED, which suggest that trust in the platform often takes a mediating role and affects the performance of Urban Data Platforms (2018). Therefore, as trust in the platform bears the potential to eventually increase platform adoption, *trust in an Urban Data Platform* is chosen as the dependent variable of this study. The trustors in this study are data providers and data users of an Urban Data Platform.

Furthermore, the literature on platform ecosystems shows that platform actors evaluate different aspects of a platform when it comes to trust. Since trust can be placed, for example, in individuals, organizations or objects (Janowicz & Noorderhaven, 2006), attention was paid to examine whether the overall level of trust in a platform can be further divided into individual *trust components*. In total three individual trust components of a platform could be identified, which are described in the following and summarized in Table 1.

First, the security of the technical infrastructure of a platform is seen as a crucial factor which affects the perceived trustworthiness of a platform. In particular, data security and privacy standards on platforms affect the willingness of stakeholders to participate and to share data on a platform (Belanger et al., 2002; Chellappa & Sin, 2005; Lee et al., 2017; Sultan & Mooraj, 2001). Consequently, *trust in the platform security* by platform users constitutes the first trust component.

Second, the competences of the platform owner are often seen as an indicator of the credibility of a platform which influence the attractiveness of a platform and the counterparty's trust in the platform (Hart & Saunders, 1997). Demonstrating expertise in a particular domain by the platform owner influences the trust that potential actors place in a platform, which in turn affects the adoption of the platform (Sultan & Mooraj, 2001). Therefore, *trust in the competences of the platform owner* by platform users represents the second trust component.

Third, literature on Smart City ecosystems indicates another trust component. As private data from citizens or businesses take an essential role in the flourishing of Smart Cities, policies and rules must be established that reflect the requirements of data providers (Cao et al., 2017; Cohen et al., 2014). Meanwhile, almost 70% of citizens are concerned that their data is being used for a different purpose than it was initially collected for (European Commission, 2015). Assuming that these concerns affect the data provider's willingness to disclose data on an Urban Data Platform, *trust in the governance of the platform owner* constitutes the third trust component.

Trust component	**Description**	**References**
Trust in platform security	Perceived trust in the security of the technical infrastructure of a platform by the platform users.	Belanger et al., 2002 Chellappa & Sin, 2005 Lee et al., 2017
Trust in competences of the platform owner	Perceived trust in the competencies of the platform owner in terms of capabilities and domain knowledge by the platform users.	Hart & Saunders, 1997 Sultan & Mooraj, 2001
Trust in governance of the platform owner	Perceived trust in the policies and rules of the platform as well as in the integrity of the platform owner by the platform users.	Cao et al., 2017 Cohen et al., 2014

Table 1: Trust components of a platform

The three trust components of a platform derived from the literature are included in the conceptual framework, and their applicability in the case of Urban Data Platforms is examined in this study. If additional components are discovered in the course of this study, these are subsequently added to the framework.

3.2. Theoretical Constructs

To answer the main research question of this study, factors of multi-stakeholder collaboration need to be identified which might be related to the level of trust in Urban Data Platforms. Based on an extensive literature review assessing the theoretical concepts of Triple Helix and Quadruple Helix collaboration as well as of inter-organizational networks, four main factors were derived. In the following, these factors, which serve as the theoretical constructs in this study, and their link to the dependent variable are discussed and translated into propositions.

Knowledge Capacity: The central thesis of the Triple Helix model claims that the interplay of government, industry and university creates an environment, in which knowledge is exchanged, produced and exploited (Etzkowitz, 2016; Etzkowitz & Leydesdorff, 1995). Similarly, knowledge exchange and knowledge building are seen as central elements in inter-organizational networks (Bryson et al., 2006; Huxham & Vangen, 2005; Weber & Khademian, 2008). Since the demonstrated expertise of a platform owner affects the perceived trustworthiness of a platform (Hart & Saunders, 1997; Sultan & Mooraj, 2001), the following relationship is proposed:

Proposition 1: *The knowledge capacity of the platform owner positively influences the level of trust in an Urban Data Platform by the platform users.*

Access to Complementary Resources: Many organizations form inter-organizational networks to overcome resource shortages or to have access to particular resources, such as technology or domain knowledge (Bryson et al., 2006; Huxham & Vangen, 2005). In addition, complementary resources present the opportunity for organizations to foster innovation, create new capabilities and improve performance in the long-term (Harrison et al., 2001). Since the development of an Urban Data Platform requires skills and expertise from various fields, the following relationship is proposed:

Proposition 2: *Access to complementary resources by the platform owner positively influences the level of trust in an Urban Data Platform by the platform users.*

Citizen Engagement: The interplay between public participation and public trust in authorities represents a complex relation with varying outcomes (Yang & Callahan, 2007; Wang & Van Wart, 2007). Yet, by including citizens into innovation processes together with government, industry and university, the Quadruple Helix model suggests that newly developed services turn out to be more citizen-centric (Carayannis & Campbell, 2009). As a consequence, greater acceptance of these services by the public can be achieved (Borkowska & Osborne, 2018). Additionally, citizens provide a broad pool of perspectives which can help to generate new ideas and improve the quality of innovation (Edler & Georghiou, 2007). Therefore, the following relationship is proposed:

Proposition 3: *Citizen engagement in the development of Urban Data Platforms positively influences the level of trust in an Urban Data Platform by the platform users.*

Triple Helix Mutual Trust: Mutual trust among members on C2C platforms increases the loyalty and the level of trust of members in the platform provider (Chen et al., 2009). Stakeholders collaborating in the development of Urban Data Platforms can become platform users themselves after the implementation of the platform. This may lead to situations where a stakeholder provides data on the platform, for example the government, which is then used by another stakeholder, for example a company. Furthermore, the platform owner usually is one of the stakeholders involved in the development of the platform, which means a prior relationship between platform user and platform owner exists. Consequently, the following relationship is proposed:

Proposition 4: *Mutual trust of Triple Helix stakeholders involved in the development of Urban Data Platforms positively influences the level of trust in an Urban Data Platform by the platform users.*

Apart from that, trust between different organizations is one of the central factors in building successful inter-organizational networks (Bryson et al., 2006; Tomlinson, 2005). If managed inadequately, a lack of trust can negatively influence the behavior of individuals of different organizations between each other (Calanni et al., 2014; Gulati et al., 2011). As a consequence,

mutual trust between organizations impacts the outcome and the effectiveness of collaboration (Provan et al., 2007). Hence, a moderating relationship is additionally proposed:

Proposition 5: *Mutual trust of Triple Helix stakeholders involved in the development of Urban Data Platforms moderates the relation between multi-stakeholder collaboration and the level of trust in an Urban Data Platform by platform users.*

Development Stage: In addition to the four variables discussed so far, the role of the development stage of an Urban Data Platform, in which stakeholders collaborate, is investigated in this study. Urban Data Platforms go through different development stages, as discussed in section 2.1.2, requiring different skills and resources at each stage. While models describing the maturity stages of Smart Cities and the development stages of Urban Data Platforms both suggest to include stakeholders in the development from an early stage (Clarke, 2017; Van Oosterhout et al., 2020), little is known about the impact of multi-stakeholder collaboration on the level of trust in the platform at different stages. For example, trust in the platform could be particularly high if all stakeholders were involved from an early stage. However, in later stages after the initial version of the Urban Data Platform is implemented, stakeholders may become platform users themselves, suggesting that their inclusion in the development in these stages affects how they perceive the platform. To investigate this relationship, the following proposition is phrased:

Proposition 6: *The development stage of an Urban Data Platform moderates the relation between multi-stakeholder collaboration and the level of trust in an Urban Data Platform by platform users.*

3.3. Initial Conceptual Model

This section presents the initial conceptual model of this study, containing the dependent variable, the theoretical constructs and the propositions derived from the academic literature. The model serves as a basis for the subsequent data collection and data analysis phases and is revised in the course of this study.

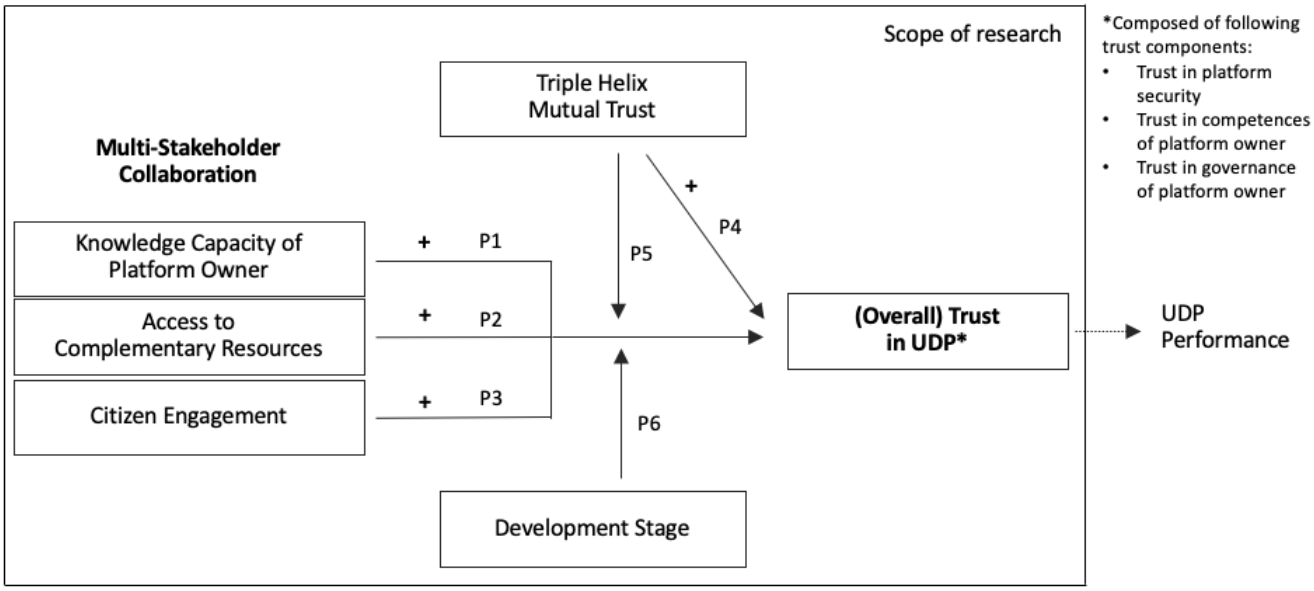

Figure 4: Initial conceptual model

4. Methodology

This chapter outlines the methodology of this study including the selected research methods. First, the research design of this study is explained. Then, the processes of data collection and data analysis are described. Lastly, the validity and reliability of this research is discussed.

4.1. Research Design

Given the novelty of the phenomenon of Urban Data Platforms in society and the scarcity of available academic literature in this field, an *exploratory research design* is adopted in this study (Stebbins, 2001). The study aims at investigating the roles and the potential relation of two important concepts within the field of Urban Data Platforms. In particular, the study has four objectives. First, it attempts to identify the factors of multi-stakeholder collaboration which are related to the overall level of trust in Urban Data Platforms. Second, it aims to explore 'how' and 'why' these factors of multi-stakeholder collaboration influence the level of trust in Urban Data Platforms. Third, it seeks to divide the overall level of trust in Urban Data Platform into individual components. Fourth, it aims to understand at which stages multi-stakeholder collaboration in the development of these platforms is particularly beneficial. By accomplishing these objectives, this exploratory study provides new insights and generates a new theoretical model in an under-researched area (Babbie, 2007; Stebbins, 2001). The model allows to derive hypotheses, which offer clear direction for future research (Stebbins, 2001).

Exploratory research is a flexible research design and not particularly tied to a specific research method (Babbie, 2007). This study adopts a *multi-method approach* using two different methods, namely *secondary data analysis* and *case studies*, to analyze data from primary and secondary sources. While primary research methods, such as observations or interviews, directly collect data from the subject of investigation, secondary research methods use existing data, for example from the literature, on the subject under study. Triangulating different data sources not only increases the robustness of a study, but allows the researcher to adjust the data collection process according to findings from previous rounds (Liamputtong, 2009; Yin, 2003). In particular, fieldwork data, for example collected through interviews, can assist in the analysis and interpretation of survey data by clarifying contradictions and providing persuasive plausibility (Sieber, 1973). As commonly done in empirical research, this study first derives a set of theoretical propositions from academic literature and constructs an initial conceptual

model which are both presented in chapter 3. The model serves as a baseline and guides the researcher through the data collection and data analyses (Flick, 2009; Yin, 2003). Subsequently, the study is carried out in two stages.

In the first stage, a secondary data analysis is conducted by analyzing data from two recent studies in the field of Urban Data Platforms. Secondary data analysis utilizes existing data which was collected by someone else for another purpose (Smith et al., 2011). Given the increasing amount of collected data available today, using secondary data is a viable option that often saves time and resources (Smith et al., 2011). Due to the availability of suitable data through Erasmus University and the time constraints of this thesis, secondary data is used in this study. The results as well an analysis of the raw data of these two studies allow to further explore the two concepts under study. In particular, the first stage contributes to two of the objectives of this study. First, it helps to identify factors of multi-stakeholder collaboration which are related to trust in an Urban Data Platform. This way, existing constructs are pre-validated and the conceptual model can be adjusted. Second, it provides insights regarding the individual trust components in the case of Urban Data Platforms.

In the second stage, case studies are performed to investigate collaboration between different stakeholders in the development of Urban Data Platforms in different cities. According to Yin (2003) case studies investigate a contemporary phenomenon in a real-life context where the boundaries between phenomenon and context are not well defined yet. Yin (2003) further differentiates between three types of case studies – exploratory, explanatory, and descriptive – which can also be combined. For example, an exploratory approach is often used as a preliminary step followed by an explanatory case study approach (Streb, 2010). Given the focus of this study, the case studies conducted in the second stage are primarily of an *exploratory* nature, following the case study guidelines by Yin (2003). Exploratory case studies do not seek to measure variables or test existing hypotheses, but rather help to assess different constructs and establish new hypotheses (Yin, 2003). However, to develop a new theoretical model and to better understand the underlying dynamics between different constructs, elements from an *explanatory* approach are additionally used (Yin, 2003). The unit of analysis in this study, which defines the 'case' of a case study (Yin, 2003), is the collaboration between multiple stakeholders that seek to develop an Urban Data Platform in a city. The results from the case studies contribute to all four objectives of this study and are eventually compared with the findings from the secondary data analysis.

4.2. Data Collection

This section describes the data sources of the two research methods in this study: secondary data analysis and case study analysis.

4.2.1. Secondary Data Analysis

After identifying an existing dataset that appears to contribute to answering the research question, the quality and 'fit' of this dataset needs to be evaluated (Stewart & Kamins, 1993). Since the data already exist in some form, it can be analyzed regarding the appropriateness for the own research topic. This includes, for example, the purpose, the researcher(s), the time or the type of generated data of the respective study, from which the data is to be used (Stewart & Kamins, 1993).

