

The encounter of digital platforms and ecosystems
with bureaucratic organizations in smart cities

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List of Abbreviations

APIs	Application Programming Interface
CDO	Chief Digital Officer
CMS	Community Management System
EC	European Commission
ERP	Enterprise Resource Planning
EU	European Union
GDPR	General Data Protection Regulation
ICT	Information and Communication Technologies
IoT	Internet of Things
IT	Information Technology
KPIs	Key Performance Indicators
SCC	Smart Cities and Communities
SDK	Software Development Kit
WTA	Winner-take-all

List of Symbols

& Ampersand (and)

% Percent

Executive Summary

Municipal governments are currently adopting a “government as a platform” approach (O’Reilly, 2010, p. 13), with the goal to leverage digital technologies to facilitate innovation and to create linkages among key stakeholders (Appio et al., 2019). This entails organizing complementors around a municipality-run, platform-based ecosystem to enable technology-driven urban entrepreneurship (Barns, 2016; O’Reilly, 2010). However, municipal governments face organizational challenges during the implementation of this “government as a platform” approach. These challenges seem to arise because municipal governments exhibit features of Weberian bureaucracy such as hierarchical decision-making, official roles, and excluding the public from internal operations (Weber, 1921/1976). Research investigating this phenomenon, however, lacks empirical studies that adopt an organizational lens.

Therefore, this dissertation is motivated by calls for more empirical investigations of public organizations (Arellano-Gault et al., 2013) and how decentralized management approaches (such as platforms) “alter, replace, or reinforce bureaucratic authority systems” (Lounsbury & Carberry, 2005, p. 515). The central research question is: *How do municipal governments adapt their bureaucratic governance to accommodate the decentralized governance of urban platforms and their ecosystems?*

To this end, I use grounded and inductive methods (Eisenhardt, 1989; Glaser & Strauss, 1967) to cross-examine seven municipal governments in Europe. Between 2017 and 2020, I collected a rich dataset that includes 76 interviews, on-site observations, and undisclosed archival data. These data allow me to explain how municipal government officers resolve organizational tensions by first applying non-bureaucratic governance mechanisms before institutionalizing resulting organizational changes. Contradicting past research, I find that technology does not dictate the organizational structure and governance. Rather, bureaucracy adapts to integrate the “government as a platform” approach into its existing structures. Further, my process highlights the paradoxical role of lower-echelon bureaucrats who act as both the custodians and change agents of bureaucracy.

My dissertation makes original contributions to three research streams. First, I contribute to the smart-city literature by providing detailed empirical insights into municipal governments. Second, I contribute to the ongoing debate about the changing nature of Weberian bureaucracy in the context of smart cities. Third, I make an empirical contribution to the theory on platform governance.

Kurzdarstellung

Die Smart City kann als eine Plattform-Organisation dargestellt werden, die aus der Stadtverwaltung, welche eine zentrale Datenplattform betreibt, und den unterschiedlichen Akteuren in der Stadt besteht (Appio et al., 2019). Die Akteure können anhand der Daten, die auf der Plattform zur Verfügung gestellt werden, innovative Services entwickeln (Barns, 2016; O'Reilly, 2010). Jedoch sehen sich Stadtverwaltungen bei der Umsetzung dieses Plattform-basierten Ansatzes mit organisatorischen Herausforderungen konfrontiert, da die organisationalen Eigenschaften der Bürokratie in Stadtverwaltungen im Widerspruch zur Plattform-Organisation zu stehen scheinen.

Meine Dissertation setzt sich damit auseinander, wie dezentrale Managementansätze (wie Plattformen) "bürokratische Autoritätssysteme verändern, ersetzen oder verstärken" (Lounsbury & Carberry, 2005, S. 515). Zugleich folgt sie dem Aufruf nach mehr empirischen Studien über öffentliche Organisationen (Arellano-Gault et al., 2013). Die zentrale Forschungsfrage lautet: *Wie passen Stadtverwaltungen ihre bürokratische Governance an, um der dezentralen Governance von städtischen Plattformen und ihren Ökosystemen gerecht zu werden?*

Aufgrund des Mangels an theoretischen Erkenntnissen und empirischen Studien, die auf diese Frage eingehen, benutze ich induktive Methoden (Eisenhardt, 1989; Glaser & Strauss, 1967). Hierfür habe ich zwischen 2017 und 2020 Daten von sieben europäischen Stadtverwaltungen erhoben, die 76 Interviews, Beobachtungen vor Ort, sowie unveröffentlichte Archivdaten beinhalten.

Das Ergebnis ist ein Prozessmodell, das darstellt, wie Beamte die auftretenden organisatorischen Spannungen in der Stadtverwaltung durch unbürokratische Governance-Mechanismen umgehen, bevor sie die Ergebnisse in den bestehenden Strukturen neu verankern. Im Gegensatz zu früheren Forschungsergebnissen stelle ich fest, dass die Technologie nicht die Organisationsstruktur diktiert. Vielmehr passt sich die Bürokratie an, um den Plattform-basierten Ansatz in ihre bestehenden Strukturen zu integrieren. Zudem hebe ich die paradoxe Rolle der Beamten hervor, die gleichzeitig als Bewahrer und Reformer der Bürokratie auftreten.

Meine Dissertation trägt zur Smart-City-Literatur bei, indem sie detaillierte empirische Einblicke in Stadtverwaltungen gibt. Ausserdem bringt sie sich in die bestehende Debatte über die ständige Weiterentwicklung der Bürokratie ein. Dazu liefert meine Dissertation einen empirischen Beitrag zur Plattform-Governance Theorie.

1. Introduction

We can have cities that are energy efficient, have secure food and water supplies, and much better government. To reach these goals, however, we need to radically rethink our approaches. Rather than static systems that are separated by function—water, food, waste, transport, education, energy and so on—we must consider them as dynamic and holistic systems. We need networked, self-regulating systems that are driven by the needs and preferences of the citizens instead of ones focused only on access and distribution.

(Pentland, 2015, p. 97)

The year 2014 marked the first time in human history that more than 50% of the global population was living in cities (Gassmann et al., 2019). Current estimates predict that this number will increase to 70% by 2050 (Mabanckou et al., 2019). Nearly 90% of this growth will be in cities in Asia and Africa (Burdett & Rode, 2018). Shanghai has been growing by about 65 people per hour since 1990, and predictions estimate this growth rate will continue through 2030. At the same time, Delhi adds 75 people to its urban population per hour. On the African continent, Lagos' population increases by 56 people per hour. In comparison, in Europe and North America 10 people per hour are added to the local population in London and 11 people per hour are added in New York (all calculations based on Burdett & Rode, 2018, pp. 36–37). In general, urbanization is a central contributor to prosperity (Clos, 2018; Glaeser, 2011). That is because cities have always been centers of knowledge creation and knowledge transfer (Glaeser, 2011), and because they are economic powerhouses where more than 70% of the world's GDP is generated (Burdett & Rode, 2018).

However, the substantial increase in people living in cities also increases population density (Glaeser, 2011). Tightly spaced, high-rise towers are emblematic of the changing face of cities around the world (Burdett & Rode, 2018). The resulting high density decreases people's health and wellbeing, and makes urban agglomerations hotbeds for diseases (Glaeser, 2011), a fact that has been underlined by the recent COVID-19 pandemic. Moreover, cities already account for nearly 75% of the global

CO₂ emissions (United Nations Environment Programme, 2021) and lead in energy consumption, with roughly 70% of global energy demand consumed in cities (Gassmann et al., 2019). Recent data substantiate global warming, reporting that the last seven years (including 2020) were the warmest years ever recorded (NASA, 2021). Overall, the next decades seem to be as critical as ever for the world's future (Stern & Zenghelis, 2018), and the outcome is inextricably linked to life in cities.

Central to solving these complex challenges is the concept of the *smart city*. Whereas the term's underlying notion of networked urbanism has existed for nearly four decades (Coletta et al., 2019; Kitchin et al., 2016), the last decade has seen rapid developments in the interdisciplinary field of smart-city research. While manifold definitions of the smart city exist, I use a holistic definition developed by Gassmann and colleagues to capture the multi-layered nature of the smart city:

A smart city systemically applies digital technologies to reduce resource input, improve its people's quality of life, and increase the competitiveness of the regional economy in a sustainable manner. It entails the use of intelligent solutions for infrastructure, energy, housing, mobility services, and security, based on integrated sensor technology, connectivity, data analytics, and independently functional value-added processes. (Gassmann et al., 2019, p. 25)

1.1 Motivation of this dissertation

Although digital technologies are at the heart of our understanding of smart cities, recent work has criticized previous research for being too focused on technology-driven urban entrepreneurship (Hollands, 2008, 2015; Kitchin, 2015). Previous studies have not dealt with the complexity of urban issues, and have mostly conceptualized smart cities as technology-enhanced infrastructure (Hollands, 2008, 2015). Based on the notion that smart cities are unique innovation platforms (Leydesdorff & Deakin, 2011), scholars are suggesting applying the platform model to the smart city to develop a holistic research framework (Appio et al., 2019; Parker et al., 2016). For that reason, a recent study conceptualizes smart cities as platforms and their surrounding ecosystems (Appio et al., 2019). This novel conceptualization is in line with the "government as a platform" approach, developed by O'Reilly (2010), which suggests that municipal governments take over the role of platform provider. The main purpose of this role is building and maintaining a central platform with standardized interfaces, to enable entrepreneurs and private companies to create novel applications based on urban data.

1.1.1 Government as a platform

Cities are more than ever the locus of where innovation takes place (Clos, 2018). Due to technological progress and a “step change in urban data” (Kitchin et al., 2016, p. 93), which entails embedding pervasive digital technologies into urban infrastructure, cities can grow jobs, companies, and value in new ways (Katz & Nowak, 2018). Moreover, cities “are the testbed of a dizzying array of innovations” (Katz & Nowak, 2018, p. 170). Ultimately, the smart city seeks to leverage these digital technologies and innovations to increase the competitiveness of local communities (Appio et al., 2019). To this end, smart cities aim to create collaborative environments (Hutchison et al., 2011), by implementing digital platforms that “facilitate innovation by creating linkages among citizens, government, business, and educational institutions” (Appio et al., 2019, p. 2).

Digital platforms are defined as

evolving organizations or meta-organizations that (1) federate and coordinate constitutive agents who can innovate and compete; (2) create value by generating and harnessing economies of scope in supply or/and in demand; and (3) entail a technological architecture that is modular and composed of a core and a periphery. (Gawer, 2014, p. 1245)

The “government as a platform” approach (O’Reilly, 2010) suggests that municipal governments converge towards the role of platform provider¹ due to their status as local authorities. Municipal governments’ functions are further “stripped down to the essential”(O’Reilly, 2010, p. 13), running their operations based on lessons derived from successful platform companies such as Microsoft, Linux, and Google. This includes creating and maintaining a digital platform with a single core data structure (Kitchin et al., 2016) that software developers can access through standardized interfaces to build applications for citizens (O’Reilly, 2010). Consequently, the “government as a platform” approach (O’Reilly, 2010) stems from the idea that open data and open standards invite innovation and enable citizen participation. By providing a central platform, municipal governments, therefore, offer a new type of infrastructure (i.e., digital infrastructure), while the citizens determine how to extract and create value using this infrastructure (O’Reilly, 2010). The modular architecture of digital platforms

¹ Platform providers serve as the users’ primary point of contact, mediate transactions, and supply the platform’s components (Eisenmann et al., 2008). Depending on the design of the platform, municipal governments can also fulfill the role of *platform sponsor*. The platform sponsor holds the rights to modify the platform’s core technology and does not interact directly with users (Eisenmann et al., 2008).

further allows municipal governments to integrate their different smart-city programs into one central strategy (Barns, 2016). Consequently, municipal governments implement digital platforms to develop smart cities that “strategically use Information and Communication Technologies (ICT) and associated big data and analytics to improve existing city services and create new services, engage citizens, foster sustainability, and resilience, solve urban issues, and stimulate innovation and grow the local economy” (Kitchin et al., 2016, p. 94).

1.1.2 Bureaucracy meets digital reality

The promise of a more efficient organization that enables economic value creation based on data has sparked the interest of many bureaucratically organized municipal governments. Currently, more than 80 cities in Europe are implementing digital platforms in their organizations to become “smart” (Van Oosterhout et al., 2020). However, “transforming government is easier said than done” (Parker et al., 2016, p. 281). Despite significant investment and enthusiasm, smart urbanism has not yet fully arrived at municipal governments (Kitchin et al., 2017; Kitchin & Moore-Cherry, 2020; Shelton et al., 2015).

Previous research describes municipal government as an “oil tanker” (Kitchin et al., 2017, p. 279) due to its bureaucratic organization, which hampers the implementation of the “government as a platform” approach (O’Reilly, 2010). Further, research finds that data collection is challenging because municipal government departments work as “silos” and are not used to collaborate with other departments (Kitchin et al., 2016, p. 97). These findings are corroborated by recent studies that identify a set of technology-related governance challenges encountered by municipal governments (Barns, 2016; Barns et al., 2017; Hollands, 2015; Kitchin, 2015). To improve our understanding of these issues, a recent study explicitly states the “need to examine further the effects of data-driven technologies on the forms and practices of municipal governments, and how these are ameliorated by governance regimes” (Kitchin & Moore-Cherry, 2020, p. 10).

While the smart-city literature seems to view bureaucracy as an obstacle, a recent study conducted by Kornberger et al. (2017) suggests that bureaucracy is more adaptable than assumed. Their empirical investigation of the municipal government in Vienna documents how senior bureaucratic officials translate open government into bureaucratically administrable objects (i.e., open government *data*). Therefore, Kornberger and colleagues conclude that the Internet might just lead to new forms of bureaucracy, which have yet to be investigated empirically to continue the ongoing

debate in contemporary organization studies on the “changing nature of bureaucracy” (2017, p. 181). However, the calls of organizational scholars for more research on the influence of digital technologies and decentralized management approaches on bureaucracy (Lounsbury & Carberry, 2005) have been left unattended (despite the notable exception of Kornberger and colleagues). Furthermore, scholars have recently emphasized the need for empirical research on public organizations (Arellano-Gault et al., 2013). However, the “government as a platform” approach (O’Reilly, 2010) is regarded as the successor of open government and open government data (Barns, 2016), indicating that the work of Kornberger et al. (2017) does not provide sufficient answers to understand the influence of digital platforms on municipal government bureaucracy.

To acquire a better understanding of what governing platforms entails, it is relevant to consult the literature on platforms and their governance. Due to their modular architecture and interdependencies between different actors, digital platforms cannot be governed by traditional principal-agent relationships (Jacobides et al., 2018; Parker et al., 2016). In contrast, municipal governments are governed based on hierarchical orders and rules (Weber, 1921/1976). Moreover, platform providers face the complex challenge of designing governance mechanisms (Wareham et al., 2014) that simultaneously ensure a stable technology core and enable a heterogeneous group of complementors that engage in creative value-adding activities (i.e., the *paradox of change*) (Tilson et al., 2010). These governance mechanisms are dynamic and evolve with the platform (Parker et al., 2016), while bureaucratic governance seeks to establish stability (Weber, 1921/1976). Moreover, more research is needed on how platform owners can manage the tensions arising from the *paradox of control* (i.e., bundling control in one central authority and simultaneously devolving control to individuals) (Cennamo & Santaló, 2019; Tilson et al., 2010).

While the “government as a platform” approach (O’Reilly, 2010) offers lessons from platform companies for municipal governments, it does not seem to address the governance challenges faced by platform managers. Furthermore, smart-city platforms and their surrounding ecosystems are cross-sector platforms (i.e., fostering interactions between public and private entities). However, so far the plethora of research on digital platforms and their ecosystems has been conducted in the private sector (Logue & Grimes, 2019). Consequently, it is not yet well understood what makes platform and ecosystem governance successful in general (De Reuver et al., 2018; Jacobides et al., 2018) and even less knowledge exists in the context of smart cities.

Overall, it seems as if the future of our planet hinges on harnessing digital technologies in cities, and the conceptualization of the smart city as platform (and its surrounding developer ecosystem) offers a framework to do so. However, we lack empirical research on the adoption of platforms as technological architecture and organizational model in bureaucratic municipal governments. Further, neither the field of organization studies, nor the field of platform research offers theoretical insights that can be applied to describe how the “government as a platform” approach (O’Reilly, 2010) unfolds in municipal governments. It is thus fundamental to investigate the implementation process of digital platforms on the level of municipal governments and the arising organizational challenges (Kitchin & Moore-Cherry, 2020; Lounsbury & Carberry, 2005).

To that end, I conduct an inductive multiple-case study (Eisenhardt, 1989; Eisenhardt & Graebner, 2007) of seven municipal governments in Europe. I use an inductive approach because to my best knowledge, no single study exists that adopts an organizational lens to investigate the “platform as a government” approach (O’Reilly, 2010) in bureaucratic organizations. This indicates that existing research does not provide adequate answers (Eisenhardt & Graebner, 2007). I collect data from multiple cases (i.e., seven municipal governments in Europe) because multiple cases are more objective and allow for greater generalizability of results (Eisenhardt & Graebner, 2007). The inductive multiple-case study approach further keeps researchers honest by closely adhering to data and using extensive tables to demonstrate the empirical richness of the data (Eisenhardt & Graebner, 2007).

The sampling strategy was based on ensuring similarities between cases in order to aid comparison and replication (i.e., all municipal governments are located in Europe and participate in the European Union (EU) sponsored Horizon 2020 Smart Cities and Communities program), and on seeking heterogeneity to increase generalizability (i.e., cities are located in different countries and differ in size). My inductive approach has guided me towards the seminal work of Max Weber (1921/1976) as the seven municipal governments that I investigate in this dissertation exhibit many of the key characteristics (e.g., rationality, hierarchy, strict obedience to rules, official competencies, and official secrecy) of Weber’s *ideal-type* bureaucracy.

Therefore, this dissertation provides an exciting opportunity to advance our understanding of the emerging tensions between bureaucratic organizations and digital platforms and of how these tensions can be resolved. Figure 1 summarizes the above-

mentioned research gaps and my research question, which I will describe in more detail in the next section.

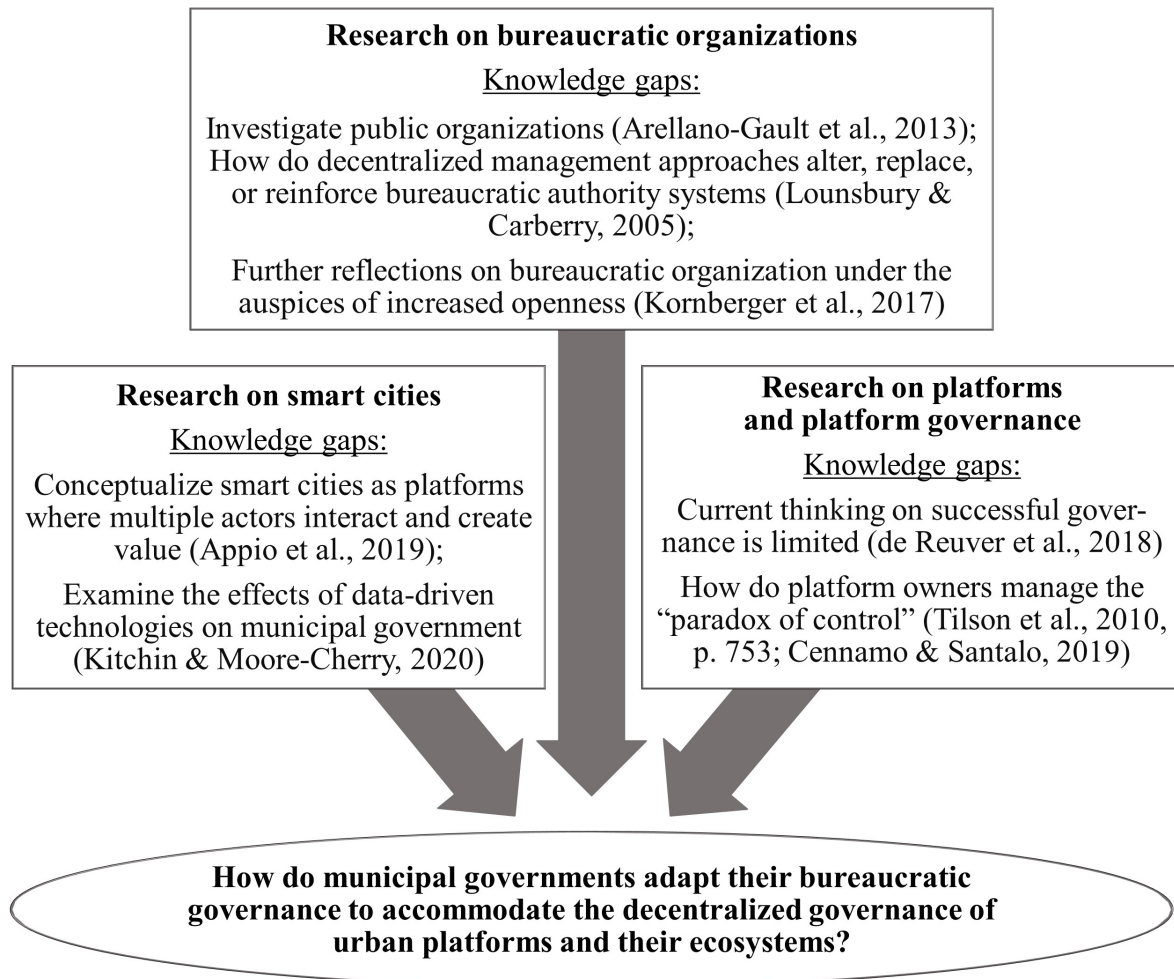


Figure 1: Literature gaps addressed by the research question

1.2 Research objectives and overall goal of this dissertation

To depict the interdependencies between infrastructure, innovation, and quality of life, smart cities have been conceptualized as municipality-based platforms with surrounding innovation ecosystems (Appio et al., 2019). This approach to organizing has been labelled “government as a platform” (Barns, 2016; O’Reilly, 2010). However, despite the scholarly attention recently paid to this phenomenon (Appio et al., 2019; Mora et al., 2019), we still lack empirical investigations of the intersection of traditional government bureaucracy and new organizational forms (i.e., a platform and its ecosystem). We also lack insights into how municipal governments cope with any tensions that arise in such contexts.

My main aim is to understand how municipal governments’ managers perceive and integrate the “government as a platform” (O’Reilly, 2010) approach in bureaucratic municipal governments. I, therefore, adopt an organizational lens to examine “the extent to which decentralized management approaches [such as platforms] alter, replace, or reinforce bureaucratic authority systems” (Lounsbury & Carberry, 2005, p. 515). I draw from three separate research streams (i.e., smart-city literature, platform literature, and literature on bureaucracy) to investigate a novel phenomenon that is situated at the intersection of these three streams. I document a process of organizational adaptation that depicts “the changing nature of bureaucracy” (Kornberger et al., 2017, p. 181).

In the smarty-city context, I expect tensions to arise between hierarchical, static, bureaucratic governance and horizontal, dynamic, platform governance. Given the lack of empirical studies on this phenomenon, and the call for more research on public organizations in general (Arellano-Gault et al., 2013), I use grounded, inductive methods (Eisenhardt, 1989; Glaser & Strauss, 1967) to cross-examine seven municipal governments in Europe that exhibit key features of Weber’s (1921/1976) ideal-type bureaucracy. Thus, my empirical investigation aims to document the implementation of urban platforms in centralized and hierarchical bureaucratic municipalities. Aiming to address this issue, the central research question in this dissertation asks:

How do municipal governments adapt their bureaucratic governance to accommodate the decentralized governance of urban platforms and their ecosystems?

To this end, I have collected data in seven European municipal governments (Munich, Lyon, Vienna, Rotterdam, Stockholm, Santiago de Compostela and Barcelona) from multiple data sources over a four-year period from 2017–2020. I have conducted 76 interviews, analyzed undisclosed archival data, and attended more than 30 meetings and

conferences to conduct observations. The interviews represent my main data source. In total, I have interviewed 73 representatives from the seven municipal governments and three independent urban data platform experts to corroborate my results.

1.3 Outline of this dissertation

The overall structure of this dissertation takes the form of eight chapters including this introductory chapter and references (Chapter Eight). Chapter Two begins by laying out the theoretical dimensions of the research and discusses the literature on smart cities (Chapter 2.1), platforms, and platform governance (Chapter 2.2), as well as bureaucracy and more recent examinations of bureaucratic organizations (Chapter 2.3). Moreover, Chapter Two introduces further definitions and constructs relevant for this dissertation. The third chapter is concerned with the method used for this dissertation. Chapter Four presents the findings of the inductive multiple-case study. The chapter starts with within-case descriptions (Chapter 4.1), followed by a presentation of the results of the cross-case analysis (Chapter 4.2). Chapter Five ties the empirical findings to the literature and discusses implications for managers and future research. Chapter Six concludes, providing a summary and critique. Finally, Chapter Seven gives an outlook on smart cities and the future of bureaucracy. Figure 2 presents a visualization of the structure of this dissertation.

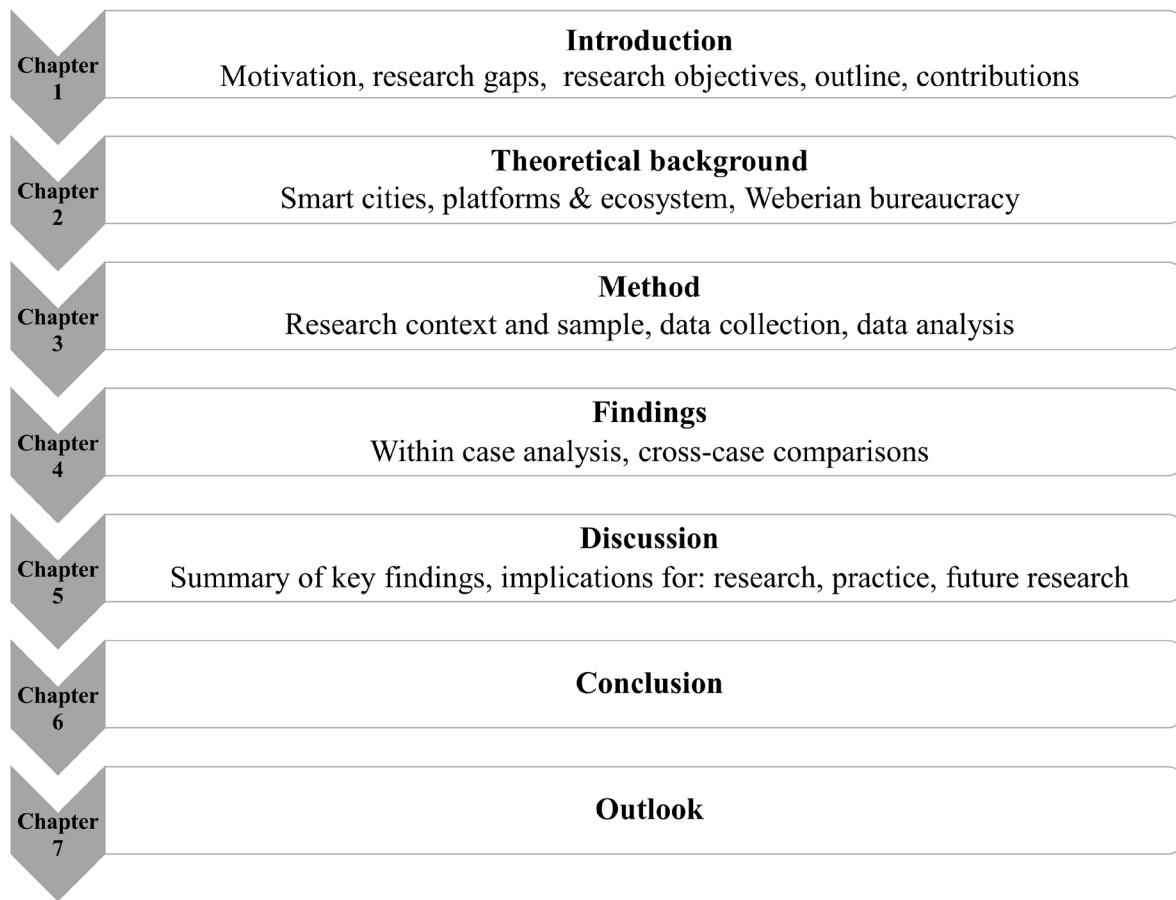


Figure 2: Outline of this dissertation

1.4 Summary of contributions

There are four important areas where this study makes an original contribution.

First, I contribute to the smart-city literature (Appio et al., 2019; Coletta et al., 2019; Kitchin & Moore-Cherry, 2020) by providing a detailed empirical analysis of the “effects of data-driven technologies on the forms and practices of municipal government” (Kitchin & Moore-Cherry, 2020, p. 10). I find that the contradicting logic of platform governance creates organizational tensions both within the bureaucratic municipal-government (official competencies) and at the interface between the municipal government and its external partners (official secrecy). The emergent process describes how these tensions are resolved through a temporary shift to a non-bureaucratic work mode, which encompasses experimentation as well as novel practices, and the subsequent formalization and institutionalization of those practices as new bureaucratic rules. Overall, my process depicts the unfolding of smart-city platforms

(Coletta et al., 2019) primarily as an organizational matter (i.e., bureaucracy has to adapt in order to integrate platform governance) rather than a technology matter (i.e., technology dictates the project's shape and fate).

Second, I contribute to the ongoing contemporary debate about the changing nature of Weberian bureaucracy (Byrkjeflot & du Gay, 2012; Courpasson, 2000; Greenwood & Lawrence, 2005; Kornberger et al., 2017) in the context of smart cities. My data suggest that changes in modern government bureaucracies can be driven by rational-oriented (*zweckrational*) (Weber, 1921/1976, p. 11) social actions aimed at reclaiming power. Moreover, I highlight the paradoxical roles of lower-echelon officers as change agents and preservers of bureaucratic values. These officials develop best practices outside bureaucratic structures. Those practices are subsequently formalized into routines to establish and diffuse new organizational capabilities (Heugens, 2005).

Third, I contribute to theory on governance platforms and ecosystems (Cennamo & Santaló, 2019; Tilson et al., 2010; Wareham et al., 2014) by empirically describing the role of a public organization as a platform provider. I show that the bureaucratic principle of documenting and institutionalizing calculable rules can support platform managers' efforts to govern the quality and coordination of complementors.

Lastly, I develop implications for practice. Drawing from my findings, an important managerial implication is that managers should try to overcome thinking in false dichotomies. Instead, managers should adopt a duality perspective, accepting the twofold nature of objects without separation. To that end I develop a managerial tool, (i.e., a 2x2 matrix) that guides managers in identifying how they can harness bureaucratic principles and platform principles to design governance mechanisms that support their intended outcomes. Moreover, I develop recommendations that are tailored to the specific characteristics of each archetype of the managerial 2x2 matrix.

2. Theoretical Background

This section is concerned with the relevant theoretical background for this thesis. The goal of this section is to provide the reader with the relevant information about what is already known about the research topic. Since my research approach is inductive and existing theory does not sufficiently explain the organizational tensions arising from the “government as a platform” approach (O’Reilly, 2010) in municipal governments, I present each research stream—smart cities, platforms, and bureaucracy—separately. I provide a brief synthesis of the three streams at the end of this chapter. However, I do not engage in developing theoretical propositions, because the “central notion is to use cases as the basis from which to develop theory inductively” (Eisenhardt & Graebner, 2007, p. 25).

2.1 Smart cities

A large and growing body of literature spanning nearly four decades has investigated the smart city and its developments (Kitchin et al., 2016; Mora et al., 2019). However, smart-city research has only been established as its own research discipline since 2009 (Mora et al., 2017). Before 2009, most research was conducted in the interdisciplinary field of urban studies and computer science (Mora et al., 2017), or “urban ICT-studies” (Graham, 2004, p. 3). Although it is abundant, the literature about smart cities is fragmented (Appio et al., 2019; Mora et al., 2017, 2019). This is due to the field’s various intellectual roots and the lack of exchange between the different research disciplines (Mora et al., 2017). Moreover, the term “smart city” has recently emerged as the “vanguard of concepts concerning urban development” (Coletta et al., 2019, p. 349) and was coined for a marketing campaign by IBM, a global technology company (Kitchin et al., 2016). Figure 3 depicts the increase of scientific publications containing the word “smart city” in the title.² Earlier terms relating to the same phenomenon include “wired city”, “creative city”, “digital city”, “intelligent city”, “ubiquitous city”, and “innovation city” (Hollands, 2008; Kitchin, 2014).

² For an overview of the developments of scientific publications containing wired city, creative city, digital city, intelligent city, ubiquitous city, and innovation city in their title, please see Appendix II.

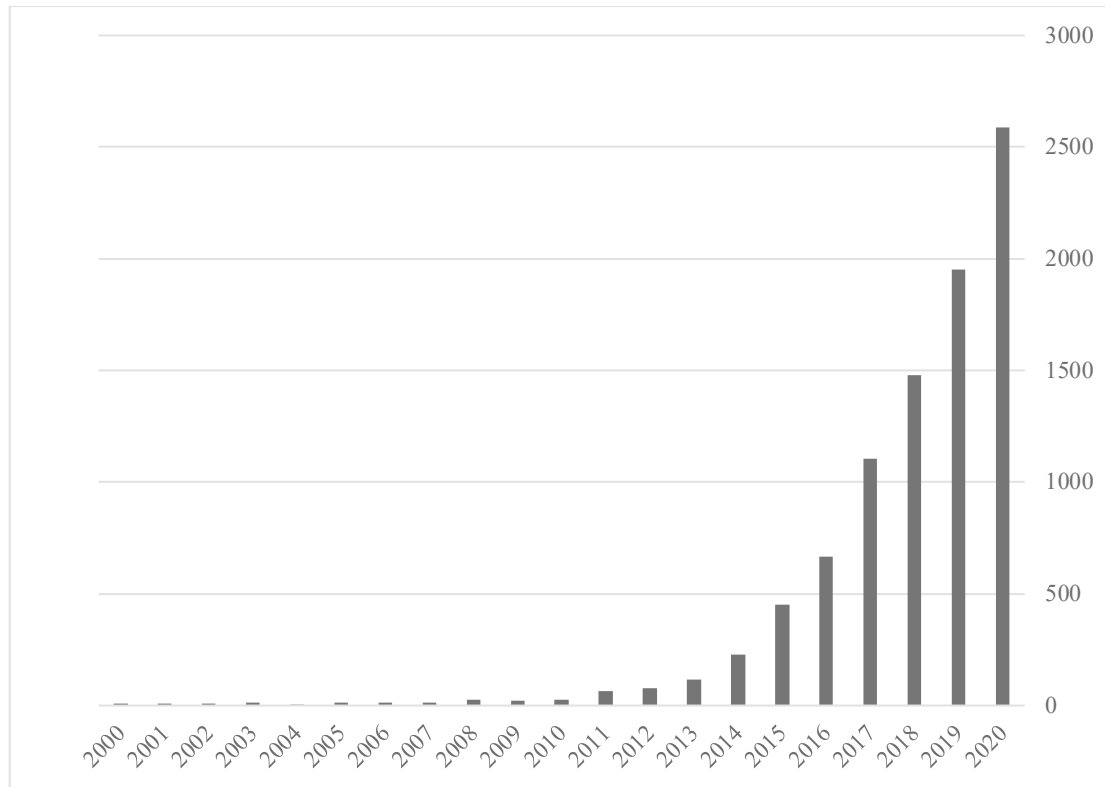


Figure 3: Scientific publications including 'smart city' in the title³

2.1.1 A brief overview of smart city research

According to a recent literature review, the research on smart cities can be segmented into five different development paths (Mora et al., 2019). Each of these paths represents different underlying assumptions about the nature of a smart city. Consequently, different views exist regarding the purpose of smart cities and how they should be developed. An overview of the five paths can be found in Table 1. I note that these paths are not mutually exclusive.

³ Based on Web of Science. Retrieved 08.03.2021.

<i>Name</i>	<i>Description</i>
Experimental path	Smart cities are described as urban testbeds for experimenting with IoT infrastructure and service applications and analyzing their functioning, relevance, and potential impact in real life environments.
Ubiquitous path	Smart cities and ubiquitous cities are considered to be two equivalent categories of cities whereby digital services are provided everywhere and at any time.
Corporate path	Urban areas become smart when they are equipped with a platform of digital solutions provided by ICT companies.
European path	Smart cities are highly efficient urban systems in which digital technologies are used to develop a new generation of buildings, energy networks and transport systems, which are instrumental in tackling environmental degradation and fighting climate change.
Holistic path	Smart cities are urban environments in which digital technologies are assembled to meet local development needs and their development process is grounded in collective intelligence, bottom-up approaches, participatory governance, open and user-driven innovation and community-led urban development.

*Table 1: Summary of smart city research paths
Based on Mora et al. (2019a, p. 64).*

First, the so-called *experimental path* treats smart cities as testbeds for experimenting with novel technological achievements in the area of the Internet of Things (IoT) and related service applications. This underlines the widespread notion in the smart-city literature that Information Technology (IT) and ICT are fueling the development of smart cities. The IoT rests on the technical vision of ubiquitous computing. Ubiquitous computing was first developed by a group of researchers at Xerox PARC (Paolo Alto Research Center). In one of the first scholarly publications about their research, they explain the concept as “the idea of spreading computers ubiquitously, but invisibly, throughout the [physical] environment” (Weiser et al., 1999, p. 693). Due to the innovation of wireless connectivity, which enabled computers to transmit information without a physical connection, this vision has now become a reality. According to Yoo et al. (2012, p. 1398) a “defining characteristic of pervasive digital technology is the incorporation of digital capabilities into objects that previously had a purely physical materiality.” Digitally enhanced objects are often referred to as *smart objects*. A smart object is a “small computer with a sensor or actuator and a communication device”

(Sundmaeker et al., 2010, p. 15). In smart cities, these smart objects are permeating the fabric of everyday life (Kitchin et al., 2016). There are six potential application areas: smart environment, smart living, smart economy, smart mobility, smart government, and smart people (Gassmann et al., 2019; Giffinger et al., 2007).

The second path is called the *ubiquitous path*. The term ubiquitous city (u-city) is considered to be equivalent to the term smart city in this research path (Mora et al., 2019). Both terms refer to the underlying idea that digital technologies foster the distribution and creation of knowledge in cities. Harvard professor Edward Glaeser explains this idea as follows: “Better information technology has made the world more information intensive, which in turn has made knowledge more valuable than ever, and that has increased the value of learning from other people in cities” (2011, p. 38).

Research in this stream suggests that knowledge plays an important role in sustaining and creating wealth in cities. Thus, local governments need to develop novel approaches to foster this post-industrial model of economic success in cities (Glaeser, 2011; Yigitcanlar et al., 2008). The South Korean government pursues a strategy in which ubiquitous digital technologies are viewed as the keystone for economic success because they increase connectivity between people and provide access to information (Mora et al., 2019; Shin & Kim, 2010). A very prominent example of this approach can be found in the South Korean city Songdo (Gassmann et al., 2019, pp. 121–130). This greenfield project was designed from scratch and focused on digital connectedness and integration of different digital technologies. Some smart-city experts refer to Songdo as one of the most comprehensive smart-city initiatives with an extensive digital shadow (Gassmann et al., 2019, p. 122).

The third path revealed in the study by Mora et al. (2019) is the so-called *corporate path*. This research cluster revolves around the involvement of ICT companies in the development of smart cities. Driven by the prospect of conquering a global market worth billions of dollars, big companies like IBM, CISCO, Microsoft, Intel, Siemens, Oracle and SAP have actively participated in promoting the concept of the smart city (Kitchin, 2014). In particular, IBM and the company’s global marketing campaign have coined the term smart city to describe the phenomenon of a networked urbanism that had already started to emerge in the 1980s (Kitchin et al., 2016). The campaign was based on the motto “building a Smarter Planet” (Mora et al., 2019), offering a standardized implementation process and a platform of digital solutions to national and local governments. In this corporate-driven approach to smart-city development, global

ICT companies consult with local governments with respect to smart-city design, development and implementation.

The fourth path is labeled the *European path*. Research in this cluster underpins the importance of embedding ICT into urban infrastructure to control and reduce greenhouse gas emissions. Moving towards a low carbon economy while simultaneously increasing economic prosperity has been the main goal of different EU-sponsored projects. Furthermore, these EU-driven initiatives focus on increasing energy efficiency through smart grids and renewable energies. For example, the European Commission's Horizon 2020 Smart Cities & Communities (SCC) program is aimed at finding renewable, urban, technical, financial and social smart solutions, with an emphasis on big data, data management and digitalization (European Commission, 2018).

The fifth and last path identified by Mora et al. (2019) is called the *holistic path*. The core literature in this path focuses on the relationship between urban innovation processes and ICTs. It is argued that ICTs should be exploited to solve the urban challenges faced by cities in Europe, America, and Asia. This development path differs from the corporate and ubiquitous paths as it builds on the idea to involve citizens first when developing smart cities (Hollands, 2008). The path represents more critical views on smart-city development (e.g., Hollands, 2008, 2015; Kitchin, 2014, 2015), which criticize that the human capital side of the smart-city equation has been neglected, arguing that technology-driven urban entrepreneurialism will lead to a splintering effect in cities. Therefore, Hollands (2008) proposes that “real” smart cities should harness digital technologies to empower people by improving democratic debates about the development of cities. This demarcates a shift from a top-down technological determinism to a bottom-up holistic interpretation of the smart city that includes human, cultural, technological, social, environmental, and economic aspects that are equally important for the development of the smart city (Leydesdorff & Deakin, 2011; Mora et al., 2019). This approach to smart-city development thus highlights the importance of collective intelligence and open, user-driven innovation.