This research utilizes secondary data from the following two studies:

a) *Survey study* on the current state-of-the-art of Urban Data Platforms in Europe (Van Oosterhout et al., 2020)
b) *Delphi study* on the role of governance of Urban Data Platforms (Sheombar et al., 2020)

The two studies are exploratory in nature and aim at further exploring the role of Urban Data Platforms in Smart Cities. In particular, the survey study investigates the drivers of adoption, performance and impact of Urban Data Platforms, whereas the Delphi study intends to identify the best options to govern Urban Data Platforms. Further, both studies have been conducted by a team of researchers of Erasmus University of Rotterdam who collaboratively conduct these studies as part of the EIP-SCC and the RUGGEDISED project. The survey study collected data from representatives of Urban Data Platform from 80 Smart Cities in Europe by using an online questionnaire. The data collection process took place in quarter 4 of 2019. The Delphi study collected data in two rounds. In the first round, data was gathered from a panel of 30 Smart City experts from different sectors, including academia, private and public, also using an online questionnaire in quarter 1 of 2020. By having participants from these three sectors, expert insights from all stakeholders of the Triple Helix, namely government, industry and university, are obtained. The second round, which zoomed in on specific points, took place in quarter 2 of 2020. Besides a set of closed questions used to collect quantitative data, the questionnaires in

both studies contained open questions that allowed participants to share further qualitative insights on the topics. Since the Delphi study was conducted in parallel to this research and the author of this study is a student at Erasmus University, additional questions proposed by the author were added to the first round of the Delphi study.

In view of the purpose, researchers, timeliness and nature of the data collected in these two studies, as well as the possibility of adding additional questions to the Delphi study, the secondary datasets promise valuable insights that help answering the research question of this study. The researcher is given access to all documents of the two studies through Erasmus University, including the results, the questionnaires and the raw data.

4.2.2. Case Study Analysis

Case study evidence can be gathered in different ways and from different sources (Yin, 2003). Depending on the research question of a study, some data sources are more suitable than others (Yin, 2003). Given the exploratory nature of this study, conducting *semi-structured interviews* with the platform owner(s) of the selected cases are chosen as the most suitable source of evidence. This allows the researcher to ask detailed questions and therefore to obtain insights which explicitly help to answer the research question (Yin, 2003). In addition, *secondary data* from the survey study of Van Oosterhout et al. (2020) regarding the selected cases is used. To be able to search for patterns and differences between cities, multiple case studies are conducted. Further, a multiple-case study provides stronger evidence than a single-case study because the data obtained comes from different cases, which reduces biases (Yin, 2003).

The case studies follow a case study protocol (Appendix A), constructed according to the guidelines of Yin (2003). The protocol helps to structure the process of conducting case studies and to improve the reliability of the obtained information (Yin, 2003). Among others, it includes the development of an interview guide (Appendix B), which consists of a list of pre-determined questions which are followed during the interviews. The questions are based on the propositions of the conceptual model, as this helps the researcher to gather evidence that directly contributes to the objective of the study (Yin, 2003), as well as on the findings from the secondary data analysis.

Three criteria are considered in the selection of the cases. First, only Smart Cities with an Urban Data Platform in an operational mode qualify as suitable cases. In order to gain insights into the collaboration between different stakeholders at the individual stages, the development of the Urban Data Platform should be as far advanced as possible. Second, the cases must have followed the Quadruple Helix approach in developing their Urban Data Platform, meaning that stakeholders from the public, private and academic sectors, as well as citizens were included in the platform development. Third, platforms must in all cases be owned by the same stakeholder – the municipality – to allow a better comparison of the cases.

A shortlist of suitable cases is obtained from the survey study of Van Oosterhout et al. (2020), providing insights regarding the development stage and the included stakeholders in the platform development. The three final cases are selected based on the judging by the researcher and his coach and by the availability of the platform owner(s) of the cities to share information on the topic. The cases and the interviewees including its functions are displayed in Table 2. All interviews lasted between 30 and 75 minutes and were conducted by phone.

Case	**Function**	**Interviewee**
Hamburg	Head of Urban Data Hub	Sascha Tegtmeyer
Cologne	Deputy Head of Digitalization	Dirk Blauhut
	Project Manager Open Data	Jayan Areekadan
Vienna	Coordinator Data Governance	Brigitte Lutz
	Lead E-Government and Smart City	Gerhard Hartmann

Table 2: Interviewees of selected cases

4.3. Data Analysis

This section describes the data analysis process of the two research methods selected: secondary data analysis and case study analysis.

4.3.1. Secondary Data Analysis

The results and the raw data of the survey study and Delphi study are utilized to verify the theoretical constructs and propositions of this study. Further, by reviewing the data from both

studies, the researcher gains a deep understanding of the latest practical findings in the field of Urban Data Platforms, which will help to conduct interviews with platform owners in the second stage.

Insights can be gained from analyzing the results of two different types of questions used in the survey study and the Delphi study. First, most of the questions in the questionnaires of both studies provided the respondents with predefined answers with scales from 1 to 5. This way, quantitative data was generated that reflect the experience of practitioners in the field of Urban Data Platforms. Several of these questions are directly related to one of the two concepts examined in this study. Second, several open questions concerning collaboration or trust in Urban Data Platforms were included in both studies. By expressing their opinions and elaborating on specific topics, qualitative data was generated. Both types of data are carefully analyzed and compared against the theoretical constructs and propositions presented in chapter 3. If needed, the conceptual model is revised based on the findings from these two studies.

Moreover, the researchers of the survey study by Van Oosterhout et al. (2020) conducted a correlation analysis between several variables of the study, including trust in Urban Data Platforms. The results of their analysis are compared against the propositions of the conceptual model of this study, allowing to assess whether relationships exist between certain factors of multi-stakeholder collaboration and trust in Urban Data Platforms. Existing correlations are then further explored in the case study analysis.

Lastly, based on the data analyses performed by the researchers of the survey study (Van Oosterhout et al., 2020), additional data analyses are performed to reveal further insights.

4.3.2. Case Study Analysis

Following the case study guidelines by Yin (2003), it can be distinguished between five dominant techniques for data analysis of case studies: pattern matching, explanation building, time-series analysis, program logic models and cross-case analysis. This study follows the established case study protocol (Appendix A) and adopts two of these techniques: *pattern matching* and *cross-case analysis.*

In the *with-in case analysis*, interview data obtained from the owner(s) of the Urban Data Platforms are analyzed individually and a report is created for each case. The report is structured as follows. First, the development process of the Urban Data Platform in the respective city is briefly described to give an overview of the case. Second, the perceived trust of the platform users in the Urban Data Platform is analyzed and individual trust components are determined. Third, each theoretical construct of the conceptual model is analyzed individually, focusing on understanding its role and its impact on the development of the Urban Data Platform and on the trust in the platform in the respective city. Thereby, an attempt is made to identify rationales for causal relationships between variables in the conceptual model in order to answer 'how' and 'why' these relationships exist. These empirically observed relationships, or patterns, are then compared with the propositions in the conceptual model, using the pattern matching technique by Yin (2003). The findings from the interview data are further triangulated with data from the survey study by Van Oosterhout et al. (2020) and with data from documents received by the interviewees. This way the results of each case become more robust, as data from multiple sources is combined (Yin, 2003).

In the *cross-case analysis*, the findings of the individual cases are compared against each other. The results of the individual cases are summarized in a 'm x n matrix', indicating if a positive, negative or no relationship between variables exists. Each observed relationship is evaluated individually, analyzing commonalities and differences between the cases. Based on this, conclusions are drawn about whether the propositions of the conceptual model, as well as newly emerged relationships, can be accepted and the conceptual model is revised accordingly.

4.4. Validity and Reliability

This study adopts two research methods whose validity and reliability needs to be addressed to guarantee the quality of the research. The 'fit' of the secondary data and its relation to the research question of this study are discussed in section 4.2.1. Further, the secondary data is triangulated with the interview data obtained through the case studies, which increases validity and reliability of the research (Shih, 1998). With regard to the case studies, Yin (2003) recommends four tests to ensure the quality of the case studies. This includes *construct validity, internal validity, external validity* and *reliability*. The steps taken to address each of these four factors in this study are summarized in Appendix C.

5. Secondary Data Analysis

This chapter presents the results of the first stage of analysis of this study. First, the main findings from the analysis of two secondary datasets, namely the *survey study* by Van Oosterhout et al. (2020) and the *Delphi study* by Sheombar et al. (2020), are discussed. Then, a revised conceptual model including the findings from the first stage is presented.

5.1. Survey Study

This section analyzes the results of the survey study by Van Oosterhout et al. (2020), which provide insights to answer the research question of this study. Furthermore, the results of an additional data analysis are presented, which build on the results of the survey study.

Firstly, the survey study assessed the importance of different aspects of trust in an Urban Data Platform. Decomposing the overall level of trust in an Urban Data Platform into individual aspects of trust, as similarly done in chapter 3.1 in this study, the researchers defined the following five trust aspects: platform security, risks of using the platform, trust in platform owner, trust in platform manager and trust in data quality of the platform. Participants were asked to rate the importance of these aspects on a scale from 1 to 5, with 1 being 'not at all important' and 5 'extremely important'. The results are displayed in Figure 5. Based on 54 responses, platform security is on average the most important aspect of trust, followed by trust in data quality of the platform and trust in the platform owner.

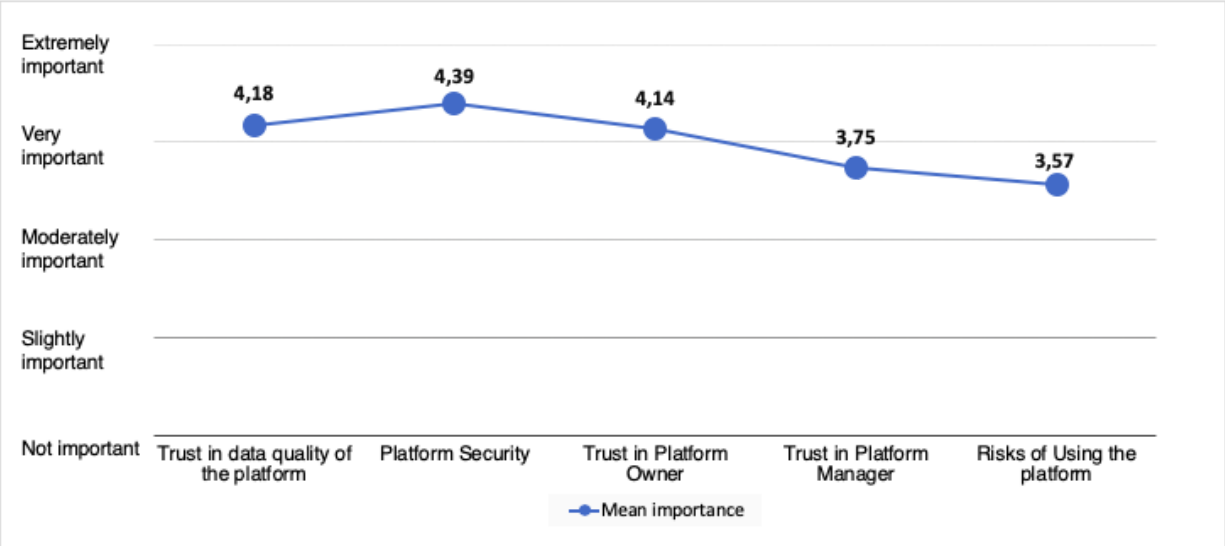

Figure 5: Aspects of trust in an Urban Data Platform (Source: Van Oosterhout et al., 2020)

A comparison of the *three trust components of platforms*, which were derived from the general platform literature and defined in chapter 3.1, with the trust aspects of the survey study allows to assess whether the general trust components of platforms apply in the case of Urban Data Platforms. *Trust in platform security*, the first trust component derived from the literature, is reflected by 'platform security' in the survey study. While being described as a key factor influencing the overall trust of a platform in several studies (Belanger et al., 2002; Chellappa & Sin, 2005; Lee et al., 2017), 'platform security' is also ranked highest in the survey study, underlining the importance of the first trust component in the case of Urban Data Platforms. *Trust in the competences of the platform owner*, the second trust component, is represented by the aspect 'trust in the platform owner' in the survey study. While this trust aspect in the survey study encompasses the capabilities, the integrity and the benevolence of the platform owner, the trust component derived from the literature refers to only one part of this aspect – the capabilities of the platform owner. The other two parts of this aspect – the integrity and the benevolence of the platform owner – are represented by the third trust component derived from the literature, *trust in the responsible governance of the platform owner*. The fact that 'trust in the platform owner' ranked third in the survey study provides evidence that the second and third trust component derived from the literature also apply in the case of Urban Data Platforms.

Moreover, three additional trust aspects were evaluated by the participants in the survey study. 'Trust in the data quality of the platform', which concerns data provided by data providers and offered on the platform, was rated on average as the second most important aspect by the participants. As none of the trust components derived from the literature considers this aspect and given its importance in the case of Urban Data Platforms, *trust in the data quality* is added as an additional trust component to the conceptual model of this study. The two remaining trust aspects in the survey study – 'trust in the platform manager' and 'risks of using the platform' – were rated considerably lower by the participants in terms of their importance concerning trust in Urban Data Platforms. In addition, as Urban Data Platforms are typically owned and managed by the same organization (Van Oosterhout et al., 2020), 'trust in the platform manager' can be neglected. 'Risks of using the platform' is covered by *trust in the responsible governance of the platform owner* in the broader sense, as the platform governance rules set by the platform owner determine the risk associated with using the platform. Therefore, no additional trust components are included.

Secondly, the survey study investigated the importance of various measures aimed at enhancing platform users' trust in an Urban Data Platform. In total, 56 participants assessed the importance of six measures, which attempt to ensure and prove the integrity of the platform manager, on a scale from 1 to 5, with 1 being 'not at all important' and 5 'extremely important'. The results, which are displayed in Figure 6, show that having a privacy statement and complying to GDPR is ranked highest on average, followed by an information transparency dashboard and a charter that describes the platform's key principles.

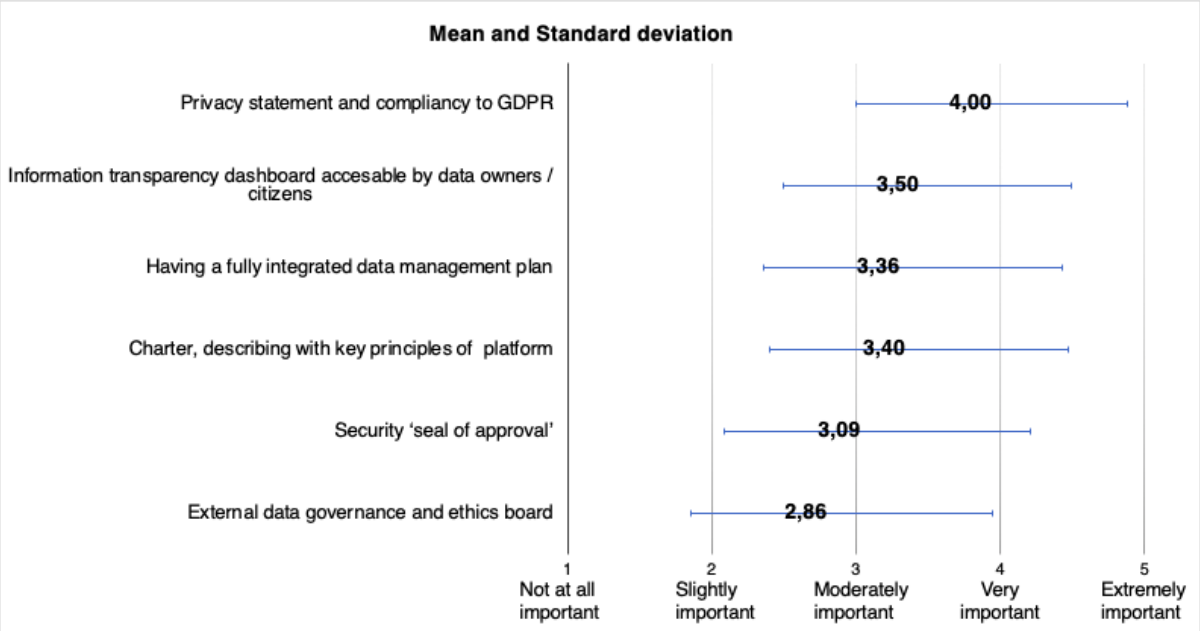

Figure 6: Trust enhancing measures in an Urban Data Platform (Source: Van Oosterhout et al., 2020)

From the six measures presented in the survey study, only the factor 'external data governance and ethics board' can be associated with multi-stakeholder collaboration, as external help is needed to install such a board. Based on the responses of all participants, this measure is on average the least important, indicating a rather low relevance for increasing trust in the platform. However, when only taking into account the responses of participants with an operational Urban Data Platform, the 'external data governance and ethics board' ranks fourth out of six, indicating that the importance of this measure might increase with the development stage of the platform. Therefore, this factor is further investigated in the second stage of this study. The implementation of the other five measures is not dependent on the help of additional actors, but can be achieved by the platform owner. Hence, these factors are not further examined in this study.

Other insights result from comments that the participants have voluntarily entered in an open text field. For example, one responded stated that *"by creating a situation that citizens have a feeling that they can influence what is going on on the platform"*, their city has achieved to increase trust in their Urban Data Platform [Platform owner, Rotterdam]. Another respondent explained that their platform *"has developed a reputation over the past 10 years for being independent of political or commercial interference in the data that it publishes"* and how data is generally managed [Platform owner, London]. While the former statement indicates a positive effect of including citizens in the development of an Urban Data Platform on the level of trust in the platform, the latter suggests that trust can be increased by purposely not collaborating with certain stakeholders from the public or private sector. Both insights are further investigated in the second stage of this study.

Thirdly, the results of Spearman correlation tests conducted by the research team of the survey study provide insights on relationships between trust in Urban Data Platforms and other variables. The value of the 'overall level of trust in the Urban Data Platform' in a city was determined by calculating the harmonic mean of the five aspects of trust discussed above. The perceived performance, or level of trust, of each of these aspects was evaluated by the respondents on a scale from 1 to 5, with 1 being 'poor' and 5 'excellent'. The correlations which were significant at a significance level of 0.05 and whose variables can be associated with multi-stakeholder collaboration are displayed in Table 3.

Variable A	**Variable B**	**Correlation coefficient**	**P - value**
Municipality capability maturity	Overall level of trust in the Urban Data Platform	0,376050559	0,010901365
Company engagement	Overall level of trust in the Urban Data Platform	0,295447976	0,046214759
Citizen engagement in the design of the platform	Overall level of trust in the Urban Data Platform	0,313946196	0,035713468

Table 3: Correlation coefficients between trust in Urban Data Platforms and factors of multi-stakeholder collaboration (Source: Van Oosterhout et al., 2020)

First, the variable 'municipality capability maturity' shows a moderate positive relationship with the 'overall level of trust in Urban Data Platforms' with a correlation

coefficient of 0,376050559, using Cohen's conventions to interpret effect sizes (1988). The value of municipality capability maturity was retrieved by calculating the harmonic mean of the values of ten different skills, such as data governance, ecosystem nurturing and data security, which are considered as important to develop an Urban Data Platform. The maturity of each of these skills was evaluated by 58 participants on a scale from 1 to 5, with 1 being 'very poor' and 5 'excellent'. The positive correlation implies that a high level of 'municipality capability maturity' must be present for achieving a high level of 'trust in Urban Data Platforms'. As the municipality is the owner of the Urban Data Platform in the majority of the cases (Van Oosterhout et al., 2020), this finding provides evidence that *proposition 1 is a necessary but not sufficient condition*.

Second, a low positive correlation is present between the variable 'company engagement' and the 'overall level of trust in Urban Data Platforms' with a correlation coefficient of 0,295447976. The value of company engagement is the harmonic mean of three values, indicating the involvement of companies in the general design, in defining rules and standards, and in developing tools and services of a city's Urban Data Platform. A total of 62 participants evaluated each factor on a scale from 1 to 5, with 1 being 'not at all' and 5 'a great deal'. The positive correlation implies that a high level of 'company engagement' must be present for achieving a high level of 'trust in Urban Data Platforms'. Since collaborating with private companies offers platform owners the opportunity to draw on additional resources, this finding provides evidence that *proposition 2 is a necessary but not sufficient condition*.

Third, there is a moderate positive correlation between 'citizen engagement in the design of the platform' and the 'overall level of trust in Urban Data Platforms' with a correlation coefficient of 0,313946196. As before, the harmonic mean of several factors was used to determine the value of citizen engagement in each city. On a scale of 1 to 5, with 1 being 'not at all' and 5 'a great deal', 61 participants indicated, for example, whether citizens could participate in the design or in decisions on the functionalities of the Urban Data Platform. The positive correlation implies that a high level of 'citizen engagement in the design of the platform' must be present for achieving a high level of 'trust in Urban Data Platforms'. Hence, this finding provides evidence that *proposition 3 is a necessary but not sufficient condition*.

Lastly, by dividing the results of the survey study according to the development stage of an Urban Data Platform, additional insights are gained into how some of the theoretical constructs of this study change over time. For each city, the research team of the survey study had calculated the harmonic mean for the variables presented below, each comprising several

aspects evaluated by the respondents on a scale of 1 to 5. On this basis, the arithmetic mean of these variables is calculated for cities at certain development stages and then compared with the arithmetic mean of all participating cities. The results are summarized in Table 4.

Variable	Average of all stages	Exploring & Planning	Building & Implementing	Operational
Municipality capability maturity	2,8	2,63	2,83	2,93
Overall level of trust in the Urban Data Platform	3,51	3,21	3,45	3,79
Company engagement	2,4	2,11	2,7	2,75
Citizen engagement in the design of the platform	1,98	1,83	2,32	1,86

Table 4: Municipality capability, trust in Urban Data Platform and stakeholder engagement in different development stages

First, the analysis shows that the municipality capability maturity increases with the development stage of an Urban Data Platform. As respondents were asked in the questionnaire to assess the current maturity at the time of conducting this survey, these results indicate that, on average, municipalities are able to increase their platform-related capabilities over time.

Second, the analysis reveals that the overall level of trust in the Urban Data Platform also increases with the development stage of an Urban Data Platform. As respondents again were asked to rate the current level of perceived trust, the results illustrate the trust levels at different development stages. Hence, it can be inferred that trust in an Urban Data Platform on average increases over time.

Third, the analysis shows that company engagement strongly increases with the development stage of an Urban Data Platform. However, respondents were asked whether companies had been included in the course of developing the platform, implying that the results do not reflect the level of company engagement at a particular stage. Nevertheless, as the value of company engagement increases with the development stage, this suggests that cities tend to involve companies at later stages of the development of their platform.

Fourth, the analysis shows that citizen engagement in the design of Urban Data Platforms is highest in cities whose platform is in the building or implementing stage. However, as before, respondents did not rate the current degree of citizen engagement, but whether

citizens had been included up to that point. Although the results do not accurately reflect the level of citizen involvement at the different stages, they do indicate that cities tend to involve citizens most when their platforms are in the building or implementing stage.

5.2. Delphi Study

This section first presents the results of the first round of the Delphi study, which contribute to answering the research question of this study. Afterwards, relevant results of the second round of the Delphi study are analyzed.

Firstly, the study suggests that *citizen engagement* is necessary for an Urban Data Platform to become successful, as 77% of the experts 'strongly agree' or 'somewhat agree' with this statement. During the development of the platform, respondents argue that citizens can be a source of innovative ideas for the city and help in defining user-centered use cases that are beneficial for the public. In addition, letting citizens participate in the development can create public acceptance and build trust. However, one of the experts points to the difficulty of involving citizens, as this can lead to minority opinions dominating the discussions. Recognizing also the challenge of effectively involving citizens, another expert suggests to follow the Triple Helix approach first and to involve citizens later on.

Overall, these results underscore the importance of citizen engagement in the development of Urban Data Platforms and provide evidence that *citizen engagement* might be a factor that influences trust in an Urban Data Platform.

Secondly, the study reveals that *collaboration between the public and the private sector* is widely seen as a key factor in the development of Urban Data Platforms. While the majority of respondents believes that the development of these platforms should be initiated and led by the government, the experts stress the importance of involving private sector experts to draw on external knowledge and resources. It is argued that local governments often lack the experience and skills to overcome the complexity of setting up an Urban Data Platform on their own, since the development of the platform's technical components requires knowledge and skills outside their traditional areas of responsibility.

These results strongly support the importance of collaboration between the private sector and public sectors, as it enables governments, who usually own the platform, to *access complementary resources* that are needed to develop an Urban Data Platform.

Thirdly, apart from having access to resources, such as technology, data management knowhow or skilled labor, the data reveals that collaboration with the private sector can provide the government with *access to funding* for the development of an Urban Data Platform. According to the respondents, co-financing of an Urban Data Platform by the public and the private sector, for example by setting up a public-private partnership and joint ownership, can be a viable solution to finance the costly endeavor of implementing and scaling a platform. By comparing an Urban Data Platform with other utilities such as the energy or telephone network, it is argued that the core of the platform and the basic features should be financed through public funds, whereas more sophisticated services building upon the infrastructure should be funded and developed by the market. Especially when scaling the platform, private funding is essential.

Consequently, *access to funding* can be regarded as another reason explaining the importance of collaboration between governments and the private sector in the development of Urban Data Platforms.

Fourthly, the study reveals that *collaboration with platform owners from other Smart Cities* plays an important role in the development of an Urban Data Platform. 70% of the experts 'strongly agree' or 'somewhat agree' that Smart Cities should work together to make Urban Data Platforms more interoperable, as this increases their attractiveness for the private sector. In addition, as individuals tend to travel and move around more often today, platform usage might be higher if the same standards and interfaces were used across cities.

In light of the stakeholders discussed so far in this study, *platform owners from other Smart Cities* seem to represent an additional stakeholder relevant to the development of Urban Data Platforms. Therefore, this stakeholder is added to the conceptual model and its role is further investigated in the second stage.

Fifthly, the study provides several insights regarding *trust between different stakeholders* of this research. To start with *citizens*, the majority of experts (67%) believes that citizens regard the public sector to be more trustworthy than the private sector to take the lead in the development of an Urban Data Platform. While this indicates which sector citizens seem to trust more in developing the platform, the study did not investigate which sector citizens trust more to own and operate the platform. However, since the owner of the platform is likely to be responsible for its development, it can be deduced that citizens' trust in the platform owner and thus in the Urban Data Platform is higher when they are owned by the public sector.

With regard to *mutual trust between the public and private sectors*, the results draw a similar picture in both directions. On a 5 point scale from 1 'high degree of trust' to 5 'complete distrust', more than 90% of the experts indicate that the level of trust in both scenarios is either 'some degree of trust', 'neither trust or distrust' or 'some distrust', relatively evenly distributed over these three points. The two ends of the scale received hardly any points. The distribution of votes shows that there appears to be trust issues between the public and private sectors, as neither sector fully trusts the other. This becomes further apparent in the experts' comments. On the one hand, experts from the public sector argue that the motives of the private sector are often unclear and in the past have often been dominated by the pursuit of economic benefit, both negatively impacting the relationship. On the other hand, experts from the private sector point to the lack of competencies of many public authorities and their low reliability with regard to long-term partnerships, both negatively impacting private sector trust in the public sector. One of the public sector experts admits that there are indeed examples where cities have started a project in the past but not maintained it.

In sum, the results reveal that there is a legacy of disappointment and mistrust on both sides, as an expert from the academic sector aptly concludes, mainly based on negative collaborative experiences from the past. This suggests that collaboration between the public and private sector affects the level of mutual trust between these parties, which deserves further research in the second stage.

Sixthly, the study investigated *at which level an Urban Data Platform is best developed*. The majority of experts suggest that the development should be kept either at a 'regional' level (43%) or at a 'local' level (37%), only 20% consider the development at an 'international' or 'multinational' level to be most beneficial. It is argued that the scale of the development should be small enough to be easily organized, but still large enough to exploit the benefits, such as interoperability. Especially the needs of citizens can best be met at the city level, and the control of an Urban Data Platform at national level could lead to dissatisfaction among citizens.

These results indicate that the level at which an Urban Data Platform is developed might influence the satisfaction of citizens and thus their attitude towards the platform.

Lastly, the study provides insights regarding the *importance of Triple Helix collaboration along different development stages* of an Urban Data Platform. On a scale from 1 to 5, with 1 being 'not at all important' and 5 'extremely important', the experts evaluated the importance of collaboration between government, industry and academia in each stage. The results show that

Triple Helix collaboration seems to be most important in an early development stage (Figure 7). 70% of the experts rated collaboration between these parties as 'extremely important' during the exploring and planning phase. After that stage, the importance of Triple Helix collaboration seems to decline. While during the building and implementation phase about 50% of the experts still consider collaboration as 'very important', only 1/3 of the participants believe collaboration to be 'very important' in the operational phase and thus after the launch of the platform.

Furthermore, the results indicate that Triple Helix collaboration is considered as more important by stakeholders from the public sector than from the private sector. Dividing the expert's answers by sector, the results show that experts from the public sector consider Triple Helix collaboration in all three stages of development to be more important than experts from the private sector. In the operational phase, for example, the average importance of Triple Helix collaboration is 3.92 based on the responses of experts from the public sector, whereas this figure is only 3.08 for responses from private sector experts.