Notwithstanding their differences, the five paths and their corresponding research clusters are all connected to the idea of digital technologies as the solution to complex challenges faced by cities (Mora et al., 2019). Their divergence might be rooted not only in the interdisciplinary research tradition of smart-city research but also in the concept of technology affordance. Technology affordance is a unique characteristic of digital technologies that refers to “an action potential, that is, to what an individual or

organization with a particular purpose can do with a technology or information system” (Majchrzak & Markus, 2012, p. 832). It is thus not surprising that the application of digital technologies to cities is interpreted differently depending on socio-economic and socio-cultural contexts (Hollands, 2015). For example, smart-city developments in Asia have been largely executed by ICT companies, while city governments have been at the forefront in Europe and North America (Hollands, 2008, 2015). In the same vein, Kitchin (2015) emphasizes that a “one-size fits all” solution to the smart city is not feasible as the smart city seems “to be far from apolitical and non-ideological” (p. 132). Furthermore, digital technologies are constantly evolving due to their reprogrammable functionality and data homogenization (Yoo et al., 2012). An example of this evolution is the “step change in urban data” (Kitchin et al., 2016, p. 93), which enables city governments to leverage real-time, machine-readable data for their governance and decision-making processes. Another example is the evolution of open data. While open data was previously linked closely to the right to information and to empowering citizens, it has evolved into being used for data-driven software development and entrepreneurship (Barns, 2016). Pervasive digital technologies have allowed a “democratized” innovation process to grow (Yoo et al., 2012, p. 1401), spreading innovation activities across different organizations and online communities (Chesbrough, 2010; Von Hippel, 2005).

Observing the success of open innovation in the private sector, local governments have started to implement platforms to facilitate co-creation processes (Appio et al., 2019; O'Reilly, 2010). According to a recent report published by McKinsey Global Institute (2018), a “new smart-city model built around citizen engagement and how smart technology solutions are used” (p. 7) is currently receiving increasing attention from municipal governments and ICT companies. In addition, the McKinsey Global Institute study shows that the massive rollout of digital technologies in cities has only had limited impact on citizens’ lives. Moreover, the smart-city ICT pioneers IBM and Cisco have adapted their original strategies in favor of more inclusive and open approaches (Kitchin, 2015). Consequently, we need a better understanding of how platforms can be utilized as meta-organizations that connect the digitally enhanced infrastructure with human and social capital in smart cities. Appio et al.’s (2019) conceptualization of smart cities as municipal government-run platforms that coordinate different actors to facilitate value creation is a first step towards creating a holistic framework to study smart cities.

2.1.2 Conceptualization of smart cities as platforms and ecosystems

As stated earlier, applying the platform and ecosystem concepts to smart cities enables a (meta-) organizational perspective that accounts for the dynamic processes and the involvement of multiple stakeholders in the smart city (Lee et al., 2014). Barns (2016) depicts this platform-based approach as the next wave of open government data. Open government data promotes efficiency, participation, innovation, and transparency, and has been regarded as a promising possibility for reinventing public sector organizations (Jetzek et al., 2013). The “government as a platform” approach (O’Reilly, 2010) advances this concept, by introducing ideas from open source software (Von Hippel & Von Krogh, 2003), open innovation (Chesbrough, 2003; Gassmann et al., 2010), and platforms (Gawer, 2014; Parker et al., 2016) as superior means for value creation for municipal governments. Due to their layered modular architecture, platforms often provide the technological core for (innovation) ecosystems. Therefore, platforms and their surrounding ecosystems provide an opportunity for smart cities to increase collaboration between different economic actors and to foster innovation and entrepreneurship, in both the public and private sectors (Appio et al., 2019; Marsal-Llacuna et al., 2015). Furthermore, technological advances have enabled real-time data generation and analysis, which allows for more efficient management and decision-making inside municipal governments (Barns et al., 2017). To visualize the data, municipal governments are investing in the construction of urban dashboards (Kitchin et al., 2016). These dashboards are capable of handling big data, allowing municipal governments to control and manage the complex operations of the city based on Key Performance Indicators (KPIs).

The framework suggested by Appio et al. (2019) addresses the multi-stakeholder environment in smart cities by connecting the digital infrastructure to human capital. Building on work by Hutchison et al. (2011) and Giffinger et al. (2007), Appio and colleague’s framework depicts platforms and ecosystems as the nexus between the physical infrastructure and the quality of life in smart cities. Hence, the municipal government as platform provider functions as the central coordinator, who enables the collaborative ecosystem. Figure 4 displays the pyramid framework.

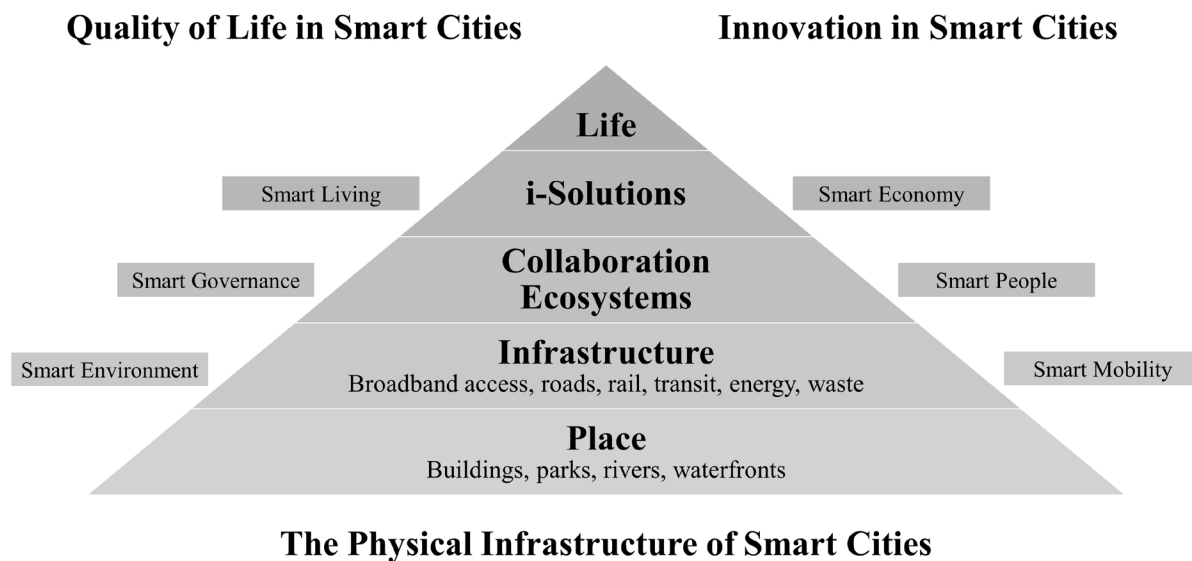


Figure 4: Conceptualization of smart cities as platforms and ecosystems
Source: Own illustration based on Appio et al. (2019, p.2)

The six dimensions that describe the characteristics of smart cities are indebted to the seminal work of Giffinger et al. (2007): smart living (quality of life), smart economy (competitiveness), smart people (social and human capital), smart governance (public and social services and citizen participation), smart mobility (transport and communication infrastructure), and smart environment (natural resources). The pyramid structure stems from Hutchison and colleagues (2011). It combines what Angelidou (2014) refers to as “hard” smart city strategies (smart buildings, smart energy grids, smart water management, smart mobility) with “soft” smart city strategies (developing human and social capital through education, culture, social inclusion and social innovation).

Combining hard and soft elements of the smart city in one framework, allows Appio et al. (2019) to circumvent the bias of an infrastructure-centric definition of the smart city. Nevertheless, they depict hard smart-city structures (i.e., the physical infrastructure) as the keystone for all smart-city developments. Adding social and human capital enables collaboration and innovation, resulting in collaborative forms of value creation. The bottom-up logic of the framework emphasizes that these three elements—physical infrastructure, innovation ecosystems, and quality of life in cities—are interdependent.

These collaborative solutions require municipal governments to take over the role as orchestrator, monitoring and steering the co-creation efforts (Janssen & Estevez, 2013).

This new role entails the application of platform thinking to government, which implies running “government as a platform” (O’Reilly, 2010, p. 13). According to O’Reilly (2010), (municipal) governments should adopt seven lessons from successful digital platform companies, such as Microsoft, Linux, and Google:

1. Open standards spark innovation.
2. Build a simple system and let it evolve.
3. Design for participation.
4. Learn from your “hackers”.
5. Data mining allows you to harness implicit participation.
6. Lower the barriers to experimentation.
7. Lead by example.

These seven lessons embrace three design principles that have proven to be successful in the context of technology: transparency, participation, and collaboration. Thus, “government as a platform” (O’Reilly, 2010) can be summarized as (municipal) government establishing a digital platform that centralizes all government data, providing a data infrastructure that software innovators can access to recombine public data to create new applications. Therefore, the digital platform has open, standardized interfaces (i.e., Application Programming Interfaces, APIs), and is governed by a simple set of clear rules. Additionally, the first version of the platform should be simple but still provide value to users. This in turn encourages people to build new applications, thereby driving the evolution of the digital platform to a more complex and more valuable system. However, this entails accepting that the most creative ideas will most likely not be developed by the platform provider (i.e., outside municipal governments’ reach).

While this idea promises to create social, environmental, and economic value, critics argue that the “government as a platform” approach (O’Reilly, 2010) fails to provide solutions for the complexity of urban life due to the inability of technology to replicate reality in detail (Hollands, 2008, 2015; Kitchin, 2015). Platform applications, such as dashboards, are not exact mirrors of reality—those working with the data reconstruct their own visions of the city (Kitchin et al., 2016; Shaw & Graham, 2017). Consequently, the outcomes of smart-city projects depend on the people working on those projects as well as on political circumstances (Coletta et al., 2019). Critics further stress that placing digital affordances in the hands of a small group of software entrepreneurs may reposition “urban spaces and city management (...) as open markets in which companies can co-create and work with the state” (Coletta et al., 2019, p. 359).

Moreover, black-boxed algorithms and filter bubbles could obscure reality, leading to decreased transparency rather than improved transparency (Kitchin et al., 2016; Shaw & Graham, 2017). Importantly, the effects of this process on municipal governments remain unclear (Kitchin & Moore-Cherry, 2020), with scholars suggesting wider structural changes and the generation of new modes of municipal governance (Kitchin et al., 2017).

Overall, these critical voices raise concerns that the new role of platform provider causes digital technologies to determine how municipal governments will be governed in the future (Barns et al., 2017; Graham et al., 2019; Marvin & Luque-Ayala, 2017). In contrast, a recent study by Kornberger et al. (2017) implies that the bureaucratic organization of municipal governments remains a decisive factor. It is, therefore, important to investigate municipal governments from an organizational perspective to resolve these opposing arguments based on empirical studies.

Before I turn to Weber's ideal-type bureaucracy (1921/1976), and its current relevance for organizations, I address the platform literature.

2.2 Digital platforms, ecosystems, and governance

The purpose of this chapter is to discuss platforms, platform-based ecosystems, and their governance in more detail. In addition, I describe how the concept of digital platforms differs from ecosystems and where they overlap. I note that I demarcate the platforms that I study as *digital platforms* to emphasize their digital capabilities. However, throughout this dissertation the terms platform and digital platform will be used synonymously.

2.2.1 Digital platforms

Each research discipline offers a slightly different definition of the platform. Economists have conceptualized platforms as two-sided markets and studied the underlying mechanisms behind these two-sided markets, their associated network effects, and the emergence of dominant platform leaders (e.g., Evans & Schmalensee, 2005; Parker & Van Alstyne, 2005; Rochet & Tirole, 2003b). Technology management scholars regard platforms as technological architectures that offer platform sponsors and complementors an infrastructure for innovation (e.g., Eisenmann, Parker, & Van Alstyne, 2006; Gawer, 2014). From a technical perspective, a digital platform is defined

as “an extensible codebase to which complementary third-party modules can be added” (De Reuver, Sørensen, & Basole, p. 127, 2018). From a sociotechnical perspective, digital platforms can be viewed as “technical elements (of software and hardware) and associated organizational processes and standards” (De Reuver et al., p. 127, 2018).

The versatility of digital technologies allows digital platforms to harness capabilities, such as reprogrammable functionality and data homogenization, which are at the core of opening up new avenues for value creation and organizing logics (Yoo et al., 2010b). These digital capabilities are leveraged through modular architectures and, consequently, digital platforms extend the outreach of an organization well outside its boundaries (De Reuver et al., 2018). Modularity in digital platforms is characterized through a stable platform core and variable periphery components (Baldwin & Woodard, 2009) and is especially well-suited for innovation (Gawer, 2014). Two main reasons for this stand out. First, modularity reduces complexity by breaking up a complex system into discrete components, which interact through standardized interfaces (Langlois, 2002; Parnas, 1972). Second, the reduced interconnectivity between the modules allows for specialization and division of innovation labor (Gawer, 2014). Thus, digital platforms have become the nexus of firms’ innovation activities across a wide range of different industries (Yoo et al., 2012).

Due to this increased strategic importance of digital platforms, the question arises of how to establish, design and grow vibrant digital platforms (Yoo et al., 2012) and their respective ecosystems (Jacobides et al., 2018). A platform’s ecosystem can be understood as the different modules or agents (either firms or individuals) that are connected to the platform (Cusumano & Gawer, 2002). The inherent idiosyncrasy of combining these modules with the platform (Tiwana et al., 2010) leads to competition that revolves around establishing generative activities (i.e., the ability of a self-contained system to produce something novel without any input from the system’s originator) associated with the digital platform (De Reuver et al., 2018; Zittrain, 2008). The success of such digital platforms and their respective ecosystems is dependent on whether direct and/or indirect network effects are successfully leveraged. Direct network effects occur when the number of users on the digital platform increases the value for each individual user (Eisenmann et al., 2006; McIntyre & Srinivasan, 2017). Indirect network effects occur when individual users assume that a higher number of users will also lead to a higher number of agents on the platform, who will develop complementary products (Rochet & Tirole, 2003). Therefore, well-designed governance mechanisms are particularly important as a means of offering external

agents incentives to join the digital platform, such as value appropriation and recognition, while the digital platform owner retains control and ownership (Benlian, et al., 2015; Rochet & Tirole, 2003).

2.2.2 Platform-based ecosystems

The concept of platforms is closely related to the idea of ecosystems and confusion persists how these two concepts relate to each other (Adner, 2017). Proprietary technology platforms (Gawer, 2014) rely on vibrant ecosystems of complementors and (two-sided) network effects for growth (Parker et al., 2016). Thus, in so-called “platform-based ecosystems” the ecosystem comprises the platform sponsor and the platform’s complementors (Jacobides et al., 2018). These complementors connect to the central platform via shared open-source standards and open interfaces (i.e., APIs) (Jacobides et al., 2018; McIntyre & Srinivasan, 2017). Many scholars hold the view that ecosystems can occur around platforms but that a platform is not a necessary prerequisite for an ecosystem to emerge (Adner, 2017; Jacobides et al., 2018).

In their seminal article, Jacobides et al. (2018) emphasize the conditions that are required for ecosystems to emerge and define ecosystems as:

...groups of firms that must deal with either unique or supermodular complementarities that are nongeneric, requiring the creation of a specific structure of relationships and alignment to create value. The strength of ecosystems, and their distinctive feature, is that they provide a structure within which complementarities (of all types) in production and/or consumption can be contained and coordinated without the need for vertical integration. (p. 2263)

If these conditions are not present, then other forms of collective economic action, such as markets, networks, alliances, and supply chains, will emerge instead. Ecosystems require a set of interdependent activities that contribute to a shared value proposition (Adner, 2017). Similar to platforms, these interdependent activities can be divided into modules (Baldwin et al., 2000). Modularity enables “coordination of independent yet interdependent firms through ecosystems” (Jacobides et al., 2018, p. 2260). These modules must be complementary to each other and must be nongeneric, as not all types of complementarities lead to ecosystems; generic complements can be traded in markets (e.g., electricity, see Jacobides et al., 2018) and do not require ecosystems. There are two types of complements that can lead to ecosystem emergence: unique complementarity (A does not function without B) (Hart & Moore, 1990) and

supermodular or Edgeworth complementarity (more of A makes B more valuable) (Milgrom & Roberts, 1990). Supermodular complementarity is the basis of direct and indirect network effects (e.g., Parker & Van Alstyne, 2005).

What Jacobides et al. (2018) refer to as “groups of firms” is defined as a “multilateral set of partners” by Adner (2017, p. 42). The term multilateral denotes that the relationships between the actors within an ecosystem cannot be broken down into dyadic or bilateral relationships (Adner, 2017; Jacobides et al., 2018). Thus, ecosystem actors benefit from increased options due to the multilateral nature of their relationships. The different actors are aligned because of a joint value proposition that they wish to achieve, and one that cannot be achieved in isolation (Adner, 2017; Adner & Kapoor, 2010; Hannah & Eisenhardt, 2018; Jacobides et al., 2018). While these characteristics delineate ecosystems from other types of organizational collectives (e.g., supply chains, clusters, networks) they are additionally more distinct because of their more “organic” governance systems (decision-making processes are, to some extent, distributed; no contractual relationships exist between ecosystem members) (Jacobides et al., 2018; Thomas & Autio, 2020). Thus, the symbiotic relationships between ecosystem actors break down traditional industry boundaries (Adner, 2017). Consequently, similar to platforms the design of ecosystems is complex (Jacobides et al., 2018).

However, the conceptualization of smart cities as platforms and ecosystems (Appio et al., 2019) as well as the “government as a platform” approach (O’Reilly, 2010) emphasize the importance of a central platform in smart cities. Moreover, value creation in smart cities is based on the notion that app developers and technology companies connect to a central city database to develop novel services and applications. I therefore suggest a more precise wording of Appio et al.’s (2019) conceptualization by stating that smart cities can be conceptualized as *platform-based ecosystems*. As my dissertation focuses on the challenges encountered by bureaucratic organizations during the implementation of the “government as a platform” approach (O’Reilly, 2010), I continue to build on previous research on digital platforms.

2.2.3 Platform governance: Tension between generativity and control

Platform governance is defined by Tiwana et al. (2010, p. 679) as “who makes what decisions about a platform.” Governance design can be investigated from three different angles: (1) decision-making rights, (2) control, and (3) proprietary versus shared ownership (Tiwana et al., 2010). Decision-making rights cover the decisions that directly affect the digital platform and the applications that are built on the platform. Some of these decision-making rights can be assigned to external actors. The control dimension of digital platform governance is rather broad and encompasses a set of formal and informal control mechanisms (Constantinides et al., 2018). Such control mechanisms are manifested in certain rules that lay out behavior on the digital platform, best practices, and gatekeeping. Other more formal rules are the boundary resources, such as Software Development Kits (SDKs) or APIs. Granting ownership to external actors is a means of appropriating value. Furthermore, monetary incentives, such as participation in revenues for licensing applications to users, can serve as governance mechanisms. Digital platform providers also have multiple options for monetizing the value that is created on the platform (Parker, Van Alstyne, & Choudary, 2016). These options cover transaction fees, access fees, and fees for enhanced access and curation.

The academic conversation about digital platform governance has focused particularly on *openness* as a proxy for governance mechanisms. Digital platform openness offers substantial value creation opportunities by leveraging the concept of open innovation (Chesbrough, 2010; Von Hippel, 2005). The focus on this openness refers in particular to the ability of the digital platform’s interfaces to attract external agents that are willing to innovate on the platform and thus contribute to the generativity (Zittrain, 2008) of the digital platform. Generativity in this context “can be viewed as the fruit of an urge to harness the possibilities enabled by the flexibility of digitizing” (Tilson et al., 2010, p. 753). Openness has, therefore, been investigated in various contexts, such as rules governing interface utilization, accessibility of information on interfaces, and the cost of access (Gawer, 2014; McIntyre & Srinivasan, 2017). Studies have further emphasized the trade-offs between more open and more closed platforms (Eisenmann, Parker, & Van Alstyne, 2008). While empirical evidence suggests that open interfaces stimulate innovation (Boudreau, 2010), some empirical results also imply that openness leads to a loss of revenues and profit (Eisenmann et al., 2008). Additionally, Boudreau (2010, 2012) more closely elaborates the different dimensions and trade-offs of openness. He finds that there are different means for opening digital platforms (i.e.,

granting access and diverting control) that result in different levels of innovativeness (Boudreau, 2010). Further, Boudreau (2012) demonstrates that adding large numbers of external agents to the platform does not necessarily result in more generative activities on the platform.