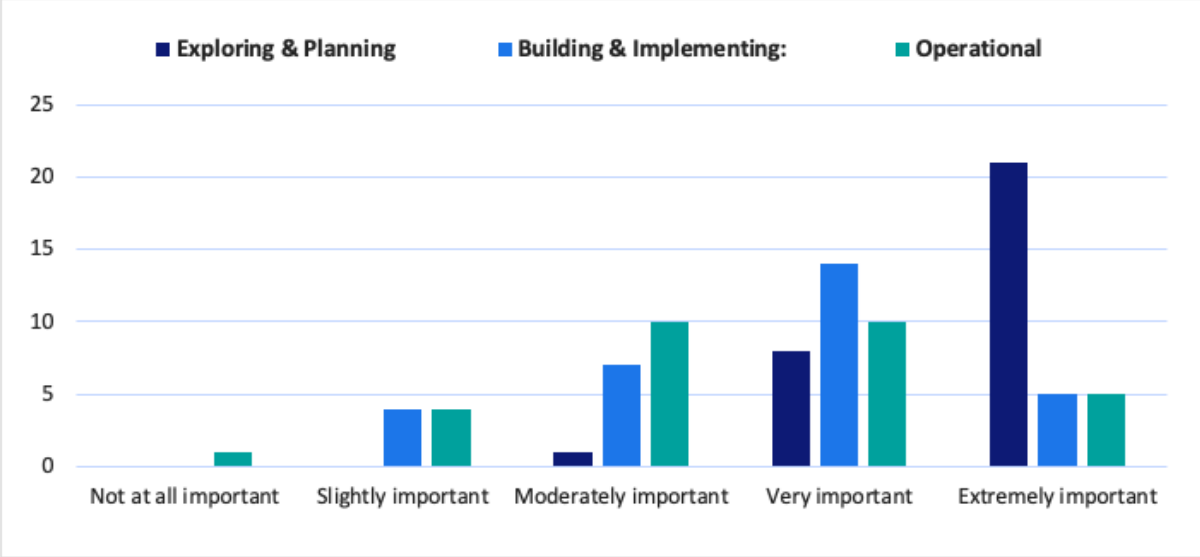

Figure 7: Triple Helix collaboration in different development stages of an Urban Data Platform (Source: Sheombar et al., 2020)

The second round of the Delphi study provides further insights on how trust between the public and the private sector can be enhanced. At first, the results are analyzed how *private sector trust in the public sector* can be increased. Presented with four different options for increasing trust in the public sector, the experts could allocate a total of 100 points to these options to reflect their relative importance. Two of the four options received remarkably more points than the others, namely *improving government's capabilities* and *creating collaborative experiences*.

This suggests that the capabilities of the government, who usually owns the platform, not only play a crucial role in the development of the platform, but also affect private sector trust in the platform owner.

Likewise, the experts were asked how *trust by the public sector in the private sector* could be improved. The experts were able to again allocate a total of 100 points to four predefined options. The results show that three of the four options received on average around 30 points each, while one option received almost no points. On the one hand, *improving the integrity of companies* and *reducing the self-centeredness of companies* could help to increase government's trust in private companies. On the other hand, *creating collaborative experiences* is seen by the experts as a factor that might also help to improve trust by the public sector in the private sector.

Taking both results together, the results suggest that creating *collaborative experiences* between the public and the private sector represents a key factor in building mutual trust between these parties. In other words, this means that, for example, the realization of joint projects between the public and private sectors could help to reduce the existing distrust between these parties.

5.3. Revised Conceptual Model

This section outlines the implications derived from the main findings of the secondary data analysis and presents a revised version of the conceptual model of this study. A final discussion and conclusion of the results, together with the findings from the case studies, is presented in chapter 7 and chapter 8.

Firstly, the Delphi study verifies the importance of citizen engagement as well as private company engagement in the development of Urban Data Platforms. While citizens can be a source of innovative ideas, private companies provide the public sector with access to resources, such as technology or skilled labor, which are needed to develop an Urban Data Platform. In addition, private companies can also provide access to funding, helping to implement and scale these platforms. To summarize the aspects that explain the importance of collaboration between the public and private sectors, and to also include academia, the initial construct 'access to complementary resources' is replaced by a broader construct called *Triple Helix collaboration* in the conceptual model. Proposition 2 is adjusted as follows:

Proposition 2: *Triple Helix collaboration in the development of Urban Data Platforms positively influences the level of trust in an Urban Data Platform by the platform users.*

Secondly, the Delphi study introduces another stakeholder relevant in the development of Urban Data Platforms, namely platform owners in other Smart Cities. Exchanging best practices with other Smart Cities on Urban Data Platform related issues is assumed to not only improve platform interoperability across cities, but also increase the capabilities of the platform owner. Therefore, *sharing best practices with other Smart Cities* is added as another construct to the conceptual model and its role is further explored in the second stage of this study.

Thirdly, the results indicate that platform owners not only increase their knowledge capacity by collaborating with other stakeholders, but also their skills in various other disciplines, for example in data management or ecosystem building. Therefore, the construct 'knowledge capacity' is extended and replaced by a new, broader construct called *platform capability of the platform owner*. This construct includes all the capabilities of the platform owner that are needed to develop and operate an Urban Data Platform. Furthermore, from the findings it can be inferred that these capabilities are positively influenced by collaborating with other stakeholders. Consequently, the conceptual model is adjusted and the new presumed relationships are further investigated in the case studies. Proposition 1 is adjusted as follows:

Proposition 1: *A strong platform capability of the platform owner positively influences the level of trust in an Urban Data Platform by the platform users.*

Fourthly, the survey study provides evidence that the three trust components of platforms derived from the literature are also applicable in the case of Urban Data Platforms. In addition, the results suggest that trust in the data quality of the platform represents another aspect that forms part of the overall level of trust in Urban Data Platforms. Therefore, *trust in the data quality* by the platform users is added as a fourth trust component to the conceptual model.

Lastly, correlations between several theoretical constructs and the dependent variable of this study were identified by the researchers of the survey study. 'Municipality capability maturity', 'company engagement' and 'citizen engagement in the design of the platform' each positively correlate with the 'overall level of trust in Urban Data Platforms' (Van Oosterhout et al., 2020). This not only supports the presumed link between the concepts of multi-stakeholder

collaboration and trust in Urban Data Platforms, but also provides evidence supporting proposition 1, 2 and 3 of this study.

The findings from the secondary analysis are included in the case study interview guide, and the revised conceptual model shown in Figure 8 serves as a basis for the case study analysis.

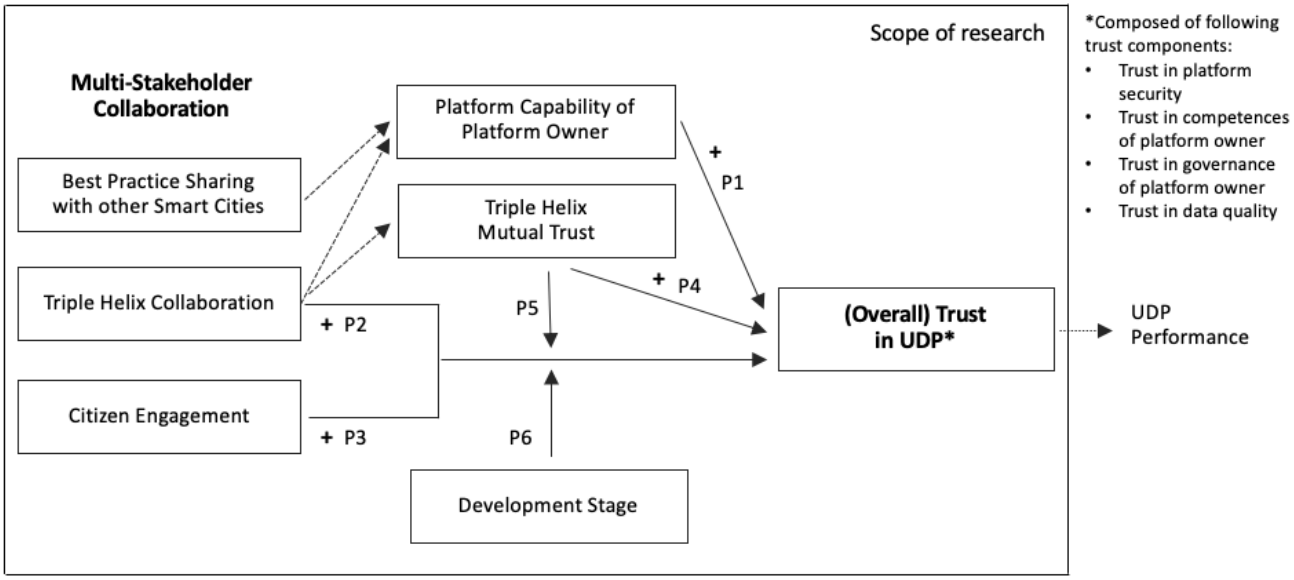

Figure 8: Revised conceptual model

6. Case Study Analysis

This chapter presents the results of the second stage of analysis of this study. First, the within-case analysis of the three cases are presented according to the methodology and structure described in chapter 4.3.2. After this, the results of the cross-case analysis are illustrated and the final conceptual model of this study is presented.

6.1. Case A: Hamburg

This section presents the within-case analysis of the development of the Urban Data Platform in Hamburg.

6.1.1. Case Description

The City of Hamburg established an *Open Data Platform* in 2012 in response to a new transparency law that came into force in Hamburg at that time. The platform, called 'Transparenzportal Hamburg', contains data sets with public information, which are primarily provided by municipal utilities and are accessible to everyone (Transparenzportal Hamburg, n.d.). From 2016, the City of Hamburg began participating in the Smart City project 'mySMARTLife', an European Smart City project (mySmartLife, n.d.), and in other local urban data projects. The aim of these activities was to investigate which urban data initiatives and use cases would be suitable for Hamburg. In this context, the municipality began developing its *Urban Data Platform*, called 'Urban Data Platform Hamburg', and launched the first version in 2017 (Urban Data Platform Hamburg, n.d.). Instead of building the platform from scratch, the City of Hamburg decided to build on the existing infrastructure of the Open Data Platform and another Spatial Data Platform, and gradually develop modules from these platforms into an Urban Data Platform. While the Open Data Platform and the Urban Data Platform are two distinct platforms today, most of the data sets available through the Open Data Platform are stored in the Urban Data Platform. As of 2020, the Urban Data Platform, which is owned and managed by the municipality, contains more than 400 data sets and about 250 applications. Furthermore, the City of Hamburg provides meta information on all datasets contained in its Urban Data Platform in a regional metadata catalogue, called 'MetaVer' (MetaVer, n.d.).

6.1.2. Trust in the Urban Data Platform

The City of Hamburg differentiates between four platform stakeholders: city administration, private companies, scientific community, and citizens. Apart from the scientific community, all of these stakeholders currently provide data to the Urban Data Platform. Due to an existing transparency law in the city, which is regularly updated by local politics, municipal utilities and other public authorities must disclose a large part of their data. Private companies and citizens, in contrast, voluntarily disclose data on the platform, because they realize that they benefit from it. For example, in its recent urban planning, the authorities were able to take into account the interests of private nightclubs in Hamburg, because they had made data available through the platform. Positive examples like this, in which data providers benefit from using the platform, not only increase the general acceptance but also the willingness to disclose data on the platform.

In terms of data usage, all four stakeholders actively use data from the Urban Data Platform. The municipality experienced that data users expect a certain degree of transparency and want to know, for example, where the data comes from and what it contains. For this reason, data sets are only added to the platform if they are described in the city's metadata catalogue, and each data set must have a data owner who can be contacted. In addition, the City of Hamburg tries to stand up for the data in the platform with its name. Both the metadata catalogue and the city seal strengthen the trust of data users in the Urban Data Platform.

Due to the difficulty of measuring the level of trust in a platform, the municipality takes the usage of the platform as a reference point. With about 3 million API requests per day on the platform, the City of Hamburg regards the overall trust in the platform as relatively high today. This is in line with the data from the survey study by Van Oosterhout et al. (2020), where trust in the platform is noticeably higher in Hamburg (4,1 on a scale from 1 to 5) than on average in other cities (3,51). On the one hand, this can be explained by the strong focus the municipality places on communicating the added value of the platform to its stakeholders. On the other hand, public trust in the government is relatively high in Hamburg, which seems to positively affect the acceptance of the Urban Data Platform. This high level of public trust, the municipality believes, is partly due to the fact that Hamburg regularly ranks among the best Smart Cities in national and international comparison and that this is recognized by the citizens.

From these findings it can be inferred that the overall level of trust in the Urban Data Platform in Hamburg can be decomposed into two components. First, as data users want to be sure that they can rely on the data from the platform for their own use, *trust in the data quality* seems to be essential. Second, once potential platform users have understood the added value, the platform appears to be well received by the stakeholders in Hamburg, indicating that platform users are generally satisfied and *trust the governance of the platform* by the municipality.

6.1.3. Multi-Stakeholder Collaboration

Triple Helix Collaboration

The City of Hamburg has collaborated with several universities in Hamburg in the development of its Urban Data Platform. While the municipality regards these projects as a success overall, because they provide valuable insights for the development of the platform, adapting to the different working methods of the academic sector and identifying transferable topics can sometimes be difficult and time consuming. The municipality has also worked closely with several IT service providers in the implementation of the platform. Since Hamburg mainly relies on Open Source software for its platform, private companies can contribute to the development of the different modules of the platform. Moreover, the municipality organizes working sessions with companies and universities several times a year, for example to determine the data sets needed for future urban data projects.

The municipality has the impression that these regular working sessions with the private and academic sectors have strengthened their trust in the municipality as the owner of the platform. In addition, the municipality experienced that publicly communicating which partners have been involved in the development of the platform advertises the platform and may help to attract other companies: *"When other companies hear which companies we are collaborating with or are interested in doing so, this naturally […] promotes the platform."* [Tegtmeyer]. Thus, a *positive effect* of Triple Helix collaboration on the overall level of trust in the Urban Data Platform can be drawn.

Citizen Engagement

The municipality has organized public working sessions with local developer communities to include their views and demands for the development of the platform. Furthermore, the interests of Hamburg's citizens with regard to urban data are indirectly reflected in the transparency law

of Hamburg which is regularly updated. However, the municipality acknowledges that the involvement of citizens can be further intensified and intends to involve citizens more frequently in the future, particularly on the topic of data governance.

A *relationship* between citizen engagement and trust in the Urban Data Platform *could not be observed*. Organizing public events, communicating ongoing projects and being transparent, however, is well received by the public and *strengthens public trust* in the City of Hamburg. This increase in public trust in the government, in turn, *positively contributes* to how citizens perceive the Urban Data Platform: *"The more modern we become [through digitizing public services], the more trust we will gain [as a municipality]. This trust can then have a positive effect on the platform, as the platform helps everywhere."* [Tegtmeyer].

Platform Capability of Platform Owner

By collaborating with private companies, the municipality can draw on the technical skills and competencies of the companies that are necessary for the continued implementation of new platform modules. At the same time, the municipality can expand its technical knowledge through these projects. Urban data projects with universities offer the municipality insights into current trends or specific urban data use cases: "*The Urban Data Hub of the municipality is co-financing two positions at the HafenCity University Hamburg. They do accompanying research [...] and show us, for example, what else you can do with these urban data*." [Tegtmeyer].

Based on these experiences, a *positive effect* of Triple Helix collaboration on the platform capabilities of the municipality can be deduced. A relationship between platform capabilities and the level of trust in the Urban Data Platform, however, *could not be observed*.

Triple Helix Mutual Trust

During the 'mySMARTLife' project, the municipality experienced that one of the private companies involved in the project initially had little confidence in the City of Hamburg to take the lead in the development of the Urban Data Platform. After some time, in which both sides could prove their abilities, mutual trust increased noticeably as both sides realized that they could benefit from each other. Similarly, the municipality is usually very cautious before entering into partnerships with private companies, as they experienced that companies often are not able to deliver on their promises.

Ultimately, the municipality views joint projects as an effective means of strengthening mutual trust, as this has proved successful on several occasions in the past: *"My impression is that today there is much more cooperation […] with companies and universities than in the*

past. And the more you do together, the more trust is built." [Tegtmeyer]. Thus, a *positive effect* of Triple Helix collaboration on mutual trust can be inferred. Further, the mutual trust built up in return appears to facilitate collaboration between the City of Hamburg and private companies, implying that mutual trust has a *positive effect* on Triple Helix collaboration.

Development Stage

The City of Hamburg has sought the help of academia in all stages of the development of its Urban Data Platform. This has enabled the municipality to answer the questions arising at each stage from a scientific perspective. In contrast, collaboration with the private sector has occurred at a somewhat later stage of development. In particular for the technical implementation of new platform modules, the municipality generally makes use of the assistance of private companies.

A *moderating effect* of the development stage of the Urban Data Platform on the relationship between multi-stakeholder collaboration and trust in these platforms *could not be identified*.

6.2. Case B: Cologne

This section presents the within-case analysis of the development of the Urban Data Platform in Cologne.

6.2.1. Case Description

Since 2012, the City of Cologne has operated an *Open Data Platform* that is freely accessible to all citizens and stakeholders in Cologne and its surrounding area (Offene Daten Köln, n.d.). The initial idea of the Open Data Platform emerged from the increased interest of civil society in public urban data. The Open Data Platform, which was developed by the City of Cologne, contains more than 350 data sets today, for example in the areas of mobility, environment, or health (Offene Daten Köln, n.d.). From 2016 to 2019, the City of Cologne participated in the 'GrowSmarter' project, an European Smart City project, and developed together with a private company a rudimentary, internal *Urban Data Platform*, called 'Open Urban Big Data Platform' (GrowSmarter, n.d.). The platform was owned by the private company, and was primarily used to aggregate project-related data and make it available to the project partners involved. In

addition, the municipality has been carrying out various urban data projects with different stakeholders in the last years. As these projects provide proof of concepts and important insights, they can be considered as an essential part in the development of an Urban Data Platform. Based on the insights from the 'GrowSmarter' project and other urban data projects, the municipality is currently implementing a new *Urban Data Platform*, which is accessible to stakeholders outside the municipality and fully owned by the City of Cologne.

6.2.2. Trust in the Urban Data Platform

During the 'GrowSmarter' project, data in the Urban Data Platform was mainly supplied by municipal utilities and by a few private companies. Both groups initially had great concerns about disclosing their data on the platform. While the municipal utilities were generally reluctant to disclose data on an external platform, private companies feared that their data could be seen and used by their competitors. Despite multiple assurances that the data is only accessible to certain groups, the companies did not fully trust the owner of the platform to the end because they were too afraid that the data could fall into the wrong hands. This was partly reinforced by the word 'open' in the name of the platform, as this implied something wrong and thus further reduced the companies' trust. Furthermore, the City of Cologne experienced that some data providers were afraid that their data could be misinterpreted by data users. To address this concern and enhance the trust of data providers, the municipality offers a well maintained metadata catalogue on its platform.

All data users during the 'GrowSmarter' project were official project partners and thus part of a closed pilot project. Trust of the users in the platform played therefore an inferior role. Nevertheless, the project showed that private companies in particular need to be sure that they can rely on the quality and reliability of the data. For a routing service provider, for example, it is essential that the real-time data from the platform is always correct and up-to-date. In order to create trust in this respect, the City of Cologne strives on the one hand to create clear and transparent data governance rules and on the other hand to act as an official data supplier to signal the correctness and authenticity of the data.

Judging by the platform usage of data providers and data users, the municipality describes that trust in its Open Data Platform and urban data projects has increased in recent years, yet constitutes a very fragile construct. With regard to the launch of the new Urban Data Platform

in Cologne, the municipality fears that this could negatively affect the overall trust in the municipality's urban data projects, especially when sensors are involved. For example, in a recent project concerning the establishment of noise sensors in the city centre, the municipality faced strong resistance. Although no sensitive data would have been recorded and citizens would not have to provide or use any data, some citizens feared until the end that their privacy would be violated by these sensors. The reason for this, the municipality believes, is a mix of fear that one's privacy could be violated and a general mistrust in the government.

From these findings it can be inferred that the overall trust in the Urban Data Platform in Cologne, or in urban data projects respectively, can be decomposed into three aspects. First, data providers are concerned about the *governance of the platform* in terms of data access rights and the purpose of data use. Second, data users need to be sure that they can rely on and trust the *quality of the data*. Third, citizens are strongly interested in the security of their privacy, implying that trust in the (data) *security of the platform* is crucial.

6.2.3. Multi-Stakeholder Collaboration

Triple Helix Collaboration

The City of Cologne has generally included academia at a very early stage in its urban data projects. Besides cooperating with students from local universities, the municipality has also actively sought the advice of knowledge institutions, for example the Fraunhofer Institute. Parallel to the 'GrowSmarter' project, the municipality started another urban data project called 'OpenAir Cologne' in 2016 together with the TH Köln (OpenAir Cologne, n.d.), testing a cloud solution from the university. Collaboration between the City of Cologne and the private sector has occurred in particular within the scope of 'GrowSmarter'. A regional software consulting company was one of the initiators of this project and played a key role as it provided both the technical expertise and the technical infrastructure. Collaborating with this company, however, limited the choice of other technology solutions as it required using their technology. Additionally, a number of private companies were involved in the project in order to provide or use urban data and also to participate in the design of the platform.

In the course of the 'GrowSmarter' project, the municipality tried to engage private companies involved in the project in the design of the platform, not only to benefit from their expertise, but also to build trust. However, the companies showed little interest to participate:

"We had hoped that [including the companies in the design of the platform] would create a bit more acceptance, but in the end it turned out that their willingness to cooperate was rather low." [Blauhut]. A positive effect of collaboration with the universities on trust in the platform could not be observed either. Thus, a relationship between Triple Helix collaboration and trust in the Urban Data Platform *cannot be established*.

Citizen Engagement

The municipality has included citizens in its urban data projects in various ways. On the one hand, the Open Knowledge Foundation, a non-profit association of private individuals, has proved to be a valuable partner in all questions concerning open data and data transparency. On the other hand, the City of Cologne actively seeks contact with specific citizen groups, for example the hacker community, data professionals or residents affected by urban data projects, in order to engage in an open dialogue. To facilitate this, a new 'future lab' was recently set up and the municipality tries to regularly visit community events in the city.

The project about noise sensors described earlier shows, however, that not all efforts led to the desired result. Although citizens were invited to exchange views and discuss their concerns, it proved very difficult to build trust and gain public acceptance for the municipality's plans. Therefore, a relationship between citizen engagement and trust in the Urban Data Platform *cannot be established.* Nevertheless, the municipality is convinced that its communication-intensive and transparent approach is well received and is slowly *increasing* public trust in the government: *"For some reason, we as the administration in Germany are always viewed very skeptically and negatively. This is clearly different in other countries. Our approach is therefore that we try to optimize trust through repeated cooperation*." [Blauhut]. This increased public trust further affects how citizens perceive and trust urban data projects carried out by the municipality. Therefore, a *positive effect* of public trust on the level of trust in the Urban Data Platform can be inferred.

Platform Capability of Platform Owner

Through the realization of individual urban data use cases, the municipality continuously gathers new knowledge on what works well and on what needs further investigation. Private companies, universities and knowledge institutions, but also citizens with specific domain knowledge and civil society associations are regularly involved in these projects as they add an additional perspective. The experience gained by the municipality from projects such as 'GrowSmarter' and 'OpenAir Cologne' benefits the development of the Urban Data Platform.

Consequently, a *positive effect* of Triple Helix Collaboration as well as citizen engagement on the platform capabilities of the City of Cologne can be drawn. An effect of the platform capabilities on the level of trust in the Urban Data Platform could *not be observed*.

Triple Helix Mutual Trust

The municipality notes that the fact that private companies are profit-oriented and therefore have a different motivation than the public sector is sometimes noticeable in joint urban data projects. Nevertheless, resulting discrepancies between the City of Cologne and the private sector could usually be resolved at an early stage through open communication or the existence of regulations, such as the GDPR, which must be adhered to by both sides. In contrast, previous urban data projects with academic institutions have shown that these institutions are driven by a very similar motivation as the public sector, the advancement and the creation of value for society and science. Mutual trust between the municipality and academic institutions is therefore naturally relatively high.

A positive effect of mutual trust on the level of trust in the Urban Data Platform or other relationships including mutual trust could *not be identified* in Cologne.

Development Stage

In the 'GrowSmarter' project, collaboration between the municipality and private companies occurred throughout the whole development process of the Urban Data Platform. However, this was also determined by the scope of the project. Apart from this, the municipality regularly involves the academic sector and its citizens in its urban data projects, especially in the early stages. This is because at the beginning of these projects there are usually many different questions that can be solved more efficiently by using the knowledge and expertise of a broader range of people: "*We have always tried to bring science on board relatively early on, because we know that many things we as a municipality simply cannot answer. […]. For example technological or socio-scientific aspects*." [Blauhut].

A *moderating effect* of the development stage of the Urban Data Platform on the relationship between multi-stakeholder collaboration and trust in these platforms *could not be identified*.

Further Insights

Besides the collaboration with the stakeholders discussed so far, the municipality is in regular exchange with cities from the surrounding area, such as Düsseldorf or Bonn. On the one hand,

this provides the City of Cologne with urban data-related insights, as these cities also engage in similar activities. On the other hand, the municipality has the belief that an Urban Data Platform should not stop at the borders of a city, but should also include cities and stakeholders from the surrounding area. Furthermore, the City of Cologne is in active contact with other Smart Cities in Europe, for example Manchester or Gent, to exchange best practices and gain new perspectives on current trends in urban data.

Therefore, collaboration with regional and international Smart Cities and the exchange of best practices clearly represents another source of knowledge for the City of Cologne, which has a *positive effect* on the municipality's platform capabilities.

6.3. Case C: Vienna

This section presents the within-case analysis of the development of the Urban Data Platform in Vienna.

6.3.1. Case Description

In 2011, the municipality of Vienna launched its 'Open Data Initiative', which resulted in the consecutive development of an *Open Data Platform* (Open Data Wien, n.d.). The Open Data Platform contains public sector data sets which are made available to all citizens and stakeholders without any restrictions for free use and further dissemination. Today, the Open Data Platform contains 499 data sets and 268 applications (Stadt Wien, 2020). Together with seven other European cities, Vienna started participating in the Smart City project 'Smarter Together' in 2016 to explore future concepts for city districts (Smarter Together, n.d.). To collect, store and exchange data from different pilot projects carried out in the 'Smarter Together' project, the municipality of Vienna developed a new, separate platform. While this platform was initially intended primarily for the project period, the municipality decided in 2019 to continue the development of this platform and turn it into an *Urban Data Platform* for the city of Vienna (Smart Data Wien, n.d.). The Urban Data Platform goes beyond the Open Data Platform, as it not only includes public sector data sets, but also confidential data, for example from sensors. Access to data is therefore restricted to certain parties. The establishment of the Urban Data Platform constitutes an important step for the municipality of Vienna to become more open and transparent as a city.

6.3.2. Trust in the Urban Data Platform

Data in the Urban Data Platform in Vienna is mainly provided by the city administration. The different departments in the public sector are obliged to contribute their data and make it accessible through the platform. In addition, data is provided by a few private companies. To safeguard the interests and rights of both stakeholders and thus also to establish trust in the Urban Data Platform, legal usage agreements are concluded with data providers.

Platform data is used by the entire community in Vienna, including private companies, universities, research institutes, public institutions, and citizens. While academia uses these data for research purposes, the private sector develops new applications for the public or for its own commercial activities. Citizens are usually in indirect contact with the Urban Data Platform as they are primarily interested in using the applications and not the platform itself. To increase platform trust of the data users, the City of Vienna tries to be very transparent in its urban data activities and to respond to the needs of the individual stakeholders by including them in its platform planning.

Based on the number of applications on the platform and the received feedback by the community, the municipality perceives the overall level of trust in the Urban Data Platform in Vienna today as relatively high. On the one hand, this is due to the municipality's efforts to openly communicate all plans and activities related to turning Vienna into a Smart City from the very beginning. This not only increased public trust in the City of Vienna, but also facilitated the development of the Urban Data Platform. On the other hand, this is due to the fact that the Urban Data Platform is owned by the government, which nowadays enjoys good public recognition in Austria. Data providers and data users would reportedly be more reluctant to adopt a city platform owned by a large private or international company like Amazon than by the City of Vienna, as trust in the latter is greater.

Decomposing the overall level of trust in the Urban Data Platform into individual trust components suggests that platform users in Vienna mainly consider two factors. First, as platform users are concerned about where the data is located, *trust in the platform security* seems to be a relevant aspect. Second, the Urban Data Platform in Vienna is trusted by many users for the reason that it is owned by the municipality, indicating that this *trust in the governance of the platform owner* forms a large part of the overall trust in the platform.

6.3.3. Multi-Stakeholder Collaboration

Triple Helix Collaboration

The City of Vienna has collaborated with several universities and research institutions in Vienna from an early stage in the development of its Urban Data Platform. These partners provide valuable insights into recent trends of Smart City developments, for example in the field of urban data technology standards. In contrast, collaboration with private companies has been less intensive as Vienna attaches great importance to not being dependent on the technology of a large company. Instead the municipality has largely developed the platform by itself, relying on Open Source standards and only including IT service providers for the technical implementation. However, during the 'Smarter together' project a cloud solution provided by an external private company was used to host the project data. The reasons for that were, first, that a cloud solution was needed quickly and, second, that the technical know-how in the city administration was not yet available at that time.