Consequently, the *design* of governance mechanisms for digital platforms is a complex task, as these mechanisms need to balance the demand of simultaneously opening certain elements to external agents in the ecosystem as well as controlling their behavior (Wareham et al., 2014). Moreover, these activities need to be aligned with what is best for the digital platform (Constantinides et al., 2018). This issue is described by scholars as simultaneously ensuring generativity and control (Yoo et al., 2010a) and evolvability and stability (Wareham et al., 2014). These dichotomies result from the underlying intricacy of digital platform governance: digital platforms offer a new form of organizing. Hence, digital platform governance cannot be assessed by looking at the relationship between a principal and an agent (Tiwana et al., 2010). Therefore, some scholars argue that governance in this setting is more an issue of coordination than control (Constantinides et al., 2018; Tiwana et al., 2010).

The complexity of designing digital platform governance has been depicted by some scholars as the balancing of *paradoxical tensions* (Tiwana et al., 2010; Wareham et al., 2014). The most prominent examples are the paradox of change and the paradox of control (Tilson et al., 2010). The paradox of change refers to the opposing logics of stability and change (Tilson et al., 2010). Stability is defined through the installed base and its permanent nature regarding the social and technical components and the connections between those components. Change, on the other hand, is enabled by the stable digital platform core that external agents connect to. However, the actions of these agents can induce change through the influx of new ideas and innovation. Fostering flexibility by allowing the establishment of new sociotechnical formations and connections is enabled by designing stable interfaces and boundary objects (i.e. SDKs and APIs) (Baldwin & Woodard, 2009; Tilson et al., 2010).

The paradox of control describes the opposing logics of bundling all control within one central authority as opposed to devolving control to the individual (i.e., increasing the level of autonomy for external agents). More elegantly stated, the paradox of control encompasses the dichotomy of centralized and decentralized control. Here the challenge lies in providing external agents with enough autonomy to establish generative activities while considering these agents' preferences with regard to services, data ownership, value appropriation and the control of resources (e.g., APIs) (Tilson et al., 2010).

Examined more closely, it becomes apparent that these paradoxes are related to each other because digital platform owners are constantly iterating the right level of control as the platform evolves, to balance stability and evolvability and to foster generativity.

To my best knowledge, Wareham et al. (2014) are the first to empirically assess the tensions for digital platform governance by adopting a paradox lens. The empirical study draws data from a single case study of an Enterprise Resource Planning (ERP) software vendor and its ecosystem. Wareham et al. (2014) investigated whether tensions between a) standard versus variety outputs, b) individual actor control versus autonomy, and c) collective identification versus individual identification manifest as contradictory or complementary logic. Contradictory logics refer to “either ... or” decision-making, while complementary logics underline that tensions are mutually enabling (Farjoun, 2010). The results emphasize that paradoxical tensions are nested across multiple levels in platforms (i.e., outputs, actors, and the platform owner), and that embracing rather than solving these tensions can foster the generativity of the digital platform. The findings further suggest that the environment influences whether tensions are approached by a contradictory or a complementary logic. A more recent study on the generativity tension and value creation implies that generativity has a positive (increased system reputation) and a negative (free riding) effect on platforms (Cennamo & Santaló, 2019). Analyzing data from the video game industry, the results indicate that the free-riding effect prevails as the platform matures, causing losses for the video game company and a drop in market share.

In summary, digital platforms and ecosystems cannot be governed by applying traditional principal-agent governance mechanisms. Decision-making processes are to some extent distributed among the members of the platform-based ecosystem (Jacobides et al., 2018). These ecosystem members are loosely connected individual stakeholders, who are interdependent due to their complementary inputs to the final solution (Jacobides et al., 2018). Innovation ecosystems rely on openness (Boudreau, 2010) and generativity. This entails a delicate balance between appropriately constraining actors' behavior to avoid value-decreasing activities and providing ecosystem members with control to foster generativity (Boudreau, 2012; Wareham et al., 2014). Moreover, by enabling generativity, platforms erode organizational boundaries (Yoo et al., 2010a).

2.3 Bureaucratic organizations

In this third and last section of the theoretical background, I turn to the founding father of bureaucracy: Max Weber. Weber introduced the concept of the ideal type of bureaucratic organization in his seminal work *Wirtschaft und Gesellschaft* (1921/1976). Since the seven European municipal governments in my study display many of the characteristics of Weber's ideal type of bureaucracy, a discussion of the concept of Weberian bureaucracy is therefore relevant.⁴ This will also help explain how bureaucracy can be affected by the introduction of platforms and ecosystems in smart cities. In the following paragraphs, I first describe the ideal type of bureaucracy according to Weber (1921/1976) and then provide more recent scholastic work on the "changing nature of bureaucracy" (Kornberger et al., 2017, p. 181).

2.3.1 The ideal-type bureaucracy

Max Weber's ideal-type bureaucracy is the result of purely means-end rational (*zweckrational*, p. 2) actions. Weber differentiates between four types of orientations for social action (p. 11): (1) rational, goal-oriented (*zweckrational*); (2) rational orientation towards an absolute value (*wertrational*); (3) affectual-emotional orientation (*affektuell*); and (4) traditional orientation (*traditionell*). This typology emphasizes the polymorphous character of social action and rationality in Weber's writings (Kalberg, 1980). I mention these four types because "Weber recognized that rationality would not always be purely instrumental: people rationalized their own versions of rationality based upon contextual pressures and interests" (Clegg, 2005, p. 532). Implementing bureaucratic organizations is, consequently, contingent on the external environment and its actors. According to Weber, a system of rationally debatable objectives stands behind every act of bureaucracy (i.e., either subsumption under norms or weighing of ends and means; p. 565). The description of the ideal type should thus be read as a blueprint for bureaucratic organizations that however could have different manifestations in the real world (p. 2).

Weber claimed that bureaucracies are technically superior to other organizations. Their rational and machine-like operations allow them to attain the highest degree of efficiency through precision, stability, reliability (p. 129), unambiguity, and strict subordination (pp. 561–562). Bureaucracy can serve purely political or purely economic

⁴ In the following, all page numbers in parentheses refer to Weber's *Wirtschaft und Gesellschaft* (1921/1976). Translations by the author.

authority (p. 571). Authority and power are legitimized by law, and there are clear rules for exercising such authority that overrule the actors' personal preferences. Authority is executed "*sine ira et studio*" (p. 129)—without hate and passion, and thus without love and enthusiasm. Each person is treated equally based on formalized rules and processes, ignoring social status. In addition, bureaucracy follows the principle of *fixed and official competencies*, which entails an explicit distribution of official duties—only people with qualified competencies (i.e., experts) are given the authority to carry out official duties (p. 551).

Bureaucracy also follows the principle of *office hierarchy*—a fixed system of superordination, and subordination in which higher offices supervise lower offices. Lower offices can voice concerns and complaints to higher offices due to their right of appeal and can make a statement of grievances. Office management is based on written documents or files (p. 552). This official role is conducted by specialist scribes and lower ranking officials (p. 552). These files, together with the continuous operations of the office, constitute the *bureau* (p. 126). The recording and filing of official decisions are important devices for the practice of bureaucracy (p. 552). The *bureau* is strictly separated from the private sphere (p. 552). Therefore, members of administrative staff are excluded from owning means of administration and production (p. 127).

Administrative staff is employed based on contracts that foresee the payment of a fixed salary and the right to receive a pension once they retire (p. 127). The salary depends on the respective level of the employee within the bureaucratic hierarchy. Officials conduct their work in the bureaucratic administration as a life-long vocation. Their careers follow a predefined career path, with promotions dependent on seniority and achievements (p. 127). Officials are further subject to strict and formalized control and discipline. All actions are governed and determined by legal competences.

Purely bureaucratic administration (i.e., bureaucratic-monocratic, file-based administration) is the most efficient and most rational way to organize and administer rational-legal authority (p. 128). The outcomes are predictable because of calculable rules, formalized processes, and hierarchical control. However, the most powerful means of bureaucratic administration is the mastery and control of technical knowledge (p. 128). Technical, expert knowledge is indispensable for bureaucracy since modern technological developments and value chains require such knowledge (p. 128). Weber states that bureaucratic administration is the equivalent to "authority by virtue of knowledge" (*Herrschaft kraft Wissen*, p. 129). Weber regards technology as the

“pacemaker for bureaucratization” (p. 561). In his analysis, only a strictly bureaucratic organization is capable of coping with rapid technological developments:

The extraordinary increase in the speed by which public announcement, as well as economic and political facts, are transmitted exerts a steady and sharp pressure in the direction of speeding up the tempo of administrative reaction towards various situations. The optimum of such reaction time is normally attained only by strictly bureaucratic organization. (p. 562)

Bureaucratic superiority is further strengthened and based on the documented processes of how bureaucracies conduct their business (*Dienstwissen*, p. 129). These internal documents are kept secret. Thus, the concept of *official secrecy* (*Amtsgeheimnisse*, p. 129) is an important source of bureaucracy’s extraordinary power (p. 129). Furthermore, bureaucracy hides its knowledge and shelters its employees’ actions from criticism (p. 572). This entails excluding the public from bureaucratic administration:

The pure interest of a bureaucracy in power, however, stretches far beyond those areas where purely professional interest might justify the demand for secrecy. The concept of “official secrecy” is the specific invention of bureaucracy, and nothing is so fanatically defended by the bureaucracy as this attitude, which cannot really be justified beyond these specifically qualified areas. (p. 573)

Once fully established, bureaucracy becomes an indestructible way to organize social and societal action (p. 570). That is because the ideal type of bureaucracy is a well-functioning, restless mechanism that dictates daily routines for its employees (p. 570). Their specialized tasks and limited authority ensure that no individual within the bureaucracy gains enough power and knowledge to endanger its existence (p. 570). Bureaucracy can function through purely political or purely economic authority (p. 571).

Overall, rationality pervades the fully bureaucratized organization and precisely therein lies its major strength:

The fully developed bureaucratic apparatus compares with other organizations exactly as does the machine with the non-mechanical modes of production. Precision, speed, unambiguity, knowledge of the files, continuity, discretion, unity, strict subordination, reduction of friction and of material and personal costs—these are raised to the optimum point in the strictly bureaucratic organization. (pp. 561-562)

2.3.2 Weberian bureaucracy in contemporary organization studies

Weber is widely acknowledged as one of the “founding fathers” of organizational theory due to his description of bureaucracy, an administrative system that emerged together with capitalism (Lounsbury & Carberry, 2005). Institutional theory can be traced back to Weber, as the term “institutional” refers to a central tenet of Weber’s writings: the relationship between organizations and external constituents (David et al., 2019). Weber’s theory of bureaucratic control further inspired research on formal structures in organizations, which are explicit activity patterns in organizations (Blau, 1970; Pugh et al., 1968). Hence, contingency theory, structural functionalism, structural contingency theory, and comparative organizational analysis are all built on Weber’s description of bureaucracy and his theory of bureaucratic control (Walton, 2005). Structural contingency theory and configurational theory have tried to further investigate whether there is a single form of bureaucracy or several different forms (Greenwood & Lawrence, 2005).

While Weber’s writings on bureaucracy, authority, power, capitalism, and methodology have shaped much of the early work in the field of organization studies, his contemporary relevance for research in the field of organization studies is less certain⁵ (Greenwood & Lawrence, 2005; Lounsbury & Carberry, 2005). Interpreting Weber’s work in the context of today’s cultural values, Clegg asks: “What are we to make of Weber today?” (2005, p. 528). Clegg observes that managing large organizations in the early 21st century is much more focused on creativity and leading through vision and purpose to infuse meaning than on the discipline of rules suggested by Weber. Furthermore, Weber was not correct when he predicted that values such as control, efficiency and rationality in Western capitalist societies and technology would transform the organization into the infamous “iron cage” (Weber, 2010).

The main downside of bureaucracy is the concern that its structure inhibits innovation (Hinings et al., 1967). Interestingly, while Weber regards technology as the “pacemaker for bureaucratization” (p. 561), ongoing technological developments have led to the development of organic organization structures (Burns & Stalker, 1961). These organic organizations are regarded as more flexible than mechanistic-bureaucratic structures. In addition, digital technology has generated a shift towards networked organizational

⁵ In contrast, Weber’s relevance for other disciplines, such as sociology, remains unquestioned (Lounsbury & Carberry, 2005).

structures that foster knowledge-based work (Greenwood & Lawrence, 2005). Furthermore, post-modern organizations are organized around projects that require project management, which seems antithetical to bureaucratic organizations (Clegg & Courpasson, 2004). Because firms face competitive, unpredictable and rapidly changing environments (Ansoff, 1988), organizing to foster innovation and technological advantages becomes a competitive advantage (Greenwood & Lawrence, 2005). Consequently, many scholars have proclaimed bureaucracy's long overdue downfall (Osborne & Gaebler, 1992).

However, Adler (2012) observes a resurgence of interest in bureaucracy for two main reasons: First, the decline of bureaucracy could lead to the concomitant loss of certain values and structures that have been beneficial for organizations. Second, bureaucracy—despite the manifold predictions of its inevitable decline—still exists in both the private and public sectors. This view is supported empirically by a meta-analysis conducted by Walton (2005). For this study, Walton synthesizes 64 statistical papers that investigate the defining structural attributes or features of bureaucracy (i.e., extensive formalization and standardization, specialized roles and departments, a differentiated vertical hierarchy and centralized policy making, and large departments) (e.g., Hall, 1963; Pugh et al., 1963; Pugh, Hickson, Hinings, & Turner, 1968). Based on Walton's results, there is a high covariance among the attributes related to the bureaucratic model of control, thus indicating the model's general validity. Furthermore, the results indicate that the particularly strong relationship between these variables enable flexibility and adaptability. Walton concludes: "Whether such adaptations represent new organizational designs remains debatable as the model of bureaucratic control continues its dominance of modes of organizational design" (2005, p. 589). This fuels the notion that the adaptability of bureaucracy has been vastly underestimated (Gazell & Pugh, 1990).

Regarding the potential decline of values, Byrkjeflot and du Gay argue that fully replacing bureaucratic values—hierarchy, authority, formality, impersonalism—with more contemporary values—informality, flexibility, and personal empowerment—comes "at a high political and governmental price" (2012, p. 94). To underline their argument, they provide a detailed description of the informal and undocumented process behind the UK government's decision to join the war in Iraq in 2003. Building on an argument by Olsen (2008), Byrkjeflot and du Gay state that modernizers who advocate for the abolition of bureaucracy seem to overlook the fact that bureaucracy is in itself an institution. Bureaucracy, with its purpose of administering rational-legal authority, is an

enduring institution that has developed differently depending on political and cultural contexts (Olsen, 2008). Consequently, “a functioning modern society depends on hierarchical bureaucracy, and thus upon a non-partisan public administration for its own functioning and reproduction” (Byrkjeflot & du Gay, 2012, p. 104).

Interestingly, the call for reinvigorating bureaucratic values has gained new meaning considering the actions of the 45th President of the United States of America, Donald J. Trump. A recent empirical study from Denmark describes the reinstatement of bureaucratic values in government after several scandals deteriorated trust in public institutions (Lopdrup-Hjorth & Roelsgaard Obling, 2019). Overall, bureaucracy has received much admiration for its liberal values (du Gay, 2000; Perrow, 1986). However, answering his own question (“What are we to make of Weber today?”), Clegg observes that “Things have changed. Dramatically. There is no point in nostalgia for a world irredeemably lost”(2005, p. 539). The legacy of Weber, in Clegg’s view, is to be reminded of the intersection between organizations and cultural studies, which has not lost its relevance over the past century.

Yet despite the influence of post-liberal values on modern organizational structures, empirical studies suggest new forms of bureaucracy. For example, an empirical study by Courpasson (2000) finds that “soft bureaucracies” consist of structures of domination and legitimacy, which allow them to simultaneously pursue innovation through network structures and to control those innovations through bureaucratic structures. Domination, he finds, is still at the core of managerial practices, even in horizontal, flat, flexible, and individualistic organizations. In these soft bureaucracies, political decisions are more centralized, while jobs and responsibilities are more decentralized. Courpasson’s (2000) analysis of these soft bureaucracies indicates four characteristics, which emphasize that bureaucracy and the “enterprise” (networked structures) should not be treated as strict dichotomy (Fournier & Grey, 1999).

First, soft bureaucracies encompass a specific combination of personal and impersonal (i.e., Weberian) obedience. Obedience is impersonal when it is to rules and norms. However, obedience can be personal when it is to certain, respected individuals. Second, centralization is a means of legitimating political decisions. As employee fluctuation increases, central decision-making becomes more important. However, rules protect employees from abuses of legitimate power by more senior and more powerful decision-makers. Third, governance is based on soft coercion and protection. Much like Weberian bureaucracy, soft bureaucracies seek to reduce and eliminate heterogeneous

behavior of individuals. This is achieved through soft coercion: “ineluctable decisions, external threat, survival requirements, managerial indicators, increased competition between people and increased discretion of local managers concerning individualistic forms of repression” (Courpasson, 2000, p. 157). However, soft bureaucracies can also be tailored to protect individuals’ vulnerability. Fourth, soft bureaucracies are governed by fusing external and internal legitimacy.

Weber’s work has highly impacted the investigation of public and government organizations. However, the declining interest of the field of organization research in the study of public organizations over the last decades (Arellano-Gault et al., 2013) provides even more questions regarding the relevance of Weber for public organizations today. Little is known about the effect of decentralized management approaches on bureaucratic authority systems (Lounsbury & Carberry, 2005) in public organizations. The recent study by Kornberger et al. (2017) is an exception. Their empirical study of the municipal government of the city of Vienna is particularly important for this dissertation. That is because Kornberger et al. (2017) use an organizational lens to analyze how bureaucracy changes when novel smart-city related concepts, such as open government, are introduced to the municipal government in Vienna. Returning to Weber and juxtaposing his description of the bureaucratic administration and the principles of open government, they suggest that these two are fundamentally different. While Weberian administration promotes expertise, the official, the office as vocation, the bureau and its files, official secrecy, clear areas of jurisdiction and a closed hierarchy, open government is grounded in distributed knowledge, the crowd, passionate amateurs, the wiki principle, transparency, voluntary co-production, and open networks. Their ethnographic study depicts how Vienna’s bureaucracy translates open government into open government data; an administrable object. This coping strategy allows senior bureaucrats to alleviate and circumvent potential tensions by translating democratic ideals into administrable objects and tasks. For example, openness as a fundamental principle of open government becomes a technical issue: data should be machine-readable. This translation is a form of shaping the different directions of bureaucracy. However, this is not regarded as a shortcoming of bureaucracy. Rather, the authors demonstrate how bureaucracy is continually changing and adapting without diverging from its core values by concluding that “extending Weber, the Internet is, despite all tropes, not a decentralizing network that leads to the end of bureaucracy but a technology that leads to new, perhaps surprising forms of bureaucratization” (Kornberger et al., 2017, p. 196).

Consequently, the changing nature of Weberian bureaucracy remains relevant today, particularly in public organizations. It seems that with the rise of the smart city and the increasing implementation of platforms as new tools for coordination and governance, studying the changing nature of Weberian bureaucracy is more relevant than ever. In the words of Lounsbury and Carberry:

We believe that current efforts to understand issues having to do with globalization, post-industrialism, and varieties of capitalism in the information age make Weber's historical analyses of capitalism, domination, authority, legitimacy, and inequality as relevant today as they were during transitions to industrialization, urbanization, and rudimentary forms of market capitalism in his lifetime. (2005, p. 502)

2.4 Summary

This chapter has reviewed the literature on smart cities, platforms, and bureaucracy. The review has surfaced overlaps between the three research streams. However, to my best knowledge, my research objective is the first to combine the three research streams due to the lack of investigations and theory on the encounter of platforms and bureaucratic municipal governments. I therefore briefly summarize the key theoretical arguments below. Please see Figure 5 for an illustrative explanation.

The smart city literature has developed rapidly over the past decade (Appio et al., 2019; Coletta et al., 2019; Kitchin et al., 2016; Mora et al., 2019). However, much of this literature has focused on the pervasiveness of digital technologies in the urban fabric (Mora et al., 2019), failing to develop an inclusive smart city (Hollands, 2008, 2015). To provide an inclusive and holistic conceptualization of the smart city, Appio et al. (2019) suggest to conceptualize smart cities as platforms and ecosystems. In this case, municipal governments take over the role as platform provider or database conveners; also referred to as “government as a platform” (Barns, 2016; O’Reilly, 2010). However, applying the “government as a platform” approach to municipal governments is rather complex (Parker et al., 2016). To a certain extent this is due to the complex nature of designing and governing digital platforms, and the existing lack of knowledge concerning tensions between generativity and control (Cennamo & Santaló, 2019; De Reuver et al., 2018; Tilson et al., 2010; Wareham et al., 2014). Thus, there is a need to examine the “effects of data-driven technologies on the forms and practices of

municipal governments” (Kitchin & Moore-Cherry, 2020, p. 10). Kornberger et al. (2017) offer insights into a related phenomenon by focusing on a precursor of “government as a platform”: open government (Barns, 2016). Their results suggest that the adaptability of bureaucratic organizations has been vastly underestimated (Gazell & Pugh, 1990). Therefore, researchers urge for more research on public organizations (Arellano-Gault et al., 2013) and on the influence of decentral management approaches (such as digital platforms) on bureaucratic control (Lounsbury & Carberry, 2005).