The municipality has launched several initiatives to engage personally with these stakeholders and include their perspectives into its planning. For example, the municipality organizes a community meeting every quarter of the year to begin the next so-called 'data phase' and update the community. With the 39th data phase starting in quarter 2 in 2020, such activities are very well received by the community and strengthen their trust in the municipality: "*The fact that these events are planned one year in advance is very well received, as it signals continuity and seriousness."* [Lutz]. Therefore, it can be inferred that Triple Helix collaboration in Vienna *leads to an increase* in trust in the Urban Data Platform.

Citizen Engagement

In collaboration with universities, the City of Vienna has conducted several surveys and invited citizens to workshops to get feedback regarding their development plans. Additionally, the citizen's interests are indirectly represented by civil society associations and (political) interest groups. In particular the 'Open Knowledge Foundation' proved to be a valuable partner that regularly provided new input and ideas for the design of the Urban Data Platform in Vienna.

In general, the City of Vienna tries to enter into a personal dialogue with its citizens whenever possible and to be transparent not only in its urban data activities, but also in other areas for which the municipality is responsible. Over the years, this has *led to an increase* in public trust in the City of Vienna, which in turn has *increased* the overall trust in the Urban Data Platform. In addition, the municipality believes that citizen engagement also has a direct

positive impact on trust in its Urban Data Platform when citizens feel that their input is appreciated: *"Citizens feel that their concerns are being taken seriously and suggestions for [the platform] are being implemented. This strengthens their trust in the platform.*" [Hartmann].

Platform Capability of Platform Owner

Collaborating with the academic sector regularly provides new insights, which helps the municipality to expand its own knowledge and to further direct the development of the Urban Data Platform. During the 'Smarter together' project, the municipality decided to partner up with an external provider of cloud solutions to develop a platform needed for the project. Developing this platform jointly with the private company allowed the municipality to access resources it did not possess and to improve its capabilities in this field. Equipped with this additional knowledge, the City of Vienna is currently in the process of rebuilding the Urban Data Platform with Open Source code in its own data center.

Consequently, it can be deduced that Triple Helix collaboration *has increased* the platform capabilities of the municipality. In addition, the citizens' regular contributions help the municipality to further develop and optimize the platform, indicating that citizen engagement too *positively influences* the municipality's platform capabilities. A relationship between the platform capabilities and trust in the Urban Data Platform *could not be observed*.

Triple Helix Mutual Trust

In the early days of Vienna's Open Data Platform the municipality experienced that several private companies would have preferred to enter into a contract with the City of Vienna and even pay for the data. The reason was that these companies feared that certain data they need would at some point no longer be available. Although the municipality tried to assure that this will not happen, some companies did not trust the municipality in this respect: *"There are many negative examples from other countries where a change in politics suddenly changed the rules of the platform. This of course makes many companies cautious."* [Hartmann]

Nevertheless, examples of platform adoption by other companies and joint urban data projects with the municipality *led to improved* private sector trust in the City of Vienna. This increased trust was subsequently reflected in an increased interest of the private sector in the platform and in collaborating with the City of Vienna, implying that there is also a *positive effect* of mutual trust on Triple Helix collaboration.

Development Stage

The academic sector as well the citizens of Vienna have been included into the municipality's urban data projects along all development stages of the Urban Data Platform. However, their contributions were needed most during an early exploration and planning stage, as many urban data related topics were still new and unexplored at that time, not only in Vienna but in Europe. Collaboration with private companies, in contrast, has been occurring in rather later development stages, for example in the implementation or operational phase. Also after the initial launch of the platform, the City of Vienna is still regularly working with private companies to develop new platform modules or to build new applications.

A *moderating effect* of the development stage of the Urban Data Platform on the relationship between multi-stakeholder collaboration and trust in these platforms *could not be identified*.

Further Insights

Apart from collaborating with the stakeholders described before, the municipality also extensively collaborated with other Smart Cities in Europe during the development of its Urban Data Platform. For example, in 2012, when the field of Urban Data Platforms in Europe was still in its infancy, the City of Vienna actively participated in 'D-A-CH-Li', an open data government cooperation between Germany, Austria, Switzerland and Liechtenstein.

As cities often face similar challenges when developing an Urban Data Platform, the City of Vienna has been doing pioneering work and exchanging best practices with many different cities, which not only saved time but also enabled the city to expand its platform capabilities. Therefore, it can be inferred that collaboration with other Smart Cities leads to *an increase* in the platform capabilities of the municipality in Vienna.

6.4. Cross-Case Analysis

This section first provides an overview of the findings from the three case studies presented above. Then, the theoretical constructs as well as the trust components presented in chapter 3 are reflected upon using the results of the cross-case analysis.

6.4.1. Findings

The relationships between the individual constructs of this study, which were established in the within-case analyses in section 6.1. to 6.3., are summarized and presented in Table 5. A '+' in the table indicates that a positive relationship was identified in the respective case. If the same relationship was identified in over half of the cases, that is in at least two cases, the proposed relationship is accepted.

Proposition	**Variable A → Variable B**	**Case A: Hamburg**	**Case B: Cologne**	**Case C: Vienna**	**Accepted**
1	Platform Capability → Trust in UDP				No
2	Triple Helix Collaboration → Trust in UDP	+		+	Yes
3	Citizen Engagement → Trust in UDP			+	No
4	Triple Helix Mutual Trust → Trust in UDP				No
Additional Relationships					
7	Triple Helix Collaboration → Platform Capability	+	+	+	Yes
8	Practice Sharing with other Smart Cities → Platform Capability		+	+	Yes
9	Citizen Engagement → Platform Capability		+	+	Yes
10	Citizen Engagement → Public Trust in Government	+	+	+	Yes
11	Public Trust in Government → Trust in UDP	+	+	+	Yes
12	Triple Helix Collaboration → Triple Helix Mutual Trust	+		+	Yes
13	Triple Helix Mutual Trust → Triple Helix Collaboration	+		+	Yes

Table 5: Cross-Case overview

Apart from proposition 1 to 4, which were formulated in chapter 3 and revised in chapter 5, seven additional relationships are presented, as these emerged during the analysis of the case study interviews. These new propositions are referred to as proposition 7 to 13. Proposition 5 and 6 of this study, suggesting a moderating effect of mutual trust and the development stage on the relation of multi-stakeholder collaboration and trust in Urban Data Platforms, are not included in Table 6, but are reflected upon in the following section.

6.4.2. Reflection on Theoretical Constructs

Triple Helix Collaboration

Proposition 2, which suggests a positive effect of Triple Helix collaboration on the level of trust in an Urban Data Platform, is supported by Case A and Case C. In both cases, the municipality regularly organizes working sessions and events to which they invite their partners from the private and academic sectors. As stated in Case C, the regularity of such sessions signals continuity and the seriousness of the municipality with regard to its Urban Data Platform, which increases the partner's trust in the Urban Data Platform. In addition, the municipality in Case A explains that demonstrating a successful collaboration with certain companies in the development of the platform can be positive publicity for the platform, which can enhance trust of other companies and attract new partners. However, neither case has actually measured the level of trust in its platform in the past. Instead, Case A and Case C use performance measurements of the platform, such as the number of daily API requests or the number of applications respectively, and received feedback by the community as indicators for the overall level of trust in their Urban Data Platform. The established relationship is thus very much based on the individual trust perception of the interviewees. Nonetheless, *proposition 2 can be accepted*.

Finding 1: Regular collaboration between the public, private and academic sectors in the development of an Urban Data Platform leads to a higher level of trust of platform users in an Urban Data Platform.

Citizen Engagement

Proposition 3, which suggests a positive effect of citizen engagement on the level of trust in an Urban Data Platform, is only supported by Case C. The municipality in Case C explains that it

is crucial for citizens to see that their needs and concerns provided through different channels are actually reflected by the further development of the platform. As this is successfully achieved in Case C, the municipality perceives that trust in its Urban Data Platform has increased through citizen engagement. However, no such relationship could be established in Case A and Case B. Therefore, *proposition 3 is rejected*.

Furthermore, the within-case analyses reveal that the general trust citizens have in their local government substantially affects how citizens perceive the trustworthiness of the Urban Data Platform. The municipality in Case A, for example, illustrates that citizens view the Urban Data Platform as one of many steps in the digitization efforts of the city's public authorities. If citizens are generally satisfied with these developments in their city and trust them, this in turn has a positive effect on their trust in the Urban Data Platform. In contrast, the municipality in Case B experienced how a general distrust of local government can prevent the implementation of urban data projects. Therefore, a new construct called *public trust in the government* and a new proposition (P11) suggesting a positive effect of public trust in the government on the level of trust in an Urban Data Platform are added to the conceptual model. Since all three cases support this new relationship, *proposition 11 is accepted*.

While public trust in the government seems to be considerably higher in some other countries according to the interviewees, for example in Scandinavia, it has traditionally been rather low in all three cases under study. The municipality in Case B assumes that this is partly due to the circumstance that public authorities in Germany in the past often had a kind of omniscient role that citizens had to submit to. However, as public authorities started to become more transparent and to communicate actively to its citizens, this level has improved over the last decade in all cases. In Case C, for example, the involvement of citizens in the planning of the Urban Data Platform proved to be very successful in improving public trust in the government. Consequently, another new proposition (P10) suggesting a positive effect of citizen engagement on public trust in the government is included in this research. Since the same effect was observed in Case A and B, *proposition 10 is accepted*.

Finding 2: Public trust in the government mediates the positive relationship between citizen engagement and overall trust of platform users in an Urban Data Platform.

Platform Capability of Platform Owner

Proposition 1, which suggests a positive effect of the platform capability of the platform owner on the level of trust in an Urban Data Platform, is not supported by any of the cases. This could be because relationships in the case studies were established by identifying rationales for causal relationships between variables in the conceptual model. Since this technique strongly depends on the observed and communicated conditions of the interviewees, a situation could arise in which an existing relationship between variables is not recognized even though one exists. Nonetheless, based on the case study results, *proposition 1 is rejected*.

Moreover, the results reveal that the municipality – as the platform owner – could increase its platform capabilities through collaboration with the private and academic sectors in all three cases. In addition, in Case B and Case C, the municipality increased its platform capabilities by including citizens in the Urban Data Platform development. While collaboration with private companies mainly improves the municipality's technical competences required for the implementation of the platform, the academic sector provides insights, for example, into platform strategy and governance. Citizens help the municipality to collect ideas for the platform's further development and to define platform requirements. Based on these results, two new propositions are added to the conceptual model, which suggest a positive effect of Triple Helix collaboration (P7) and citizen engagement (P9) respectively on the platform capability of the platform owner. As the majority of the cases support these relationships, *proposition 7 and 9 are accepted*.

Apart from this, the municipalities of Case B and Case C state that they have benefited considerably from collaboration with other Smart Cities that are also developing an Urban Data Platform. Exchanging best practices and discussing latest trends with comparable cities not only save the municipalities time but also increase their platform capabilities. Consequently, a new proposition (P8) suggesting a positive effect of sharing best practices with other Smart Cities on the platform capability of the platform owner is added. Given the majority of the cases supporting this relationship, *proposition 8 is accepted*.

Finding 3: Collaboration with the academic and private sectors, with platform owners in other Smart Cities, and with citizens each leads to a higher maturity of the platform capabilities of the platform owner.

Triple Helix Mutual Trust

Proposition 4, which suggests a positive effect of Triple Helix Mutual Trust on the level of trust in an Urban Data Platform, is not supported by any of the cases. Similarly as with proposition 1, this could be because the technique used in the case study analysis to establish relationships is not suitable for these constructs. Based on the results, *proposition 4 is rejected*.

Furthermore, mutual trust between the municipality and academic institutions was perceived as high by the municipalities in all three cases throughout their joint urban data projects. The municipality of Case B explains that the academic and public sectors generally have similar interests and strive to advance science and society respectively, which goes well together. In contrast, in Case A and Case C there were examples where mutual trust between the municipality and some companies of the private sector was rather low in the early days of their platforms. In Case A the municipality experienced that a private company once had little trust in the municipality's ability to take the lead in the platform's development, and conversely the municipality is also rather cautious about entering into new partnerships with private companies because of false promises made by companies in the past. Ultimately, Case A and Case C state that joint projects are the most effective way to increase mutual trust. Moreover, in both cases greater mutual trust subsequently led to an increase in collaboration between these parties. Therefore, two new propositions are added to the conceptual model, which suggest a positive effect of Triple Helix collaboration on mutual trust (P12) and vice versa (P13). With Case A and Case C supporting these two relationships, *proposition 12 and 13 are accepted*.

Finding 4: Collaborative experience from projects undertaken by the public and private sectors lead to an increase in mutual trust between these parties, which in turn encourages further collaboration between them.

For proposition 5, which suggests a moderating effect of mutual trust on the relation between multi-stakeholder collaboration and the level of trust in an Urban Data Platform, no evidence could be found. This could be due to the way the proposition was formulated. While it is theorized that mutual trust in relationships affects the effectiveness as well as the outcome of collaboration (Bryson et al., 2006; Provan et al., 2007), the interviews reveal that building trust in the platform was rarely the main goal of collaborations between the municipality and other stakeholders, but rather a welcome side-effect. In addition, neither the cities themselves nor this

study measured mutual trust between the various relationships, preventing a quantitative measurement of the proposition. *Proposition 5 is rejected*.

Development Stage

The case study analysis provides no evidence for proposition 6, which suggests a moderating effect of the development stage of an Urban Data Platform on the relation between multi-stakeholder collaboration and the level of trust in an Urban Data Platform. Similarly as with proposition 5, this could be because the constructs of this proposition were not quantified, which makes it difficult to evaluate a moderating effect. *Proposition 6 is rejected*.

Apart from that, several patterns emerged from the analyses. First, collaboration between the municipality and the academic sector takes place particularly in the exploration and planning stage of the Urban Data Platform. While the municipality in Case A has collaborated with academia in all stages, Case B and C state that an academic perspective was particularly helpful in an early phase, when there were still many open and unresolved issues. Second, private companies are mainly included in the implementing and operational stage. In Case A and Case C, the municipalities regularly collaborate with private companies to develop new modules for their platforms. Third, citizens seem to be included in the exploration and planning stage of the platform, but also project-specific at later points in time. Case B, for example, involved its citizens in a sensor project to identify their needs and integrate them in the project.

Finding 5: In the development of an Urban Data Platform, collaboration between the municipality and the academic sector is most beneficial at an early exploration and planning stage. In contrast, collaboration between the municipality and the private sector is most beneficial in later stages, when the platform is being implemented.

6.4.3. Reflection on Trust Components of Urban Data Platforms

Based on the findings of the within-case analysis of the cities Hamburg, Cologne and Vienna, the overall trust in an Urban Data Platform can be decomposed into three components.

First, *trust in the security of the platform* is identified as a relevant trust component in Case B and Case C. Particularly for citizens it is important that their privacy is protected and that data is securely stored on a trusted platform, as illustrated in Case B. Citizens in Case C, for example,

prefer to have their personal data stored on European servers, as trust in those is higher than in non-European ones.

Second, *trust in the data quality* is identified as a relevant trust component in Case A and Case B. While in both cases data users demand a certain degree of transparency regarding the origin of the data to be able to assess its quality, Case B further points out that private companies using this data to build new business models must be sure that specific data flows are available on the platform on a long-term basis.

Third, *trust in the governance of the platform owner* is identified as a relevant trust component in all three cases. This includes trust in the integrity of the platform owner, or the organization owning the platform, but also trust in all urban data projects and strategic decisions by the platform owner, for example with regard to data governance, which are related to the development and operation of the Urban Data Platform.

Finding 6: The overall level of trust of platform users in an Urban Data Platform is composed of a) trust in the data quality, b) trust in the security of the platform, and c) trust in the governance of the platform owner.

6.5. Final Conceptual Model

This section presents the final conceptual model of this study, encompassing the empirical results of the secondary data analysis and the case study analysis. In addition to propositions 1 to 3, which were derived from the academic literature and are accepted, seven new relationships emerged in the course of this study, depicted as propositions 7 to 13, which are also accepted. Dashed lines between two constructs indicate relationships that could be accepted by the secondary data analysis, but not by the case study analysis. This will be further discussed in section 7. The relationships shown in the final conceptual model in Figure 9 can serve as hypotheses for future research.

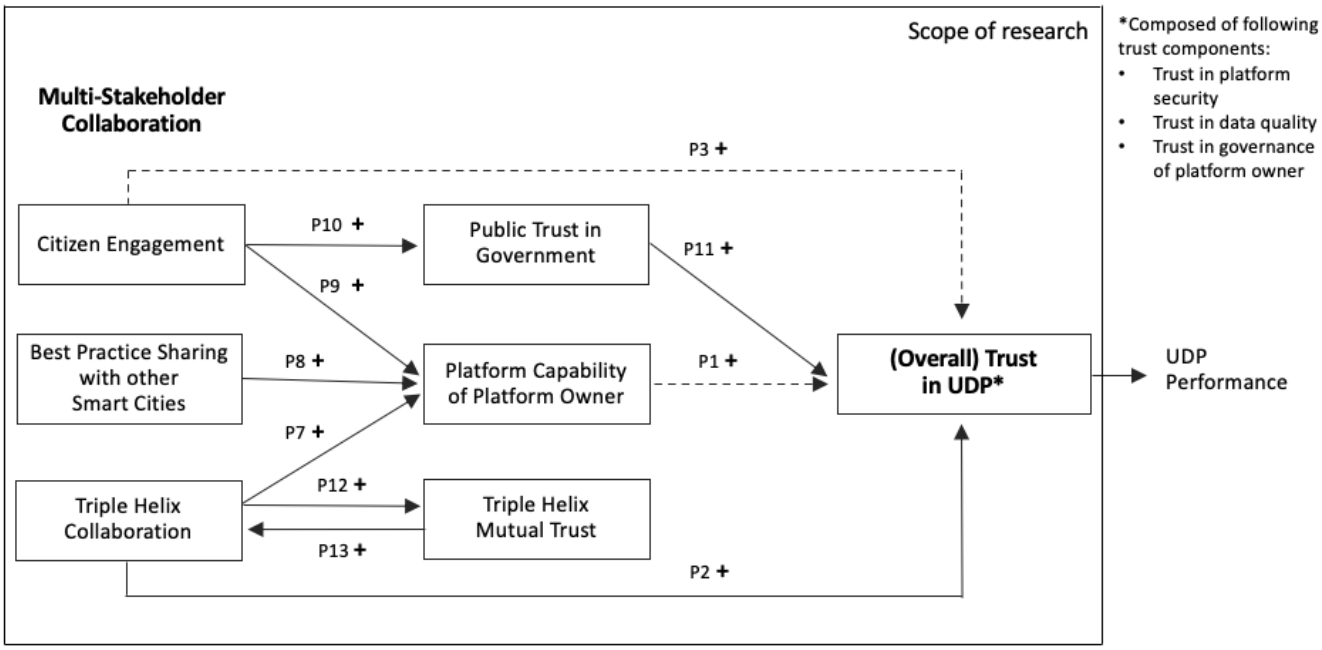

Figure 9: Final conceptual model

7. Discussion

This chapter discusses the two central concepts of this study by contrasting the results of the secondary data analysis and the case study analysis. In addition, the findings are linked to the academic literature.

7.1. Multi-Stakeholder Collaboration

Similar to the development and governance of successful Smart Cities (Nam & Pardo, 2011), the results from both stages of this study underline the importance of collaboration of different stakeholders in the development of Urban Data Platforms. The stakeholders analyzed in this study are discussed in the following.

Firstly, the positive correlation between *company engagement* and trust in Urban Data Platforms found in the secondary data analysis (Van Oosterhout et al., 2020) is supported by the findings from the case studies. The municipalities (as the platform owners) in Case A and C explain how regular collaboration with the private sector can lead to an increase in trust in the platform. Similar to what Sultan and Mooraj (2001) point out in their study on B2B e-commerce platforms, signaling existing partnerships can be a way to increase the perceived trustworthiness of a platform owner and thus that of an Urban Data Platform. In contrast, no direct relationship between *academia engagement* and trust in Urban Data Platforms could be established in this study. Due to their scientific methods and carefully researched contributions, all platform owners in the case studies, however, emphasize the importance of including academic institutions in urban data projects. Ultimately, access to knowledge is seen as the main reason for collaboration with both of these stakeholders, as this not only strengthens the municipality's own capabilities, but also increases the speed of platform development. This finding is in line with the central thesis of the Triple Helix model (Etzkowitz, 2016; Etzkowitz & Leydesdorff, 1995), as well as theory on inter-organizational networks (Bryson et al., 2006; Huxham & Vangen, 2005), both claiming that collaboration between heterogeneous parties allows the exchange and creation of new knowledge.

Secondly, while a positive correlation between *citizen engagement* in the design of Urban Data Platforms and trust in Urban Data Platforms is present in the secondary data analysis (Van Oosterhout et al., 2020), a direct effect of citizen engagement on trust in these platforms could

only be identified in one of the case studies. Instead, platform owners in the case studies indicate that citizens' trust in the platform is very much dependent on their public trust in the (local) government, as the platform is typically operated by the municipality. As public trust in the government increases, so does trust in the Urban Data Platform. With citizen engagement in the development of the platform being a way of increasing public trust according to the platform owner in Case A, this could explain the positive relationship between citizen engagement and trust in Urban Data Platforms found in the secondary data analysis. This finding can be linked to the literature covering public participation and public trust (Wang & Van Wart, 2007). Although researchers are divided on an increase in public trust through public participation, Wang and Van Wart (2007) show that public trust increases in cases where services are subsequently developed that reflect the public's needs, which is the case with the development of Urban Data Platforms. Moreover, the case study analysis reveals that including citizens at the different development stages allows their needs and requirements to be integrated into the further development of the platform, reflecting the rationale of the Quadruple Helix approach in the literature (Borkowska & Osborne, 2018, Carayannis & Campbell, 2009).

Thirdly, *platform owners from other Smart Cities* emerged as a new stakeholder in this study, which is regularly involved in the development of a city's Urban Data Platform. While platform owners in the case studies highlight the importance of exchanging best practices with other cities to expand their own platform capabilities, Smart City experts in the Delphi study point out that coordination between platform owners can improve the interoperability of the platforms, which may increase their attractiveness for the private sector (Sheombar et al., 2020). Given the importance of collaboration between Smart Cities deduced from this study, and the fact that no literature could be found to investigate the implications of these collaborations in the field of Smart Cities or Urban Data Platforms, this represents an interesting area for future studies. The prevalence of collaboration between Smart Cities is also reflected in the large number of European Smart City projects which have been launched in recent years and are supported by the European Union (EIP-SCC, n.d).

With the municipality as the owner of the Urban Data Platform, this study found that collaboration with each of the four stakeholders discussed above can help the municipality to expand its platform-related capabilities. Further, the secondary data analysis shows that there is a positive correlation between a municipality's platform capabilities and trust in an Urban Data Platform (Van Oosterhout et al., 2020). While this relationship was further investigated in

the case studies, no evidence for a causal relationship between these variables could be found. Unlike in other platform ecosystems, where a platform's credibility and trust in the platform can be increased by demonstrating the owner's competencies (Hart & Saunders, 1997), this causal effect seems not to exist in the case of Urban Data Platforms. This could be because the majority of (potential) platform users may not recognize the platform owner's capability, as most users have no direct contact with the platform owner. Instead, this lack of support for a causal relationship suggests that there is an indirect effect of the municipality's platform capabilities on the level of trust in the platform. Since platform owners in the case studies explain that increased platform knowledge generally benefits the successful development and operation of an Urban Data Platform, an increase in the quality of the platform – caused by increased capabilities of the platform owner – could in turn have a positive effect on the trust of platform users in the platform. However, these presumed relationships require further research.

Lastly, this study investigated the role of mutual trust between the public, private and academic sectors. First illustrated in the secondary data analysis of the Delphi study (Sheombar et al., 2020), the case studies provide further evidence that joint collaborative experiences between the public and private sectors can increase mutual trust between these parties. Similar to Provan et al. (2007) in the literature on inter-organizational networks, who argue that trust cannot be created overnight and develops over time, the platform owners in Case A and Case C give examples in which an initially low level of mutual trust with a private sector company has slowly increased over the course of joint projects. Mutual trust between the public and academic sectors, in contrast, was seen as high in all case studies and was never an issue in the collaboration between these parties.

7.2. Trust in the Urban Data Platform

From the academic literature on trust it becomes evident that trustees can be not only individuals, but also organizations or objects, such as hardware or software, in which a person can have trust (Janowicz & Noorderhaven, 2006). Similarly, this study reveals that platform users evaluate different aspects of an Urban Data Platform in terms of their trustworthiness, allowing the overall level of trust in Urban Data Platforms to be decomposed into individual components. The findings from both analysis stages are largely congruent and lead to the identification of three individual trust components. While two of the three general platform

components derived from the literature and presented in chapter 3 seem to be applicable also in the case of Urban Data Platforms, a new trust component was additionally identified.

First, *trust in the security of the platform* was ranked highest in terms of importance by the participants in the survey study (Van Oosterhout et al., 2020) and was also identified in two out of three cases studies. This is line with several studies from the platform literature, where platform security is seen as the key factor influencing the overall trustworthiness of a platform (Belanger et al., 2002; Chellappa & Sin, 2005; Lee et al., 2017; Sultan & Mooraj, 2001). Second, *trust in the data quality* of the platform was considered the second most important aspect in the survey study (Van Oosterhout et al., 2020) and was identified in two of the three cases. This trust component could not be found in the literature on general platform ecosystems, possibly because trust in data quality seems to be particularly relevant for Urban Data Platforms, which are a rather new phenomenon in the literature. Third, *trust in the governance of the platform owner* represents the last component, which comprises not only trust in the organization that owns the Urban Data Platform, but also trust in the activities and strategic decisions of the platform owner concerning the development and governance of these platforms. This trust component was ranked third in the survey study in terms of importance (Van Oosterhout et al., 2020) and was present in all the case studies. While the existence of clear and transparent governance rules, as proposed by Cao et al. (2017) and Cohen et al. (2014) in their studies on data exchange in Smart Cities, certainly helps to increase platform users' trust in the platform, the case studies suggest that platform users' trust in the platform owner is formed by the totality of the perceived decisions and activities of the platform owner. Meanwhile, *trust in the competences of the platform owner* – which was derived as another trust component from the literature (Hart & Saunders, 1997; Sultan & Mooraj, 2001) – could not be supported as a relevant trust component either in the secondary data analysis or the case study analysis. As discussed above, this could be due to the circumstance that platform users generally have no or little direct contact with the owner of an Urban Data Platform and are therefore presumably not in a position to directly assess its capabilities. Instead, platform users tend to engage directly with the Urban Data Platform and observe the properties and governance of the platform, factors that are reflected in the other trust components.

8. Conclusion

This chapter presents the main findings of this study and answers the research question defined in chapter 1. In addition, the theoretical and managerial implications of the results are discussed, and finally the limitations of this study and directions for future research are outlined.

8.1. Main Findings

This exploratory study aims to reveal insights on the concepts of *multi-stakeholder collaboration in the development of Urban Data Platforms* and *trust in Urban Data Platforms* and their relation to each other. In a two-stage process using secondary data and case studies, the initial conceptual model derived from the literature was iteratively refined and the final conceptual model was ultimately presented in chapter 6.5. The main findings of both stages are presented in this section, answering first the main research question and then the three sub-research questions of this study.

Which factors of multi-stakeholder collaboration in the development of Urban Data Platforms influence the level of trust in Urban Data Platforms?

This study shows that collaboration between the platform owner, which in most cases is the municipality, and multiple other stakeholders not only facilitates the development of an Urban Data Platform, but also influences the overall trust of platform users in the platform. Relevant stakeholders that could be identified are *private companies*, *academic institutions*, *platform owners in other Smart Cities* that are also developing an Urban Data Platform, and *citizens*. Collaboration with each of these stakeholders either directly or indirectly affects the overall level of trust in an Urban Data Platform.

i. How and why do these factors of multi-stakeholder collaboration influence the overall level of trust in Urban Data Platforms?

Firstly, this research found that collaboration between the municipality (as the platform owner), private companies and academic institutions leads to a *direct increase* of the level of trust in Urban Data Platforms. On the one hand, this is because regular touchpoints and joint projects signal continuity and the seriousness of the platform owner's Urban Data Platform activities.

On the other hand, the successful collaboration with certain companies can be a positive advertisement for the platform. Moreover, collaboration with these two stakeholders also seems to *indirectly increase* trust in Urban Data Platforms. By joining forces and accessing external resources, platform owners can actively expand their platform-related capabilities. The secondary data analysis reveals that these platform capabilities of the municipality in turn are positively correlated with trust in Urban Data Platforms (Van Oosterhout et al., 2020). Although this correlation does not imply a causal effect, it indicates that strong platform capabilities of the platform owner must be present to achieve a high level of trust in an Urban Data Platform.

Secondly, collaboration between the municipality (as the platform owner) and platform owners from other Smart Cities can *indirectly increase* the level of trust in Urban Data Platforms. As cities often go through similar stages and face similar challenges in the development of their Urban Data Platform, exchanging insights actively enhances the platform capabilities of the platform owner. As explained above, the positive correlation between platform capability of the municipality and trust in Urban Data Platforms (Van Oosterhout et al., 2020) suggests that an increase in the platform capabilities, in this case caused by collaborating with other Smart Cities, is associated with an increase in trust in an Urban Data Platform.