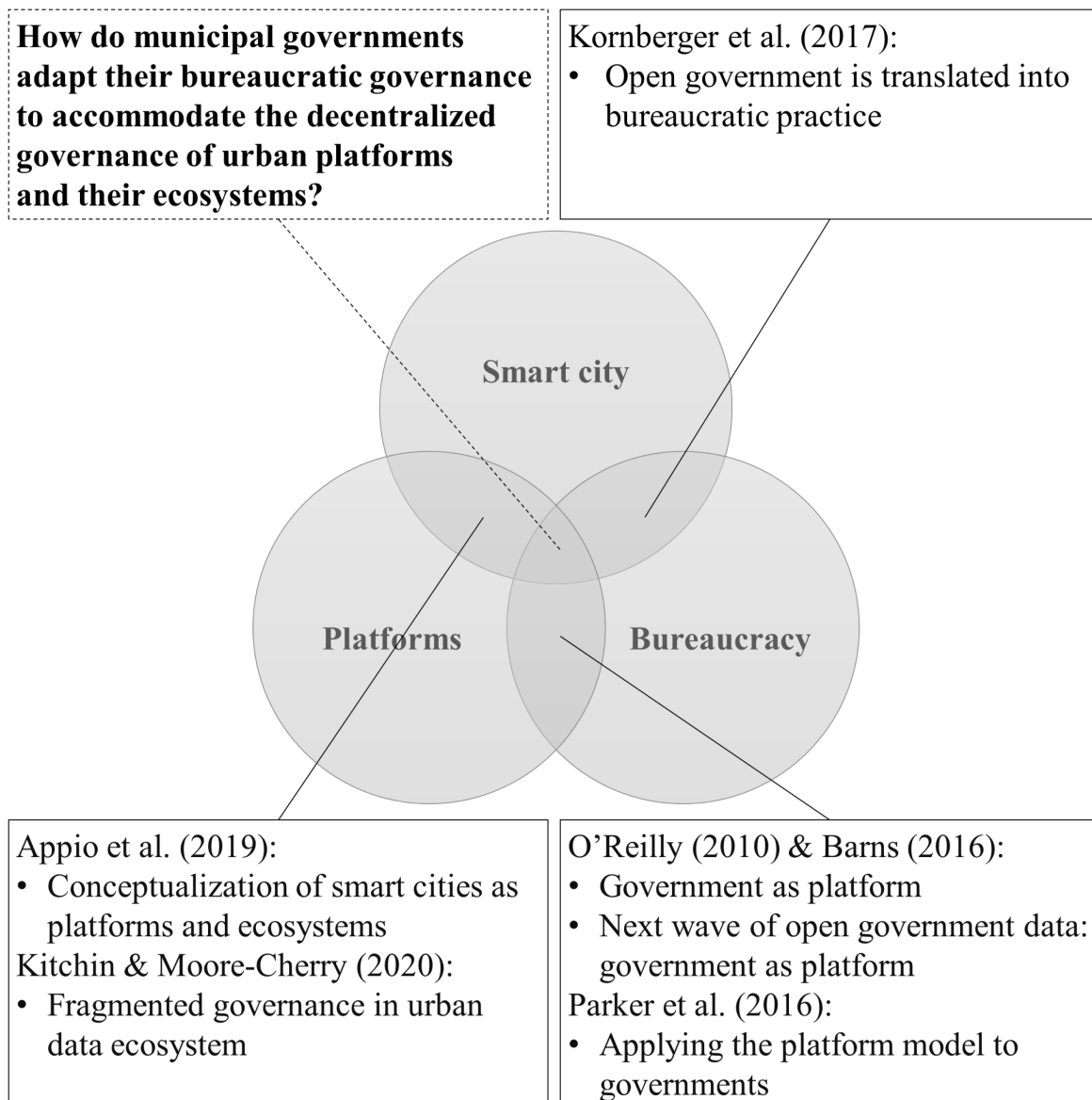


Figure 5: Visual explanation of the research objective and existing literature

3. Method

I use an inductive, multi-case study approach that follows the replication logic. The cases were treated as multiple experiments used to confirm or disconfirm inferences from the other cases (Yin, 1994). Applying the comparative case-study methodology (e.g., Eisenhardt, 1989; Yin, 1994), I selected seven relevant cases and collected data from multiple sources within each case. Subsequently, I conducted in-depth, within-case analysis followed by cross-case analysis (Eisenhardt, 1989). As my findings are grounded in a variety of empirical evidence, the results should be more valid and generalizable than those of most single case studies (Eisenhardt & Graebner, 2007).

3.1 Research context and sample

I study smart cities because these public organizations are well-suited for studies of organizational change infused by novel technologies (Greenwood & Lawrence, 2005) and, more generally, studies of the changing nature of the Weberian bureaucracy (Arellano-Gault et al., 2013; Kornberger et al., 2017). Specifically, I focus on the municipal governments of Munich, Lyon, Vienna, Rotterdam, Stockholm, Santiago de Compostela, and Barcelona. To find public organizations that fit my research focus (Eisenhardt, 1989), I first sought similarities within the set of potential cases that would aid in comparison and replication. All of the selected cities were supported by the European Commission's (EC) Horizon 2020 "Smart Cities & Communities" (SCC) program, which distinguished them as leading European examples of smart-city initiatives (European Commission, 2018). The program revolved around energy, urban, technical, financial, and social smart solutions with an emphasis on big data, data management, and digitalization (European Commission, 2018). I also sought heterogeneity to increase generalizability, which I ensured by choosing cities of different sizes and in different countries. Moreover, six of the cities are so-called "lighthouse cities" (i.e., cities that were chosen for large-scale infrastructure implementation), while Santiago de Compostela is a so-called "follower city" (observes lighthouse projects but is not funded by the EU for infrastructure implementation).

3.2 Data collection

The data collection stretched over four years from 2017-2020. I used several different data sources: semi-structured interviews⁶, undisclosed and open archival data, and observations (see Table 2). Most of my data came from semi-structured interviews with informants directly involved in smart-city projects. The archival data and the observations expanded my understanding of each case and of the broader context, and offered insights that corroborated or rejected my interview findings (Yin, 1994).

⁶ Karin Kloeti, Anne Tiepolt, Tobias Meister, Jan Albers, and Alexander Churyukanov supported the data collection of semi-structured interviews under the supervision of the author of this Dissertation. The interview guideline and its subsequent adaptations were developed by the author of this Dissertation. The students could use the interview material for their Master theses.

City (Population)	Interviewees (# interviews) (individual identifiers)	Archival material	Observations
Munich (1.5 million)	Team leader – Data Services (1) (A1) Team leader – Geoinformatics Services (2) (A4) Team leader – Energy Refurbishment (1) (A11) Project manager – Car sharing/mobility stations (1) (A8) Officers – Data Services (5) (A2, A3, A5) Officers – Car sharing/mobility team (3) (A7, A9, A10) <i>Total: 13</i>	Project books Presentations E-Mails Posters Prototypes Website	Data-platform workshops (2) General assemblies (3) Peer-to-peer workshops (3) Smart-city and community meetings (4) Phone conversations
Lyon (513,000)	Director – Innovation and Economic Action (1) (B4) Team leader – Data Services (2) (B2) Project manager – Lyon Confluence (3) (B1) Project manager – Networks and Planning Unit (1) (B3) <i>Total: 7</i>	Project books Presentations E-Mails Website	Data-platform workshops (2) General assemblies (3) Peer-to-peer workshops (3) Smart-city and community meetings (4) Phone conversations
Vienna (1.9 million)	Director – Data Governance (1) (C7) Team leader – Data Services (2) (C4) Officers – Data Services (4) (C1, C2, C3, C5) Officers – Mobility Team (5) (C6, C10, C11, C13, C14) Officers – Energy Refurbishment (3) (C8, C9, C12) <i>Total: 15</i>	Project books Presentations Website	General assemblies (3) Peer-to-peer workshops (3) Smart-city and community meetings (4) Phone conversations
Rotterdam (650,000)	Senior Program Manager – Digital City (1) (D1) Director – Data Analytics (1) (D5) Project Manager – Smart City (1) (D3) Specialists (Data, urban platform, communications) (3) (D2, D4, D6) Senior executive – Private company (D7) <i>Total: 7</i>	Project books Presentations Website Press releases Publications	Smart-city and community meetings (4) Cross-smart-cities and communities task group Phone conversations
Stockholm (974,000)	Lead Project Manager – Smart City Project (1) (E2) Project leader – IoT and Data Platform (1) (E1)	Presentations Website	Smart-city and community meetings (4)

City (Population)	Interviewees (# interviews) (individual identifiers)	Archival material	Observations
	Senior Director – Environment and Health Department (1) (E3) Officers – Smart City and Data Strategy (3) (E4, E5, E8) Specialists (Sales, Platform Data Architecture) (2) (E6, E7) <i>Total: 8</i>		Cross-smart-cities and communities task group Phone conversations
Santiago de Compostela (100,000)	Officers – Data Services (5) (F1, F2, F3, F4, F15) Officers – Mobility Team (4) (F7, F8, F12, F13) Specialist – Energy Refurbishment (6) (F5, F6, F9, F10, F11, F14) Specialist – Application development (1) (F16) <i>Total: 16</i>	Project books Presentations Website	Data-platform workshop (1) General assemblies (3) Peer-to-peer workshops (3)
Barcelona (5.6 million)	Senior Officers – Data Office (2) (G4 & G5) Project Managers – IT Department (3) (G1, G2 & G3) Specialist – Smart City and Business Models (1) (G6) Project Manager – Private company (1) (G7) <i>Total: 7</i>	Website Presentations Internal documents Publications	Smart-city and community meetings (3) Cross-smart-cities and communities task group Smart-city expo (1)
Independent experts	Expert – Urban-data platform/geoinformatics (1) (X1) Expert – Urban-data platform/EU Horizon 2020 (1) (X2) Expert – Open data and standards (1) (X3) <i>Total: 3</i>		

Table 2: Case and data overview

Interviews. I conducted a total of 76 semi-structured interviews between September 2017 and August 2020. Seventy-three of the interviewees were directly involved in the design and development of the smart-city measures. Three interviewees were independent experts on urban-data platforms who had extensive experience in European smart-city projects and were able to corroborate my findings. To ensure a representative sample, I talked to people across levels and disciplines. For example, I interviewed officers responsible for: (1) the technical development of the urban platform, (2) city planning, (3) use-case development, (4) energy, and (5) transportation. To include the

most knowledgeable informants, I used a “snowballing” technique, asking each initial interviewee for recommendations on additional interviewees. The interviews lasted an average of 80 minutes, and they were recorded and transcribed verbatim to ensure reliability. The interviews were undertaken in German, Spanish, and English. I wrote the case notes within 24 hours of each interview (Eisenhardt, 1989; Miles & Huberman, 1994).

My interview guideline (see Appendix III) revolved around tensions related to collaboration, organization, and data privacy, but I did not directly ask for information on organizational tensions. Rather, I started with general questions (Spradley, 1979) about the interviewee’s role in the municipal government and in the project, tasks, and relationships with employees in other departments. I encouraged respondents to wander freely in their narratives and probed whenever possible. After each interview, I assessed the interview protocol and re-designed some of the interview questions. I continuously and systematically iterated between analysis and data collection in order to become increasingly focused in my interviews (Glaser & Strauss, 1967). I conducted additional and follow-up interviews until I achieved theoretical saturation (Strauss & Corbin, 1990).

Archival data. I gathered written documentation from the focal municipal governments and their project partners to corroborate the findings. I collected internal documents, such as presentations, studies, press material, project books, and other deliverables for the European Commission. In addition, I collected material that was distributed externally by the cities, such as press articles, presentations, websites, and other publicly available material. I used this material to corroborate data from the interviews and to identify other avenues worth exploring.

Observations. Between September 2017 and March 2020, I observed city-internal workshops, cross-collaboration workshops, meetings of representatives of all Horizon 2020 projects, and telephone conferences (see Table 3). I also observed knowledge-exchange meetings organized by the European Commission, with focus groups working on such topics as data platforms, the digital twin (i.e., a three-dimensional model of the city), smart energy, and smart mobility. I documented my observations in writing and engaged in many informal conversations regarding the municipal governments’ views on platforms in smart cities and the arising challenges.

Event name (Location, Year)	Description	Example observations
Business model workshops (Munich, 2018, 2017; Lyon, 2017, 2016, Vienna 2018)	Design-thinking based two-day workshops to develop innovative business models for smart living, e-mobility, and digital platforms.	Munich 2018: During an internal workshop, a senior officer highlights that they do not want to be a “Google city”.
Peer-to-peer workshops (Sønderborg, 2017; Munich, 2018; Vienna, 2018; San Sebastian 2018; Lyon 2019)	Internal workshops inside the different Horizon 2020 smart-city projects and community exchanges with other lighthouse cities. The aim is to share experiences and promote peer-learning and the joint development of scalable solutions.	Lyon 2019: The platform team from Munich presents its solution and approach to the digital twin in front of the other platform teams of the SCC projects (around 50-60 participants). One comment from the audience emphasizes that data should be viewed as soil that nurtures a green future in Europe instead of “the new oil”.
General assemblies (Vienna, 2018; Sofia, 2019; <i>Online</i> , 2020)	Yearly assembly of all members of the project’s consortium. During this event, the project coordination team provides an update about the progress of the implementation of the different measures. In addition, each city (the general assembly is hosted in a different city each year) demonstrates the measures it has implemented by organizing site visits and project demonstrations.	Vienna 2018: The Vienna project team demonstrates how they have enabled citizen-engagement. In collaboration with a private consulting company, the municipal government has set up a temporary information center in a container in the area of the refurbishment works. This has motivated citizens, who live in the refurbished buildings, to come forward and discuss their ideas and provide recommendations to the municipal government.
SCC cross-collaboration meetings (Sønderborg, 2017; Lisbon 2018; Stavanger 2018; San Sebastian 2019; Lyon 2019)	Hosted by different lighthouse cities, these meetings are organized twice a year. The goal is to assemble all project teams and consortium members from all 17 lighthouse projects (i.e., 46 lighthouse cities (EU SCIS, 2021c)) to exchange ideas, engage in cross-collaboration workshops and meet	Lyon 2019: In a cross-collaboration format, different business models are developed. For example, the mobility teams from all lighthouse projects create a joint solution for a shared problem. They focus on developing an app that enables commuters to share a ride to the closest train or bus station.

Event name (Location, Year)	Description	Example observations
	representatives from the EC.	
SCC Business model and finance taskforce meetings (Barcelona 2018; Stavanger 2018; Lisbon 2018; San Sebastian 2019; Lyon 2019)	This taskforce consists of the business model and finance experts from each SCC project. The goal is to harmonize approaches and to develop templates that can be used by other municipal governments that are not participating in the SCC work program.	Barcelona 2018: A business model expert from Barcelona explains how his team calculated the hours saved by storing all data on a central data platform to convince senior officials of the municipal government to support the development of the platform. Moreover, this example aimed to demonstrate that business models in a smart-city context create social value by improving the efficiency of citizen services.
Phone conversations and conference calls	Over a period of three years monthly calls with the project lead of the replication and business model workstream of one of the projects. Over 100 calls with members from the municipal governments to support the development of the platform, business model scaling and other innovation-related issues. Monthly update calls with the business model and finance taskforce.	Several phone calls with officers from the lighthouse projects that focused on how to convince other departments of the organization to share their data. Conference calls with the business model and finance taskforce that focused on how to harmonize the different lighthouse projects to achieve economies of scale and economies of scope.

Table 3: Observations

3.3 Data Analysis

My analysis followed a systematic and iterative approach in line with Glaser and Strauss (1967) and Miles and Huberman (1994). I went back and forth among the data, emerging patterns, and extant literature to better understand the organizational challenges faced by municipal governments during the implementation of their digital platforms.

First, I compiled separate case studies on each city in my set using my data. To categorize the raw data, I followed a technique suggested by Van Maanen (1979) in which I coded the data using *in vivo* codes (i.e., first-order codes composed of language used by informants) or descriptive phrases when *in vivo* coding was not available. *In vivo* codes allowed me to gain initial insights into the challenges associated with coordinating different stakeholders, collaborating on tasks without clear goals, and dealing with issues like data quality and data privacy. Two researchers independently coded all interviews. Discrepancies in the coding were resolved through discussion, which occasionally involved a third colleague as a moderator.

Second, I searched for links among the first-order concepts. This enabled me to group the first-order concepts into second-order themes. A crucial aspect of this inductive analysis was that codes emerged from the data rather than from pre-defined hypotheses (Strauss & Corbin, 1990). The preliminary results of this stage were shared with several trusted, senior-level respondents in order to incorporate their views.

Third, I moved from within-case analysis to cross-case analysis. Using standard cross-case analysis techniques (Eisenhardt, 1989; Miles & Huberman, 1994), I searched for similar concepts and categories by comparing the second-order themes of each case. Similar themes were aggregated into dimensions, which functioned as the building blocks of the emerging framework. To label these dimensions, I searched for similar descriptions of organizational challenges, tensions, and potential solutions. Again, the reliability was assessed by involving a second researcher, who probed the labels. Disagreements were resolved through discussion and additional rounds of probing until the two researchers reached agreement. The coding structure is illustrated in Figure 6, which displays the implementation process of digital platforms in smart cities.

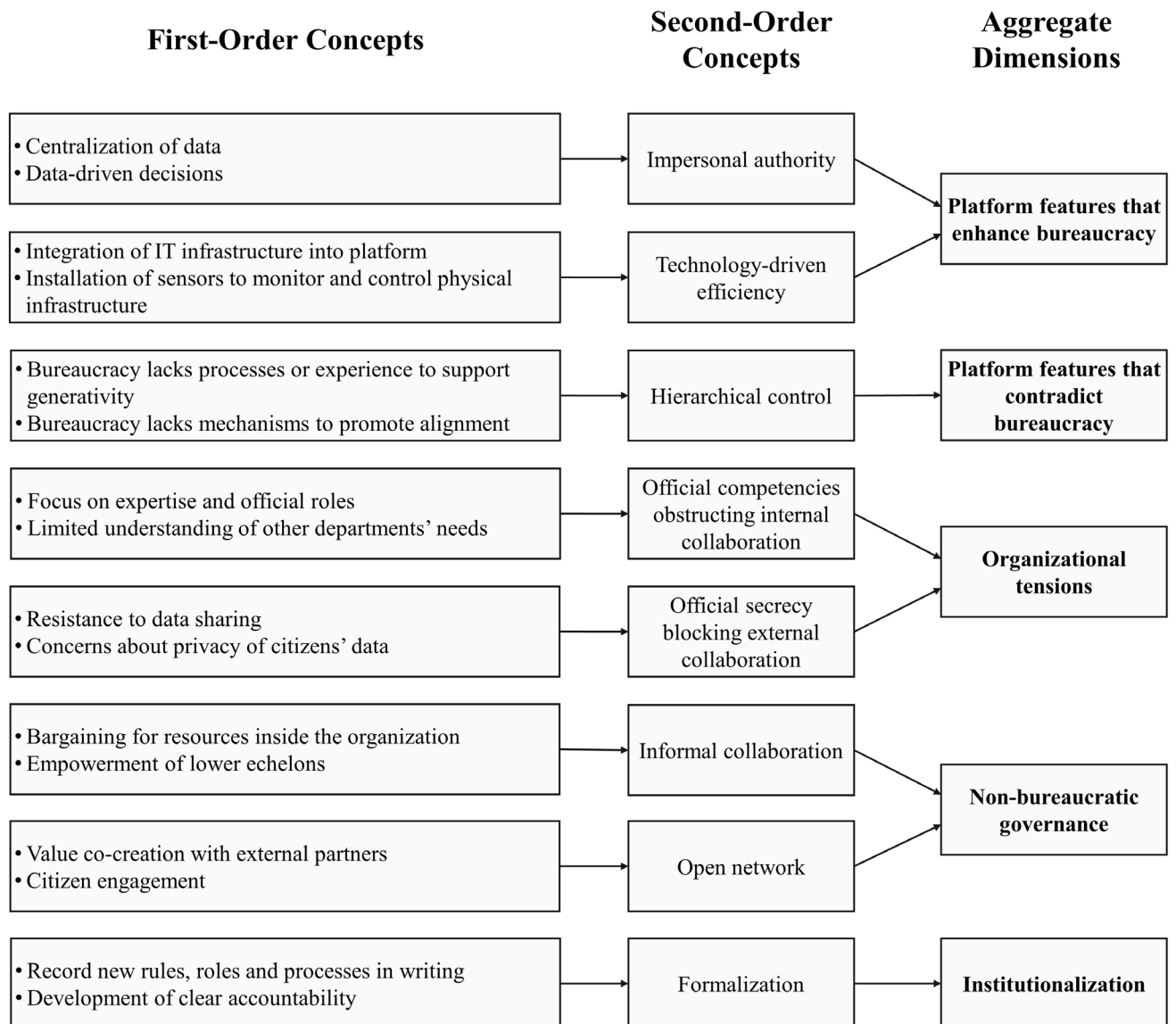


Figure 6: Data structure: Implementation process of digital platforms in smart cities

4. Findings

This section is comprised of two parts. First, I present within-case data, an important step in case study research that allows researchers to deal with the “staggering volume of data” (Eisenhardt, 1989, p. 540). While there is no standardized format for presenting within-case data (Eisenhardt, 1989), I describe each case in detail, which is the most common and established approach (Eisenhardt, 1989; Yin, 1994). This allows me to become “intimately familiar with each case as a stand-alone entity” (Eisenhardt, 1989, p. 540). Second, I present the results of the cross-case comparison of the seven individual cases. I develop an empirical process by guiding the reader through each step of the process in separate sub-sections. Each part of the process is demonstrated by evidence from the cases. Additionally, I use extensive tables and visualizations to convey the depth of my empirical grounding (Eisenhardt & Graebner, 2007). This second part of the findings section focuses on the replicable patterns across the seven cases, to serve the main purpose of this dissertation: developing generalizable results.