Lastly, this study reveals that including citizens in the development of Urban Data Platforms *indirectly increases* trust in Urban Data Platforms in two ways. First, similar to collaboration with the stakeholders discussed before, citizens can supply municipalities with new insights that are beneficial for the development of the platform, thus increasing the municipality's platform capability. The effect associated with the positive correlation also applies in this case. Second, and more importantly, citizen involvement in the development of Urban Data Platforms seems to substantially strengthen public trust in the (local) government. As observed in all three cases in the case study analysis, a higher level of public trust in the government is associated with a higher level of acceptance and trust in the Urban Data Platform, since these platforms are owned by municipalities. Conversely, a low level of public trust can lead to a fundamental distrust of the development of an Urban Data Platform, which considerably hinders its development. Important to note is that the level of public trust in the government reflects not only how satisfied citizens are with the Urban Data Platform, but also, for example, the degree of digitization of public services or the general quality of public life in the city. Consequently, public trust in the government is influenced by many factors, with citizens' engagement in the development of Urban Data Platforms being one of them.

ii. In which trust components can the overall level of trust in an Urban Data Platform be decomposed?

The case study analysis shows that trust in an Urban Data Platform can be decomposed into three individual trust components, which are evaluated by the different platform users in terms of their trustworthiness. These trust components, which collectively represent the overall trust in an Urban Data Platform, are *trust in the platform security*, *trust in the data quality*, and *trust in the governance of the platform owner*. While the first two components are of technical nature, concerning the infrastructure of the platform and the data and services provided through the platform, the latter concerns the platform owner as an organization, including all activities and strategic decisions of the platform owner related to the development and operation of an Urban Data Platform. The secondary data analysis supports the relevance of these three components and further indicates that trust in platform security constitutes the most important component, followed by trust in data quality and trust in the platform owner (Van Oosterhout et al., 2020).

iii. At which stages in the development of Urban Data Platforms is multi-stakeholder collaboration particularly beneficial?

The secondary data analysis shows that Smart City experts from the public, private and academic sectors believe Triple Helix collaboration to be most important in the early exploration and planning stage of the platform (Sheombar et al., 2020). After that, the importance of Triple Helix collaboration declines. Platform owners in the case studies confirm that collaboration with the academic sector is indeed most beneficial in an early stage, as their scientific insights are of great help in designing and planning the platform. Collaboration with the private sector, however, is preferred by the platform owners in later stages, as private companies with their technical skills can help to implement the technical infrastructure of the platform. This is also reflected in the results of the secondary data analysis, which indicate that platform owners include private companies in the development at a rather later stage. Meanwhile, citizens are occasionally involved at all stages to include their ideas and needs into the further development of the platform. In conclusion, platform owners in the case studies point out that the development of an Urban Data Platform is never complete, but that the platform is continuously being expanded with additional use cases and modules. Developing a new module usually follows the typical development phases from planning to implementation, indicating that each of these stakeholders is needed in recurring cycles.

A summary of the key findings of the case study analysis are presented below in Table 6.

#	**Finding**
1	Regular collaboration between the public, private and academic sectors in the development of an Urban Data Platform leads to a higher level of trust of platform users in an Urban Data Platform.
2	Public trust in the government mediates the positive relationship between citizen engagement and overall trust of platform users in an Urban Data Platform.
3	Collaboration with the academic and private sectors, with platform owners in other Smart Cities, and with citizens each leads to a higher maturity of the platform capabilities of the platform owner.
4	Collaborative experience from projects undertaken by the public and private sectors leads to an increase in mutual trust between these parties, which in turn encourages further collaboration between them.
5	In the development of an Urban Data Platform, collaboration between the municipality and the academic sector is most beneficial at an early exploration and planning stage. In contrast, collaboration between the municipality and the private sector is most beneficial in later stages, when the platform is being implemented.
6	The overall level of trust of platform users in an Urban Data Platform is composed of a) trust in data quality, b) trust in the security of the platform, and c) trust in the governance of the platform owner.

Table 6: Key findings derived from the case study analysis

8.2. Theoretical Contributions

This research contributes to the academic literature in several ways. Firstly, with Urban Data Platforms increasingly becoming a central building block in the development of Smart Cities (EIP-SCC, 2017) and user trust in these platforms affecting platform adoption (RUGGEDISED, 2018), a better scientific understanding of the concept of trust in Urban Data Platforms is needed to facilitate the development of Smart Cities in the long term. Deduced from secondary data and newly collected data from case studies, this study explores three trust components, which together comprise the overall level of trust in Urban Data Platforms. Despite the existence of research on trust in a variety of platform ecosystems (Belanger et al., 2002; Hurni & Huber, 2014, Lee et al., 2017), this research is the first to investigate trust in Urban Data Platforms using multiple case studies.

Secondly, this study investigates the role of multiple stakeholders that participate in the development of Urban Data Platforms. While research in recent years has mainly focused on collaboration modes in the development of Smart Cities (Giffinger & Gudrun, 2010, Meijer & Bolivar, 2015), this study addresses specifically Urban Data Platforms as the object of investigation. To the knowledge of the author, this research is the first to investigate how and why cities follow the Quadruple Helix approach, conceptualized by Carayannis and Campbell in 2009, in developing their Urban Data Platform.

Lastly, the main academic contribution of this research is the established link between the concepts of multi-stakeholder collaboration and trust in Urban Data Platforms, resulting in a new conceptual model. Apart from constructs derived from the theoretical literature, this model includes new variables such as *best practice sharing with other Smart Cities* or *public trust in the government*, which were identified in the course of this study and tested by a cross-case analysis. Through semi-constructed interviews with the platform owners of three Urban Data Platforms, rationales for causal relationships between variables in the conceptual model were discovered. These established relationships can serve as hypotheses and offer a direction for future research in a field that has been little explored so far.

8.3. Managerial Implications

This research offers several managerial implications on how to increase trust in Urban Data Platforms by involving different stakeholders in the development of the platform. Since the platform owners of the Urban Data Platforms examined in the case studies were exclusively municipalities, the recommendations primarily address platform owners from the public sector.

Firstly, platform-related working sessions with private companies and academic institutions as well as events with citizens to discuss current developments of the Urban Data Platform should be well-planned and held regularly. This signals continuity and the seriousness of the platform owner's plans, which strengthens the trust of platform users in the platform.

Secondly, successful urban data projects with private companies can be used to publicly promote the Urban Data Platform. This can increase the attractiveness of the platform and, in particular, increase trust of other companies in the platform.

Thirdly, public trust in the government constitutes a key factor in how an Urban Data Platform is perceived by the citizens. When citizens are generally satisfied with the work of the municipality and have trust in its activities, this positively affects their trust in the Urban Data Platform. Conversely, a low level of public trust in the municipality can substantially hinder the development and adoption of the Urban Data Platform in a city. Including citizens in the development of the platform is one way of increasing public trust in the government.

Fourthly, collaboration with private companies, academic institutions, platform owners in other Smart Cities, and citizens can each help to expand the capabilities of the platform owner needed to develop an Urban Data Platform. Since the survey study reveals a positive correlation between the maturity of a municipality's platform capabilities and trust in an Urban Data Platform (Van Oosterhout et al., 2020), municipalities should actively seek to increase their platform capabilities. Especially collaborating with other Smart Cities can accelerate the development of the Urban Data Platform, as cities usually go through similar stages and can thus share valuable experiences.

Lastly, several additional factors were mentioned by the platform owners in the case studies that seem to strengthen trust in an Urban Data Platform. This includes having a public metadata catalogue that describes all data sets of the platform, vouching for the quality of the data as the municipality, and being transparent as a municipality by actively communicating intended developments with regard to the Urban Data Platform in a city.

8.4. Limitations and Further Research

This research holds several limitations due to the methodology chosen, the cases selected, and the field of study, but also provides a solid foundation for further research in the field of multi-stakeholder collaboration and trust in Urban Data Platforms.

Firstly, this study followed an explorative approach in investigating the concepts under study, as little is known in this field so far. While the secondary data analysis shows several correlations between variables included in the conceptual model, for example between citizen engagement and trust in Urban Data Platforms (Van Oosterhout et al., 2020), it does not imply that causal relationships are present. Meanwhile, the case studies attempted to identify rationales for causal relationships between certain variables in the conceptual model through

semi-structured interviews with platform owners. However, variables were not quantitatively measured and effect sizes between variables were not determined, possibly leading to misinterpretations of relationships in the conceptual model and thus limiting the validity of this study. Future research should build upon the conceptual model developed in this study and seek to quantify the variables to determine with more certainty whether causal relationships exist.

Secondly, all relationships in the final conceptual model are based on the perception of the interviewees and the interpretation of the researcher, hence decreasing the validity of the results. Although the case studies followed a case study protocol and information was triangulated to minimize the bias, an inherent bias is inevitable in case study research (Yin, 2013). Furthermore, the selected cases were located in different cities in Europe, resulting in interviews being conducted by phone rather than in person. Apart from this, interviewees in each city were exclusively employees of the municipality, which own the Urban Data Platform in all cases. The perceived level of trust in the platform is therefore not based on the perception of the majority of (potential) platform users in a city, but on the perspective of the platform owner. As this shows only half of the picture, future research on trust in Urban Data Platforms should try to take into account the perceptions of data providers and data users of these platforms. Moreover, mutual trust between the public, private and academic sectors was also examined on the basis of the perception of the municipalities. Similarly, future research should try to include the perspectives of all stakeholders identified in this study and further investigate how mutual trust between these parties influences the development of Urban Data Platforms.

Thirdly, drawing the line between activities that are related to the development of an Urban Data Platform and those that are not was sometimes difficult and eventually depended on the researcher's interpretation. Before implementing and adding new modules to their Urban Data Platform, platform owners often carry out pilot projects together with other stakeholders using real urban data. As these urban data projects provide valuable insights for the actual implementation of the platform module, these activities were considered as part of the development of Urban Data Platforms in this research. In addition, the platform owners in the different cities had slightly different opinions on where an Urban Data Platform starts and where it ends. While this was a minor problem for this research because of its exploratory nature, it is something that future researchers need to be aware of.

Lastly, the generalizability of the findings of this study is limited due to two reasons. On the one hand, a rather small sample size of three cases was studied in the case study analysis due to time constraints. On the other hand, the analyses show that the way in which different stakeholders collaborate in the development of an Urban Data Platform varies from case to case. Although only cases were selected which, based on the results of the survey study by Van Oosterhout et al. (2020), fulfilled certain criteria, the cases differed, for example, in terms of the intensity of collaboration between different stakeholders or the type of collaboration. When replicating this research, future studies could focus on fine-tuning the variables included in the theoretical framework and, for example, examine which types of private companies should be involved in order to build trust in Urban Data Platforms.

In conclusion, by diving into the concepts of collaboration in the development of Urban Data Platforms and trust in these platforms, this study offers many opportunities for further research. As emphasized by all interviewees in this study, the development of Urban Data Platforms will never be complete, but will continue in the future to address emerging urban challenges.

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Appendix

Appendix A: Case Study Protocol

Case study protocol component	Applicability in this study
Overview of the case study project	The overview of the case study project can be found in chapters 1 to 4.
Field procedures	The following major tasks are followed in the data collection process: - Smart Cities are contacted through the RUGGEDISED network. - Interviewees receive a document with a brief summary of the research topic ahead of the interview. - Interviews are conducted via phone (e.g. Skype). - Interviews are recorded and transcribed, if permitted. - Interviews are conducted in April and May.
Case study interview questions	The case study interview guide (Appendix B) is followed during the interviews.
Guide for case study report	The initial conceptual model from chapter 3 and the findings from the secondary data analysis serve as a guideline for outlining the cases.

Table 7: Case study protocol (Source: Yin, 2003)

Appendix B: Case Study Interview Guide

The following structure and questions serve as a guideline for the case study interviews. However, the interviews are semi-structured, which means that the order of the questions might change and additional questions are asked throughout the interview.

1. **Introduction:** General terms are discussed, including purpose, format, structure and duration of the interview. In addition, the confidentiality of the interview is clarified.

2. **General questions:** The role of the interviewee, the purpose of the Urban Data Platform and the current development stage of the Urban Data Platform are asked.

3. **Trust in the Urban Data Platform:**
    - How would you describe the overall level of trust in the platform by platform users in your city? (data providers vs. data users; citizens vs. organizations)
    - Do you see reasons why trust is particularly high/ low in your city?
    - Have you observed a change in the level of trust in the platform over time? If so, how and why?
    - How do you measure trust in the platform?
    - In your experience, which trust aspects do platform users care about most in your city? (data provider vs. data user)
    - Have you been able to successfully increase trust in these aspects in the past? If so, how?

4. **Factors of multi-stakeholder collaboration:**
    - Have you collaborated with private companies and/or universities during the development of your Urban Data Platform? If so, at which stages and why?
    - Have citizens in your city had the opportunity to participate in the development of your platform? If so, at which stages and why?
    - Have you collaborated with other stakeholders that you haven't mentioned yet during the development of your platform? If so, at which stages and why?
    - Have you experienced that collaborating with these parties has had a positive/ negative effect on user trust in your platform? If so, which effect and why is that?

5. **The role of Triple Helix mutual trust:**
    - How would you describe the level of mutual trust between your organization and the private and academic sectors?
    - With regard to collaboration with these parties, has prevailing trust/ distrust affected the collaboration with these parties in the past? If so, how?
    - Have you undertaken steps to improve mutual trust between your organization and these parties in the past? If so, which steps? And what was the outcome?

6. **Optional: General factors increasing overall trust in Urban Data Platforms:** If time permits, the interviewee is asked for further general factors which have increased the overall trust in their Urban Data Platform.

7. **End:** The interviewee is thanked for his/her time. It is asked if there are other people from his/her organization that could provide valuable insights regarding this topic.

Appendix C: Validity and Reliability of Case Studies

Test	Case study tactic	Application in this study
Construct validity	Use multiple sources of evidence.	Semi-constructed interview data is triangulated with secondary data from the survey study and document data.
	Establish a chain of evidence.	Selection of the cases is explained in detail in chapter 4.2.
	Have key informants review the draft case study report.	Interview transcripts are sent to the interviewees afterwards to confirm the data.
Internal validity	Conduct pattern matching.	Propositions from conceptual model are matched with patterns from the case study analysis.
	Conduct explanation building.	Not applied.
	Conduct time series analysis.	Not applied.
External validity	Use replication logic.	Propositions from conceptual model are applied to different cases.
Reliability	Use case study protocol.	Case study protocol is developed and used for the interviews (Appendix A).
	Use case study database.	Interviews are recorded and transcribed.

Table 8: Validity and reliability of case studies