4.1 Within-case description

All seven municipal governments participated in research and innovation projects that received funding from the EU’s Horizon 2020 initiative. The program ran from 2014-2020 and with an overall budget of €80 billion. Its goal is to “ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation” (European Commission, 2021). Munich, Lyon, Vienna, Rotterdam, Stockholm, Santiago de Compostela, and Barcelona have all participated or are still participating in a Horizon 2020 work program called “SCC lighthouse projects”. Each smart-city project in this work program consists of three lighthouse cities (i.e., areas for large-scale project demonstration and implementation) and three to five follower cities. Lighthouse cities receive funds from the EU for project implementation (e.g., refurbishment of buildings) and hiring project management staff. In addition, the lighthouse cities need to commit funds to these projects as well. An overview of the projects can be found in Table 4.

While the projects may differ in their scope and project set-up, they all cover similar areas, focusing on renewable energies, e-mobility and implementing digital platforms that serve as the technological backbone of their measures. Moreover, the interviewees emphasized that they implemented these different measures by defining so-called “use-

cases.”⁷ For example, a use-case from Munich is the implementation of different types of sensors into so-called “smart lampposts” (A2). The use-case description includes detailing how the use-case creates value for the municipal government and/or the citizens. In addition, the description provides a list of stakeholders that were involved including their responsibilities and a project plan for the implementation. These use-cases served as learning opportunities for the municipal governments and were evaluated once they were fully implemented. Successful use-cases are currently rolled-out in other parts of the cities (i.e., implementing sensors across the whole city), while less successful uses-cases were either adapted or not pursued further.

Overall, the participants emphasized that learning and experimentation were two important and valuable aspects of their projects. In addition, it is important to note that some of the municipal governments were already involved in some sort of platform or smart-city projects before starting the Horizon 2020-funded projects. Thus, I observed how the seven municipal governments centralized their scattered smart-city initiatives into one main strategic objective, which was enabled by a central digital platform.

⁷ For a more detailed collection of use-cases and business models in smart cities please refer to the “Handbook Smart City Business Model Innovation”. The Handbook has been developed by the author of this dissertation in collaboration with Karin Kloeti, Prof. Dr. Maximilian Palmié and Prof. Dr. Oliver Gassmann. It can be retrieved using this link: <https://www.smarter-together.eu/file-download/download/public/1035>.

	<i>GrowSmarter</i> ⁸	<i>SmarterTogether</i> ⁹	<i>Ruggedised</i> ¹⁰
Project duration	January 2015- December 2019	February 2016- January 2021	March 2017- October 2021
Lighthouse cities	Barcelona Stockholm Cologne	Munich Vienna Lyon	Rotterdam Glasgow Umea
Follower cities	Graz Porto Suceava Cork Valletta	Santiago de Compostela Sofia Venice Kiev Yokohama	Parma Brno Gdansk
Total cost in € [EU contribution]	34,445,071 [24,820,974]	29,119,448 [24,742,979]	19,562,867 [17,692,858]
Project goals	Low energy districts (e.g., smart building refurbishment) Integrated infrastructure (e.g., big data management) Sustainable urban mobility (e.g., smart traffic management)	Living labs for citizen engagement District heating and renewable energies Holistic refurbishment of low energy districts Smart data platform E-mobility solutions for sustainable mobility	Smart thermal grid solutions E-mobility and smart electricity grid Energy management and ICT

*Table 4: Overview of the SCC01 lighthouse projects
Cities in bold are part of this multiple-case study*

⁸ Source: EU SCIS (2021a). For more detailed information on the GrowSmarter project, please visit the project website: <https://grow-smarter.eu/home/>

⁹ Source: EU SCIS (2021b). For more detailed information on the SmarterTogether project, please visit the project website: <https://www.smarter-together.eu/>

¹⁰ Source: EU SCIS (2021d) For more information on the Ruggedised project, please visit the project website: <https://ruggedised.eu/home/>

4.1.1 Case A: Munich

Located in south-east Germany, the city of Munich has a population of around 1.5 million people. At the end of 2019, 37,570 people were employed by the city's municipal government (Landeshauptstadt München Personal- und Organisationsreferat, 2019). Prior to joining SmarterTogether in February 2016, Munich's municipal government developed a City Intelligent Platform in collaboration with Siemens AG. Their cooperation began in 2011 as part of a joint research project. The basic idea of the City Intelligent Platform was to collect data from sensors located throughout the city's infrastructure. The sensors were integrated into refurbished buildings to measure energy efficiency, and into smart lampposts to collect data on CO₂ emissions, temperature, and air quality. Furthermore, the City Intelligent Platform was designed to collect and analyze real-time data.

At the start of SmarterTogether, the technological development and improvement of the platform was handed over to a private company. Eventually, Munich's municipal government took over the role of platform provider, with the private company acting as the platform sponsor. According to a data services officer (A5), it was a deliberate decision to separate the technological development of the platform from the municipal government's IT department. This separation allowed for more experimentation and freedom (A5). Furthermore, the technological changes were viewed as very complex, potentially leading to disruptions of the daily operations of the municipal government. With the CIP, the municipal government opted for a solution that was not based on an open-source community, such as the so-called "Fiware" solution used in Vienna.

The City Intelligence Platform was intended not to serve as a local data repository but rather to analyze and facilitate data exchange between the different digital services and data sources inside the municipal government. However, the role of the City Intelligence Platform shifted slightly to align with the goals of SmarterTogether and a new vision developed by the municipal government's leadership. Furthermore, the City Intelligence Platform should not be confused with the municipal government's open data platform. This platform had been developed by a subsidiary of the municipal government: the municipal public utilities. Since the municipal public utilities had built up considerable expertise and knowledge in this domain, it was decided to leave the operation of the open data platform in their hands. However, they were required to share data via an interface with the City Intelligence Platform.

The core team developing and managing the platform started as a group of four employees of the municipal government that was later completed by the team leader of the Geoinformatics Services as the importance of geospatial data for the project increased. I interviewed all five core team members at least once. Overall, the team interacted with five key stakeholders: the private company responsible for platform development, the municipal public utilities, the local public transportation authority, the Geoinformatics Services, and Securitas (a private security company that is responsible for the building data). Together with their stakeholders, the platform team approached the development of the platform on a “use-case by use-case” basis. This was because they discovered that large-scale experimentation and a quick overhaul of the current operations would not be possible within the municipal government.

The evolvement of the platform further led to a wave of centralization. At the beginning, different data sources were used in different departments (A2). Each department even used its own platform, but the different platforms were unable to communicate with each other. Therefore, the municipal government sought to utilize the City Intelligence Platform to connect all these platforms to enable data centralization. The centralization effort was regarded as an important source of value creation for the whole city. Other data sources that connect to the platform are open data from external providers (e.g., weather data), sensor data (mostly provided by third parties such as Securitas or start-ups), and geospatial data. The geospatial data were retrieved from the geospatial data platform. This platform went live in 2018 and is sponsored by the municipal government. Overall, SmarterTogether provided fresh impetus to update the existing sensor infrastructure and to add new sensors. A schematic overview of the City Intelligence Platform can be found in Figure 7.

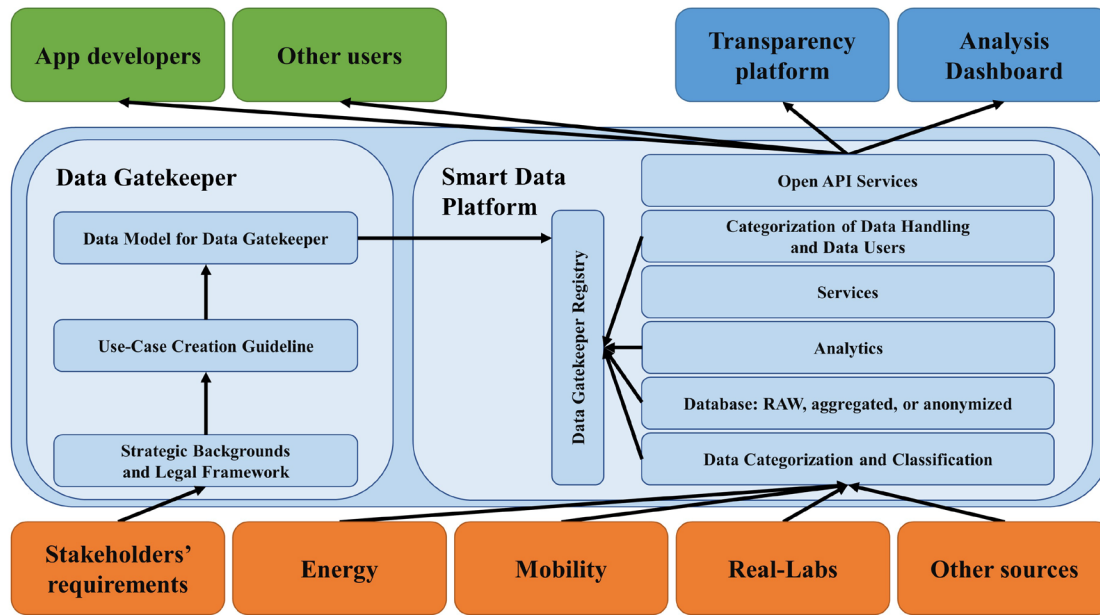


Figure 7: Munich–Overview data platform, data sources, and applications
Source: Own illustration based on SmarterTogether archival material.¹¹

As stated above, the team concentrated on a few use-cases to develop the platform. Its focus areas were related to energy, mobility, and providing KPIs for the monitoring of SmarterTogether. However, the team encountered several challenges: First, the platform team had limited support from the upper echelons. This made collaboration with other departments very difficult. Many departments did not understand the value of the platform and did not want to engage in additional work on top of their daily workload. Thus, the team told me that they were extremely dependent on their intrinsic motivation to push the project, and on their colleagues' goodwill to put in some extra work (A1, A2, A5). Second, some departments did not want to share data. Several of the municipal government's subsidiaries were used to working very independently and felt that sharing data with the platform team would be intrusive (A2). Consequently, the platform development was held up more by resource constraints and stakeholder alignment issues inside the organization than by technological issues.

During one of my observations while attending a platform development workshop, I was able to witness the repeated emphasis of an upper-echelon official on not wanting to be a "Google city". This mirrored the concerns around innovation and experimentation described to me by the platform team lead (A1). The platform team

¹¹ Source: https://www.smarter-together.eu/sites/default/files/2018-05/SDP_Transparency-Dashboard_Seite_2.jpg, Accessed: 18.02.2020.

lead outlined that many of his colleagues did not view innovation as a “real task”. To circumvent this impasse, the team published an open innovation call to attract start-ups that innovate in sensor development. They also wanted to attract companies that could build end-to-end applications for the City Intelligence Platform. Although two start-ups filed for bankruptcy during the project and were not able to fulfil their commitments, the platform team was very satisfied with the solutions developed by the other start-ups.

The platform team further proved itself to be innovative when it observed that data sharing was often impeded by data privacy concerns. The officers highlighted that data privacy was taken very seriously by the municipal government (A2, A5) and that breaching data privacy laws could harm the municipal government’s reputation. Therefore, the platform team collaborated with the Fraunhofer Institute to develop their own process for data governance; a guideline called “Data Gatekeeper”. The team felt that the Data Gatekeeper was needed because the EU’s new data privacy and security law the General Data Protection Regulation (GDPR) did not cover all the relevant areas (A5). In principle, the Data Gatekeeper is a process that ensures that data are handled according to high data security and data privacy standards. This includes the active curation of metadata by different departments.

To ensure high standards of data privacy and data security, the municipal government conducted three co-creation workshops with citizens. These workshops aimed to engage citizens, inform them about current measures and to get a better understanding of the kind of data citizens felt comfortable sharing. A small group of citizens coalesced into the so-called “data consulting team” as a result of these workshops. This team now collaborates with the platform team, particularly around questions regarding data privacy. In addition, the team decided to build a so-called “Transparency Dashboard” that was developed in response to conversations with citizens in the workshops. The dashboard is publicly available and describes what kind of data are collected and how they are used. These co-creation workshops and several other exchanges with citizens even led some citizens to change their mind and become more open and supportive of the implementation of sensors (A1, A5).

Starting in early 2020, the platform team has expanded its collaboration with the Geoinformatics Services team to develop a “digital twin”: a three-dimensional model-of the city. The idea behind this project is to enable better decision-making and monitoring of the city. The Geoinformatics Services department is the leader of this project. According to the team leader, a “real” digital twin is more than just a visualization of the infrastructure of the city. A real digital twin has access to a large pool of data to

build simulations and provide forecasts (A4). Consequently, the digital twin is the latest “hot topic” (A4) that drives the digitalization inside the municipal government.

4.1.2 Case B: Lyon

Lyon is located at the confluence of the rivers Rhone and Saone in France and has a population of 513,000 inhabitants. The municipal government of Lyon is not only responsible for the city itself but also the surrounding urban area, including 50 smaller cities (collectively called “Grand Lyon”). Thus, the around 9,000 civil servants are managing and providing services to 1.5 million people in total (B4). Lyon is the “Silicon Valley of France” (Gassmann et al., 2019, p. 109) due to an extensive ecosystem of entrepreneurs and investors. The municipal government has focused much of its efforts on projects that distinguish the city as a leader in the green energy revolution (Gassmann et al., 2019). Consequently, the development of the platform focused on collecting and analyzing energy-related data, and on developing new services around energy consumption for citizens (B1).

The municipal government’s platform emerged from a joint project with Toshiba. However, when Lyon joined the SmarterTogether project in February 2016, the goal was to replace the current Toshiba solution of the Community Management System (CMS) with an open-source solution. That is because the municipal government did not want to pay license fees for updates and they feared that a vendor lock-in would limit the development of the platform (B3, B4). The open-source version of the CMS was developed by the IT department of the municipal government. Its main purpose is to collect data (mostly energy consumption data) from the new Lyon Confluence district. The team behind this activity is relatively small compared to the other cities: it consists of five people who work in different departments. To actively monitor energy consumption, the platform team developed a data management application that assesses energy consumption and performance (B1). In addition, the CMS tries to collect as many data points as possible with the goal to build a large database that attracts talented developers and tech-entrepreneurs.

The CMS mainly serves as an interface that allows users to visualize and analyze the data stored on the “Grand Lyon Data” platform. The CMS further centralizes and combines several data sources. The Grand Lyon Data platform is the central database behind the CMS. While the Grand Lyon Data platform is also referred to as the municipal government’s open data platform, not all data on the platform are classified

as open data. Therefore, the open data platform gives access to a subset of the large pool of data, which is collected from multiple data sources. First, it collects data from the municipal government's internal information system. Second, data are collected from around 30 partners of the municipal government (public and private sector). Third, data are sent to the platform via multiple sensors (e.g., noise, pollution, temperature). Due to their close collaboration on innovative energy solutions, the French utility company Enedis is also directly linked to the CMS. Furthermore, the analysis of energy data is partly conducted by a private company called "Enertech" (B1, B3). Figure 8 displays a simplified overview of the data platforms and data sources.

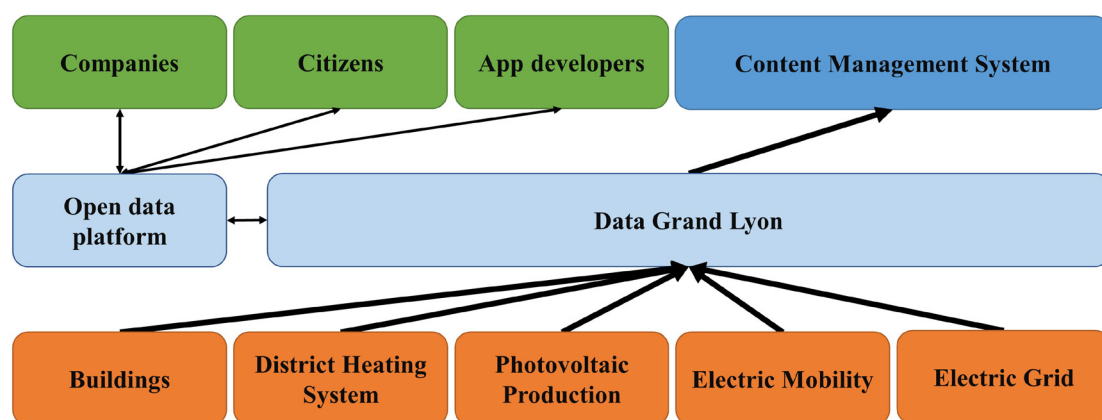


Figure 8: Lyon—Overview data platform, data sources, and applications
 Source: Personal communication with the lead project manager, March 3rd, 2020

However, sharing data was not as simple as imagined. First, many departments inside the municipal government were reluctant to share their data (B3). In addition, it was difficult to coordinate these data flows because most of them were not centralized. To solve this issue the platform team had to engage in lengthy discussions about the purpose and which data could be shared (B3). Second, despite the multiple data sources, data sharing was not facilitated via standardized APIs but by a contractual data sharing agreement (B3). This contractual agreement allows the data providers to specify the use of the data. Everyone who is working with the data must sign an additional contractual agreement, which states that the data are used only as intended by the data provider (B1).

In a similar vein, the open data platform is governed by complex access rules. Users who want to access data must create an account and state their purpose. Furthermore, accessibility depends on the person who is accessing the data (i.e., someone from the

municipal government or a citizen) and the purpose intended by the data provider. Whereas this contract-based management of the platform's interfaces ensures high levels of data security and privacy, it limits the platform's openness. Consequently, some private companies did not want to sign the data sharing agreement (B3). For example, Google was unwilling to do so because they regarded the process as too complex. As a result, the option to display public transportation routes on Google Maps is now no longer available because Google cannot access public transportation data anymore. Hence, one major issue of the platform project was to solve legal problems related to data sharing (B1).

Another major problem was the technical realization of the machine-to-machine communication (B1). That is because the new Lyon Confluence district is a greenfield project realized on an inactive brownfield industrial site (Gassmann et al., 2019). While impressive in their architectural design and innovativeness, the installation of low-cost and low-tech infrastructure inside the new buildings was perceived as very time consuming (B1). Often, sensors were active but could not transmit data because the wireless network did not work (B1). However, data transmission between the sensors and smart meters inside the buildings and the CMS is crucial because the platform enables the buildings to manage their energy systems automatically (B4). This ties into the larger vision of Lyon Confluence to reach a zero-carbon emission target. Furthermore, the district became one of the world's first WWF-certified sustainable districts (Gassmann et al., 2019).

The development of Lyon Confluence was conducted by a private company called "SPL Lyon Confluence". This company was founded in 1999 and has the legal authority to sell and purchase properties in the Lyon Confluence area (Gassmann et al., 2019). This private company, which is owned by public shareholders (the majority shareholder is the municipal government) can make decisions independently, without having to re-confirm with more senior officials from the municipal government.

The platform team currently develops new applications for the platform that are not related to energy. In early 2020, the platform team has started an ambitious project that aims to set up a "citizen cloud" in collaboration with a local start-up. The idea emerged because the officials agreed that the CMS could not store private citizen data due to privacy concerns (B3). The project foresees that all relevant data are centralized on one platform. For example, citizens can access their own personal data (e.g., social security

number), bank data, insurance data, and energy consumption data via one interface (B3). Other early-stage projects include healthcare and public transport.

4.1.3 Case C: Vienna

Located in northeastern Austria at the Danube River, Vienna has a population of approximately 1.9 million inhabitants. The city's municipal government encompasses 70 departments and has 65,000 employees (C7). Vienna is a pioneer in open government data and introduced its open government data platform in 2010. The municipal government thus closely collaborates with app developers and even invites the developers behind the most promising and successful apps to present their work inside the municipal government (C7). There are more than 400 data points available and over 200 apps have been built (see Kornberger et al., 2017 for a detailed study of open government data in Vienna). When Vienna joined the SmarterTogether project in 2016, this fully operational open data platform was already in place. However, due to the requirements of the project, the municipal government started to develop a new platform.

The officers that were involved in the development of the platform were from two separate departments. While the IT department supported the technical development, the municipal public utilities were responsible for the sensors because they had more experience in sensors and sensor technologies (C4). The platform team inside the IT department decided to use an open-source code developed by the Fiware Foundation. The Fiware software was developed in an earlier EU-sponsored project targeting smart-city platforms. The municipal government chose this software because it is a modular system and thus flexible and adaptable to their needs. For example, an add-in is used for data visualization. However, due to the nature of the open-source software, the source code of the platform can be changed by developers who are members of the Fiware Foundation. Furthermore, the Foundation's members can exchange information and code. The municipal government therefore takes over the role of platform provider but is not the platform sponsor. Furthermore, the platform team wanted to ensure that the data are stored on a server that is hosted by the municipal government. This was driven by the rising concerns about data privacy and the lack of control over where (i.e., in which country) international IT companies might store sensitive government data.

The platform's data sources are sensors, internal data from the municipal government (buildings, energy, human resources), and data provided by citizens. In 2020, the platform was mainly used to store and harmonize data between the different departments and other municipality government-owned companies such as the utility

company and the public transport authority. Interestingly, these companies were used to working very independently. This made them initially reluctant to share their data. Moreover, they felt that the data belonged to them and allowed them to build their own applications. However, after some conversations, the two companies realized that their objectives were similar to those pursued by the municipal government and that centralizing and bundling competencies would be more efficient. Consequently, the municipal government now engages in close collaborations with its subsidiary companies (C7).

Access to the platform is based on different levels of access rights. Companies that want to access data to build applications need to pay for the data, whereas citizens get access for free (C2). Furthermore, employees of the municipal government have more access rights than the public. To manage these access rights, the municipal government has developed and committed itself to a data excellence strategy. This strategy has been developed based on the experiences that were made during SmarterTogether. The strategy foresees to develop new roles inside each department. The so-called “Data Stewards” are responsible for data standardization and act as sort of human interface to the platform. To develop these new roles, officials receive additional training and education about data, data management, and platforms (C7). For an overview of the data platform see Figure 9.

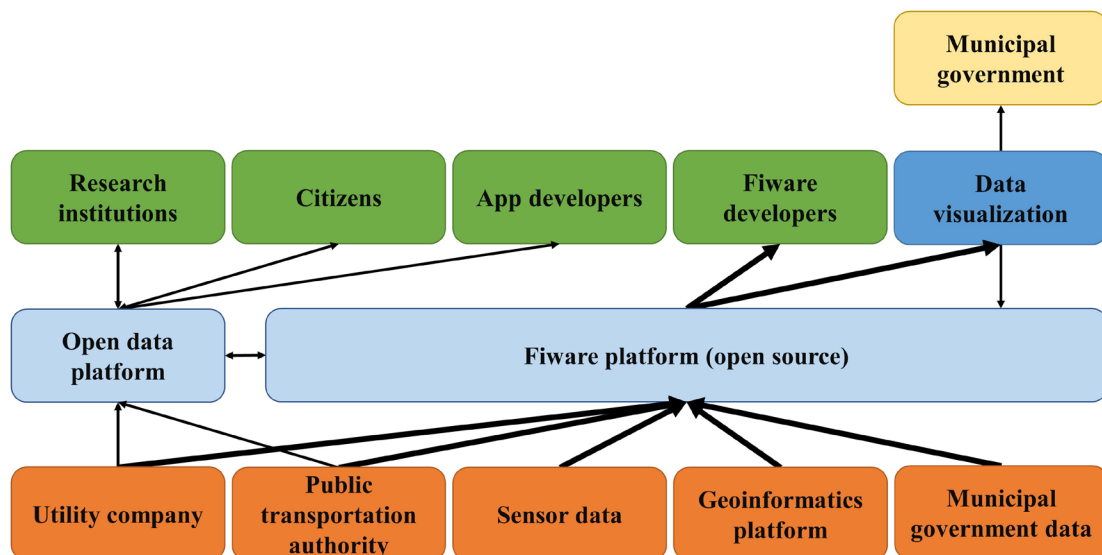


Figure 9: Vienna—Overview data platform, data sources, and applications
 Source: Personal communication with the data governance director March 27th, 2020.

Another issue that is addressed with this new strategy is the decentralized structure of the departments. The departments differed in their degree of digitalization and their willingness to centralize data. Further, as the departments tend to work in silos it was particularly difficult to coordinate data flows and to implement common data standards across the organization (C4). Moreover, data from different departments could not be merged because they had different formats. Therefore, the municipal government decided to create the role of a Chief Information Officer who manages data and IT to clarify responsibilities. The data excellence strategy now integrates and harmonizes data flows across the municipal government.

Recognizing that the smart city is less of a technological and more of a cultural phenomenon, the municipal government founded an internal innovation lab in 2017 (C4). The team is responsible for developing new apps and experimenting with new prototypes. Furthermore, the platform team emphasized that collaborating with other cities in Europe has improved their own project. Therefore, the municipal government wants to continue engaging in close collaborations and knowledge exchanges with other cities in the future. One example is the annual Data Governance and Open Data Day hosted by Vienna's municipal government.

4.1.4 Case D: Rotterdam

Rotterdam is the second largest city of the Netherlands with a population of approximately 650,000 people. It is located at the banks of the Nieuwe Maas river and home to Europe's biggest port. The municipal government has around 12,000 employees and is divided into six main departments (D3). The development on the digital platform started in 2015, when a private company demonstrated their 3D-modelling technology to a few technical experts inside the municipal government (D7). Furthermore, the company conducted several interviews with potential users of this digital twin to get a better understanding of what users might expect from their solution. These interviews inspired one of the urban planners inside the city to pursue a broader vision of the future of the city (D7). In 2018, the effort to develop a digital twin and some other digitalization projects developed by other departments were bundled into the "Digital City" program (D1). This project pursues two goals: First, it aims to develop a platform for the city's digital twin. Second, it tries to understand how living in cities will change in the future. Moreover, the digital city team joined the EU smart-city project called "Ruggedised" to develop the digital twin in 2017 (D1, D7).

Consequently, the efforts of the municipal government and of the Ruggedised project pursue joint objectives.

In the beginning, the platform was developed by the Digital City team in collaboration with a private company (D1, D7). The private company developed the technological side of the project, while the municipal government takes over the role as platform provider and manages the platform (D3). However, a year into the project the municipal government decided to become more actively involved in the development process (D7). Therefore, it internalized more developing tasks and did not renew the contract with the private company. In addition, the local university (Erasmus University Rotterdam) supports the city with expert knowledge and conducts small research projects upon the request of the municipal government. Erasmus University is also an important partner in the Ruggedised project.

The platform is based on an open-source solution (D1). Data are transmitted to the platform from the municipal government, knowledge institutions, companies, and sensors. The data are stored in a data warehouse on the platform. These data are used for the development of the digital twin and some data are published on the open data platform; also referred to as data marketplace (D1). In addition, data are analyzed and used for decision-making. Applications that are built on the platform are energy management in buildings, public lighting, and smart waste management. To establish cost-effective long-range communication between sensors and the platform, the municipal government furthermore tests and implements Long Range wireless network connectivity (Ruggedised, n.d.-a). The platform can only be accessed by officials from the municipal government. The data provided on the open data platform is accessible by everyone. However, for data privacy reasons, the municipal government mainly publishes aggregated datasets. Figure 10 presents a schematic overview of the platform.

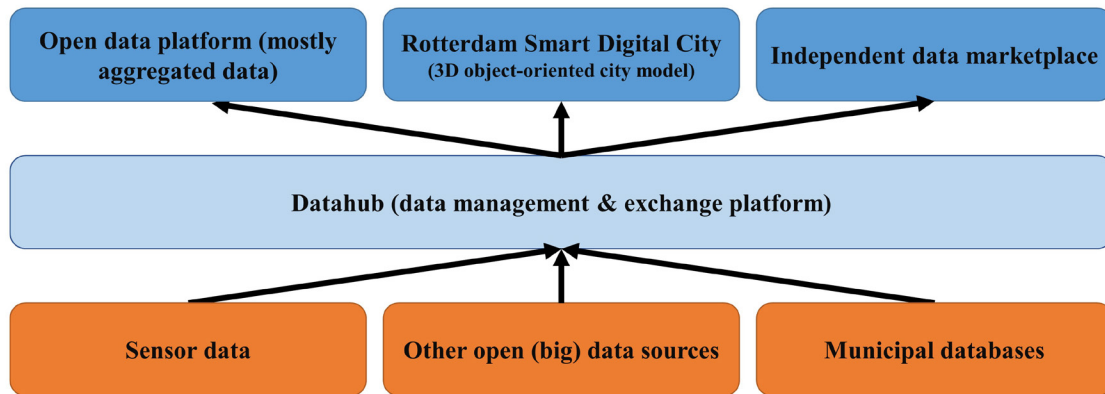


Figure 10: Rotterdam—Overview data platform, data sources, and applications
Source: Own illustration based on Ruggedised (n.d.-b).

Overall, there are five main programs inside the municipal government that are connected to digitalization and the smart city. The Digital City program is one of them. While these programs try to collaborate and exchange knowledge, it took the different departments that were leading the projects six months to understand “each other’s language” (D3). For example, some programs are focused on identifying and assessing the relevance of novel technologies such as Blockchain, while other programs are implementing data-driven processes inside the organization (D3). Furthermore, these programs differ in size and manpower. The “Digitalization Agenda” program is driven by around 600 people, whereas the “Smart City” program is led by only 12 officers. Therefore, the platform team struggled to identify and coordinate the relevant actors for their project (D1, D3). Moreover, it was difficult to convince other departments of the platform’s value and how it could enable more efficiency inside their departments (D1).

Recognizing the challenges that arise from the decentralized structure, the municipal government established new roles and responsibilities. The most important role is the Chief Digital Officer (CDO), the most senior role tasked with bundling and streamlining different smart-city programs (D3). Furthermore, the municipal government developed new roles and processes that connect the different departments. These “Process Owners” are responsible for managing data flows and data standardization along the entire process of for example extracting data from sensors in buildings (D2). “Data Brokers” are data scientists and data experts who advise departments about data privacy issues, data standardization, and help them locate relevant data inside the organization (D2). Interestingly, departments are more often advised not to open their data to the public. That is because the municipality cannot control how the data are used and might be

liable and accountable if the data are not treated according to the GDPR and other laws (D2).

Rotterdam's municipal government plans to continue to develop its digital twin model. The team has already built a first version that they now want to test and improve (D6). An additional goal for the future is to build a vibrant data marketplace, which can be accessed by public and private entities to build innovative applications that can improve the future of Rotterdam.

4.1.5 Case E: Stockholm

Stockholm is the capital of Sweden, located on the country's east coast and the Gulf of Finland. Stockholm is the country's largest city with a population of 974,000 people. Around 40,000 people work for the municipal government, which is made up of 50 departments (E4). The city joined the GrowSmarter project in 2015, during which it developed a platform together with the technology company IBM. Since, there is no central IT department inside the municipal government, each department has its own IT system; laptops and maintenance services are provided by an external service company. The goal of the municipal government in this initiative was therefore to centralize data and to combine analytical capabilities in one central analytics platform (E4). This internal digital connection between the departments is led by the newly established "Digitalization department" (E5). Moreover, the municipal government aims to create value for its citizens by pursuing a holistic smart-city strategy (E1).

All data are stored on a data warehouse platform. This platform can be accessed via a user interface. Direct access is limited to one specialized department inside the city that manages the platform. On top of this data-warehouse platform sits a platform, which was developed by the software company SAP. This platform is used for analytics and provides several business-intelligence tools. These tools are mainly used for financial analysis and financial reporting (E5). Like other cities, the municipal government, which has a long track record of collaborating with private companies, is currently reducing these collaborations to make the technological development of the platform inhouse (E5). As of 2020, 4,000 users across the municipal government were connected to the analytics platform. The main data sources are different kinds of sensors, a platform, which contains geospatial data, and private companies that collect data on behalf of the city (e.g., private housing companies that collect building data). These data are important because the municipal government conducts data-based scenario analyses

to improve decision-making (E1, E5). However, data sharing is hampered due to a lack of data standardization. Moreover, the missing digital interfaces between different departments as well as departments and the platform impede the automation of data sharing processes. Therefore, departments that want to generate specialized reports need to make a request to the data warehouse team. Figure 11 provides an illustrative overview of the platform.

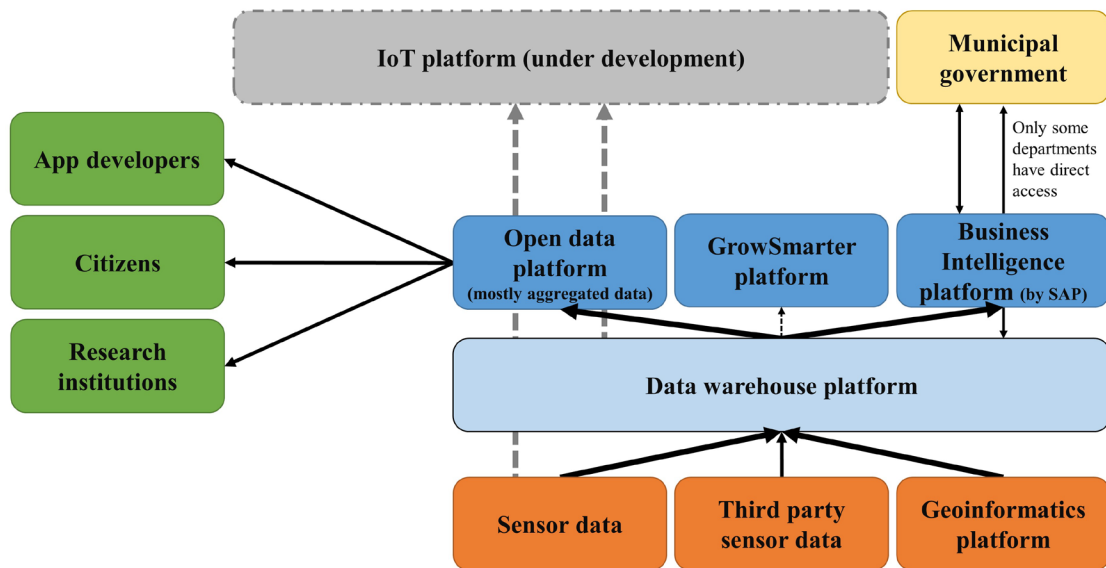


Figure 11: Stockholm—Overview data platform, data sources, and applications
Source: Own illustration based on interview data.

In addition to the data warehouse and the analytics platform, the municipal government operates an open data platform. While the officials think that using open data to enhance transparency is important, it is difficult to access the data on the platform (E4). The current process foresees that users request certain information and the municipal government then decides if it grants this request. These decisions can be rather complex as a Swedish law requires the municipal government to publish information on request. However, many officers were concerned about violating data privacy and the lack of control they had over how the open data would be used. Therefore, the responsible officials are publishing aggregated data and closely adhere to the GDPR. Furthermore, they decided not to make real-time data publicly available.

In the beginning, the developed data and use-cases were based on an open-source platform developed by IBM during the GrowSmarter project. These use-cases focused mainly on traffic on the streets of Stockholm. The main reason for this choice was that the municipal government had committed itself to become carbon-neutral by 2040. To

meet this goal, the city experimented with sensors and digital technologies to nudge people to choose more environmentally friendly modes of transportation. To test the sensors in a pilot project, the government chose a large stadium that struggled with large crowds entering and exiting simultaneously. This allowed the team to test different sensors (E2) and identify some problems (e.g., some sensors were not equipped to be used outdoors).

These experiments were not always welcomed across the whole municipal government as some officials did not understand how the platform could generate value (E1). Furthermore, the GrowSmarter platform team found the implementation to be rather difficult due to technical issues (e.g., the sensors) and coordinating the different stakeholders (E2). Moreover, it was difficult to convince other departments to join their efforts and harmonize the different IT systems and data formats across the organization. This was complicated further by the lack of responsibility felt by the other departments that did not want to commit resources to this project. Consequently, an important learning was that in the future, the different departments should try to collaborate as much as possible on topics such as data collection, standardization, and management to achieve analytical capabilities for the whole municipal government (E8).

While the development of the IBM platform was discontinued after GrowSmarter ended in 2019, the municipal government aims to integrate this platform with an IoT-platform. This IoT-platform demonstrates the municipal government's ambitions to reach its carbon-neutral objective; in part by leveraging big data for machine learning algorithms. This platform is currently procured and will most likely be developed by a private company (E8). However, before the municipal government can embark on this ambitious project, it needs to establish more information flows inside the municipal government and develop standardized interfaces between the departments (E1, E8).

4.1.6 Case F: Santiago de Compostela

Santiago de Compostela is the capital of the autonomous community of Galicia in northwestern Spain and has a population of approximately 100,000 inhabitants. It is a UNESCO world heritage city and attracts thousands of pilgrims every year (SmarterTogether, 2021). Since 2012 Santiago has been working on a smart-city initiative called "SMARTiago". The program was sponsored by the EU and aimed at connecting different stakeholders to collaborate on innovative solutions. The focus areas were mobility, public lighting, heritage conversation, and waste management. In

the SmarterTogether project, which Santiago joined in early 2016, the city takes on the role of a follower city. Therefore, the municipal government receives funding to add additional staff and to attend cross-collaboration workshops with other cities from the SCC program. However, the city receives no funding for infrastructure development or the implementation of smart-city solutions.

Notwithstanding their status as follower city, Santiago de Compostela pursued a clear vision regarding its data platform. According to the municipal government, an integrated data platform is the first important step towards becoming a smart city. Thus, the municipal government initiated the development of a platform that aimed at integrating information from different departments into a central data repository. Consequently, the main users of this platform were officers of the municipal government. The platform would further allow the municipal government to extract data from each department thereby enabling officers to make data-driven decisions. The platform also improves transparency as it enables a holistic overview of the municipal government. Moreover, the platform improved administrative services by increasing efficiencies. The platform was developed by a private company and the municipal government is the platform provider. The main data sources were internal data from the different departments, data from the public transportation company, and data from sensors in refurbished buildings. Figure 12 depicts the platform.

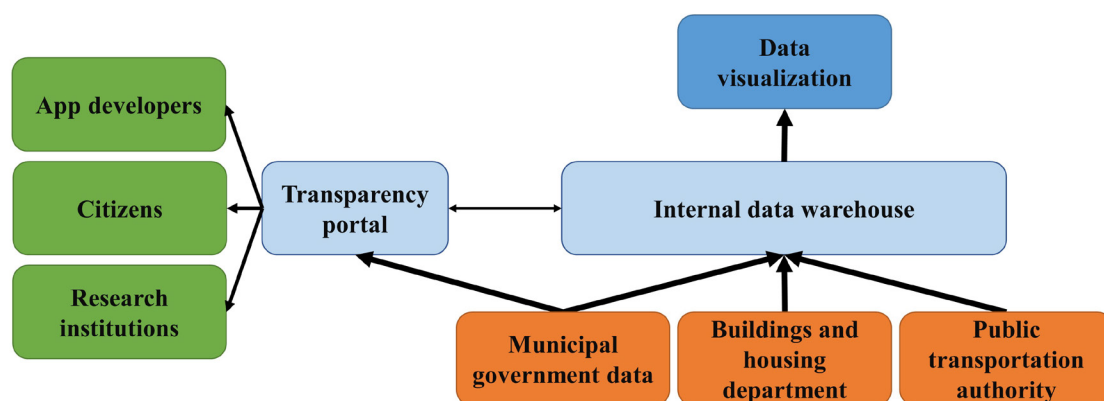


Figure 12: Santiago d. C.–Overview data platform, data sources, and applications

Source: Own illustration based on interview data.

In addition, the municipal government pursued an open government data strategy by partnering with three other Spanish cities to develop an open data platform. The vision for this platform was to build a “transparency portal” that allows citizens to access public data. Furthermore, private companies and other third parties such as research

institutions have open access to the data. The aim behind this platform was twofold: First, the four municipal governments wanted to enable developers to create innovative solutions that might solve administrative problems. Second, the municipal governments wanted to apply one type of data standard consistently across the four cities to enable scaling of technology projects.

However, when the municipal government started to develop its internal platform, it was confronted with a lack of standardization between the different departments. Each department was using its own format and did not understand the need to change to a different format in the beginning. Furthermore, some departments refused to share their data and wanted to continue developing their own projects (F2). During the early development phase of the platform, it was very difficult to solve these problems because there was no joint initiative and a lack of support from senior officials.

Despite these issues, Santiago de Compostela's municipal government actively engages its citizens. On top of encouraging citizen-driven innovation, it also conducted several interviews with citizens to understand their needs. Furthermore, the municipal government opened its internal platform to enable citizen participation. For example, citizens were able to choose which projects should be realized, project budgets, and how these projects should be implemented.

In the future, the municipal government seeks to hire more employees with technological capabilities. Furthermore, it aims at extending citizen participation and to improve its open datasets.

4.1.7 Case G: Barcelona

Barcelona is located at the northeastern coast of Spain and has around 5.6 million inhabitants. The city's municipal government is divided into two branches—a political branch and an executive branch. Around 15,000 people work for the municipal government. Barcelona has become a household name in the smart city community as the host city of the annual Smart City Expo World Congress.¹² The municipal government initiated its first project to develop a platform in 2011. However, it was not until 2015 that the municipal government presented its first holistic strategy: the “Barcelona Digital City” plan. This initiative entailed the centralization of all data on a

¹² For more information, please visit <https://www.smartcityexpo.com/>.

“transversal” platform, which provides the single source of all municipal data (G5). At the same time, Barcelona joined the Horizon 2020 GrowSmarter project.

In 2019, the IT department finished the development of the municipal government’s main platform. This platform connects the different data sources from the departments and serves as the main database for the data collected from the sensor network (G1). The IT department decided to build an open-source platform and published the source code on the developer platform GitHub. This allows developers on GitHub to write code for the platform. The team still posts problems on the GitHub site and engages with the community. Moreover, the team found that the GitHub community is much faster and more flexible than the developers under contract with the municipal government. Once the IT department had finished the technological development of the platform, the management of the platform was handed over to the “Data Office” (G2). This gives the municipal government the dual role of platform provider and platform sponsor.

The Data Office was founded in 2018 and is responsible for managing the whole process related to data maintenance. This includes data governance, data management, and data quality. In addition, the Data Office engages in growing the platform, by connecting more data sources from inside the municipal government to the platform. The officers in the Data Office, who manage specified data sources and data flows by means of agile software development are called “Product Owners”. Furthermore, the transversal platform is extended by integrating legacy projects (F4). One of these legacy projects is a platform that was developed during the EU-funded GrowSmarter project. This “GrowSmarter platform” was developed in collaboration with a private company and a local research institution. Its focus was on building a tool to visualize different data and analytics on a dashboard. This data-integration on the GrowSmarter platform allows the developer team behind the transversal platform to extend the existing functionalities of the GrowSmarter dashboard and database (G5).

The main data source of the transversal platform is a network of different types of sensors (e.g., sensors in buildings, noise sensors, traffic sensors, and air quality sensors) (G1). The platform centralizes and collects data from the municipal government as well as an app that citizens use to voice complaints or provide information on urban problems. The platform is also linked to an app hosted by the police. As of 2020, there were 467 datasets stored on the transversal platform (G5). In contrast, private companies can neither access the platform directly nor contribute data to the platform. A schematic overview of the platform can be found in Figure 13.

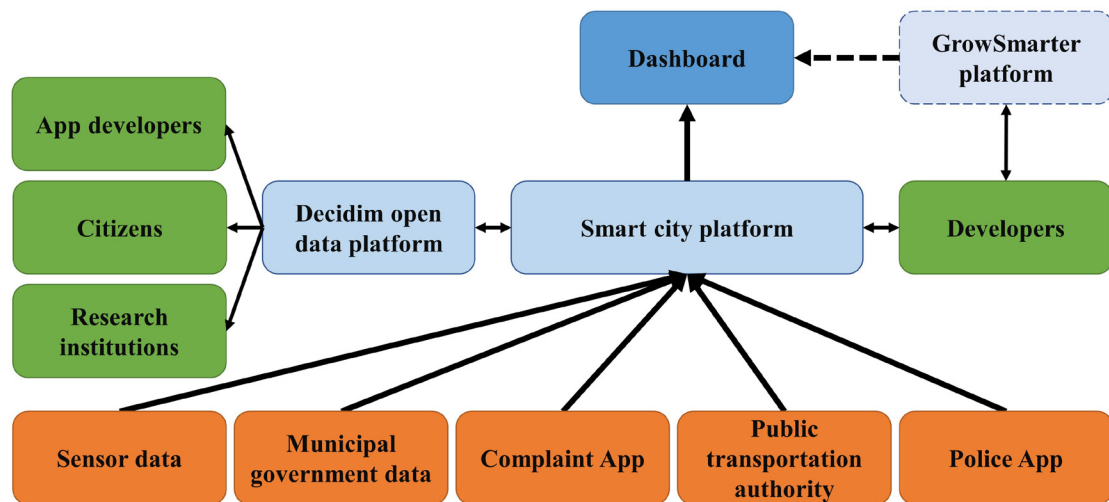


Figure 13: Barcelona–Overview data platform, data sources, and applications
Source: Own illustration based on interview data.

In addition to the central platform, the municipal government also operates and maintains an open data platform. It is based on an open-source software called “Decidim” that is intended to enable participatory democracy for citizens and organizations (Decidim, n.d.). This open-source platform was developed by the municipal government in Barcelona and funded by the EU. The Decidim platform has two access levels: an open data platform and a citizen participation platform. While everyone can access the open data platform, only citizens from Barcelona with an authenticated login can register on the platform for citizen participation. As of 2020, there were 44,185 registered participants (G2). In total, 23,733 proposals were posted on the platform and 10,178 of these proposals were accepted (G2). Such proposals address budgets or urban planning decisions for certain neighborhoods (G1). Overall, the municipal government of Barcelona wants to give their citizens more decision-making power and actively engage citizens in the conversation about Barcelona’s future.

Moreover, the municipal government wants to collaborate with research institutions and support small businesses and start-ups. The municipal government has an established and close relationship with its local universities and research institutions. One of these universities was also involved in the GrowSmarter project and supported the development of the GrowSmarter platform. For example, to illustrate the value of the platform, a group of researchers calculated the time that can be saved when all data are digitalized and stored in one central location (G6).

However, the development projects of the transversal and GrowSmarter platforms also struggled with the internal silo structure of their organization. The silos impeded data harmonization and centralization (G6). The situation was exacerbated by the lack of data standards, requiring the IT team to convert data formats manually. The teams were further confronted with complex coordination problems when trying to align different stakeholders and provide the requested data on time (G5, G6).

While the transversal platform was operational in 2020, it will continue to grow due to the integration of the legacy projects. Furthermore, the municipal government plans to establish a digital infrastructure across the city because senior officials believe that they should be leading the development of this vital infrastructure just as they have developed road networks (G2). Another ongoing project is the improvement and roll-out of the sensor network, which is a part of the digital infrastructure. To make voting more secure and protect it against data tampering, the municipal government wants to experiment with Blockchain technology on the Decidim platform.

4.2 Cross-case comparisons

I investigated how municipal government officers perceived and managed the development and integration of a platform and its surrounding ecosystem (i.e., “government as a platform”) in seven European smart cities. Despite some practice-differences between the cases (e.g., outsourcing the technology versus developing it in-house), I observed an overarching pattern. Specifically, I uncovered a process through which municipal government officers resolved the organizational tensions arising from the bureaucracy-opposing features of platforms as well as the subsequent institutionalization of new roles, rules, and processes to incorporate urban platforms in municipal bureaucracies (see Figure 14).

First, the project teams identified platform features that enhanced or contradicted bureaucracy. Second, tensions arose from trying to deal with the poorly fitting platform features. Third, the tensions were resolved by a temporary shift to non-bureaucratic governance. Fourth, new roles, rules, and processes were developed to “marry” the new logic of governance as platforms with the bureaucratic organization. They were then swiftly institutionalized via the written file, one of the most important tools of bureaucracy.

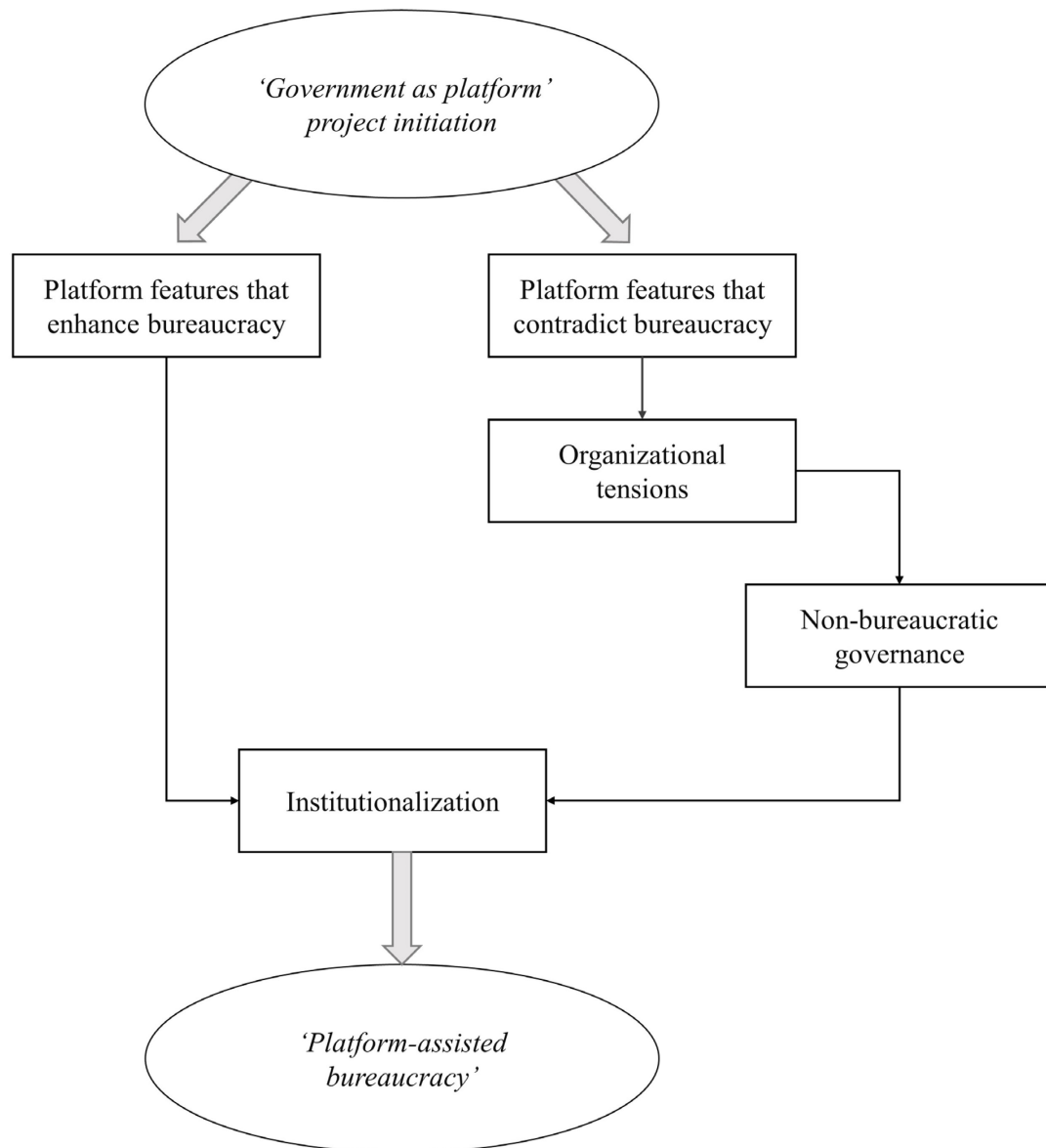


Figure 14: Visualization: Implementation process of digital platforms in smart cities

4.2.1 Platform features that enhance bureaucracy

Data centralization and system integration

The informants repeatedly emphasized the importance of data as a tool that fosters the core bureaucratic principle of *impersonal authority*. By centralizing the data on the platform, municipalities created “a joint map of the data that we have in our municipality” (C7). The platform was designed as a central data warehouse for all organizational members. This increased the information available to government officers and improved their ability to “use data to make strategic decisions for tomorrow” (B4). Most importantly, the ability to cite data points as the basis for decisions and to use data to measure performance (i.e., key performance indicators) helped to legitimize actions, thereby fostering impersonal authority.

Moreover, in the spirit of bureaucracy, municipal government officers aimed to leverage platform technologies to increase *efficiency* by integrating the IT infrastructure into a single digital platform. As stated by the team leader for data services in Munich:

The city has developed a strategy for the different departments to run and implement their own digital solutions. It is important that we integrate those solutions into the new platform. (A1)

Efficiency was also enhanced by upgrading the physical and digital infrastructure through the installation of “a number of different sensors” (E2) in equipment. In Munich, for example, sensors were integrated into “intelligent lampposts” (A2), and sensors were used to measure energy flows in a new zero-energy district in Lyon. Table 5 provides an overview of the relevant quotes supporting these findings.

<i>Impersonal authority</i>		<i>Technology-driven efficiency</i>	
<i>Centralization of data</i>	<i>Data-driven decisions</i>	<i>Integration of IT infrastructure into platform</i>	<i>Installation of sensors to monitor and control physical infrastructure</i>
<i>Munich: Strong</i> “What we now need is data integration and centralization.” (A4) <i>Lyon: Strong</i> “The purpose is to have all data on this platform.” (B3) <i>Vienna: Strong</i> “It makes a lot of sense to have everything on one platform and to continuously update the data.” (C5) <i>Rotterdam: Strong</i> “The vision is to have one urban-data platform with all the data from the city.” (D5) <i>Stockholm: Moderate</i> “We need to consolidate the data now.” (E2) <i>Santiago de Compostela: Strong</i> “You have to connect the data from one department to the data from others.” (F4)	<i>Munich: Strong</i> “Data helps those in charge make better decisions.” (A2) <i>Lyon: Strong</i> “We use aggregate information—aggregate data—to visualize and make strategic decisions.” (B4) <i>Vienna: Strong</i> “How do you make decisions without data?” (C7) <i>Rotterdam: Strong</i> “We want to use data to make better data-driven decisions and to make simulations of the future.” (D1) <i>Stockholm: Strong</i> “We want to create a better foundation for [data-driven] decision making.” (E6) <i>Santiago de Compostela: Strong</i> “We are planning to evaluate projects based on objective, data-driven metrics.” (F4)	<i>Munich: Strong</i> “The system gives data to the geoportal, which sends it to the platform.” (A4) <i>Lyon: Strong</i> “We are integrating the open data portal and the technical infrastructure with the platform.” (B3) <i>Vienna: Strong</i> “Our platform integrates the formally separated systems of public transport and our utility company.” (C7) <i>Rotterdam: Moderate</i> “We want to automate certain services, so we need to integrate the different systems.” (D5) <i>Stockholm: Strong</i> “We developed integration programs that would connect to vendor systems.” (E7) <i>Santiago de Compostela: Strong</i> “We want to integrate all our services on one platform.” (F1)	<i>Munich: Strong</i> “We are now measuring air quality, noise, traffic density, and some other things.” (A5) <i>Lyon: Strong</i> “We are using sensors to measure energy consumption in our smart buildings.” (B2) <i>Vienna: Strong</i> “We are currently implementing 10’000 sensors across the city.” (C4) <i>Rotterdam: Strong</i> “We use different sensors for the different use cases.” (D5) <i>Stockholm: Strong</i> “We are using multiple sensors and AI to improve traffic flows.” (E1) <i>Santiago de Compostela: Moderate</i> “You need to put a sensor in every trashcan. That makes a city intelligent.” (F4)

<i>Impersonal authority</i>		<i>Technology-driven efficiency</i>	
<i>Centralization of data</i>	<i>Data-driven decisions</i>	<i>Integration of IT infrastructure into platform</i>	<i>Installation of sensors to monitor and control physical infrastructure</i>
<i>Barcelona: Strong</i>	<i>Barcelona: Strong</i>	<i>Barcelona: Strong</i>	<i>Barcelona: Strong</i>
“It is better to perform your services or reach your goals when you pour all the data together and share it.” (G4)	“We want to make use of that data for information, for predictions, and for analytics.” (G1)	“We have one internal platform that we want to connect to the sensor network and the open data platform.” (G4)	“[Sensors] are a game changer in terms of how technology is implemented in the Barcelona City Council.” (G4)

Table 5: Cross-case comparisons: Platform features that enhance bureaucracy¹³

4.2.2 Platform features that contradict bureaucracy

Generativity and stakeholder alignment

This agile and open innovation process is unique and not very traditional for our city. (E1)

The bureaucratic municipal governments lacked the processes and experience needed to enable the platform feature of generativity. While it was important to co-create innovative services together with “the community” (C4) in order to build a “community of knowledge” (D1), the platform teams did not know where to start because they “did not know what to do” (D2) and because they had never done this before. Participants emphasized that they were “experimenting” (A1, C4) to uncover interesting use cases:

The platform will not deliver the uses cases by itself. We need to figure out which data are interesting and what we want to use them for. (C3)

One data specialist stated that the municipality’s official bureaucratic processes made it “much more complicated” (D2) to find the right people. Moreover, even when right partners were identified, it still took “a lot of time” (D2) to determine how to structure

¹³ Notes regarding the strength of the evidence: Strong: repeatedly indicated by most interviewees; moderate: indicated by some interviewees. weak: indicated by few interviewees.

and manage a use case. A project manager in Barcelona added that it was difficult to decide which use cases “made sense” (G3). A project manager in Stockholm explained that the departments were not asking the right questions [e.g., “How do we collect data so that they support our use case?”] because city officials were “not accustomed to working like that” (E1).

Another feature of platform governance that respondents found at odds with their municipal bureaucracies, was that of *aligning* stakeholders. A data officer explained:

There are so many stakeholders, and we are not able to assemble all of them in one room. Therefore, we are trying to act as the interface for everyone. (A3)

The task of finding solutions for “bigger problems” (B1) required the coordination and alignment of actors from multiple departments. While the municipal government officers hoped that the platform would facilitate coordination, it was difficult to align multiple parties. Our respondents emphasized that they could not “give orders to other departments” (D2) to ensure alignment and that there were no existing horizontal alignment mechanisms within their organizations. Along these lines, a data-services officer stated that “we are stuck in discussions, and we do not even know what we are talking about” (A5). Another informant explained that there was confusion about “how to provide all of the information to the right people at the right time” (G3). A data-services officer from Munich outlined this issue: “Coordination becomes more complex, and we have to invest more time and resources into coordinating all of the partners” (A3). Table 6 provides an overview of the relevant quotes supporting these findings.

Hierarchical control

<i>Bureaucracy lacks processes or experience to support generativity</i>	<i>Bureaucracy lacks mechanisms to promote alignment</i>
<i>Munich: Strong</i> “It is an agile development process, so new questions are coming up all the time.” (A2)	<i>Munich: Strong</i> “In general, it is difficult to talk to people inside the city without first going up the hierarchy.” (A2)
<i>Lyon: Strong</i> “It is not easy in the public sector to have a big team for technical development. The process is very linear and not very agile.” (B3)	<i>Lyon: Strong</i> “We clearly underestimated how difficult it is to coordinate the data providers, the technology company, and the city administration.” (B4)
<i>Vienna: Strong</i> “It took six months just to publish the tender. Once the app was built, nobody was interested anymore.” (C4)	<i>Vienna: Strong</i> “We need someone who owns and oversees the whole process.” (C2)
<i>Rotterdam: Strong</i> “We are working on innovation, so it is all new to us all of the time.” (D1)	<i>Rotterdam: Strong</i> “A big issue is the governance: Who owns it? who manages it?” (D6)
<i>Stockholm: Moderate</i> “In this user-oriented innovation process, you have to understand the end user. That is not how we usually work here.” (E1)	<i>Stockholm: Strong</i> “From the beginning, governance was a problem. Someone needs to be responsible in the city.” (E1)
<i>Santiago de Compostela: Strong</i> “I do not know what the different phases are to reach those goals.” (F3)	<i>Santiago de Compostela: Strong</i> “Coordination is very difficult.” (F4)
<i>Barcelona: Moderate</i> “It was hard to define real use cases because you have to identify a real need.” (G3)	<i>Barcelona: Moderate</i> “It is difficult to align the external developers with the slow machine of our administration.” (G2)

Table 6: Cross-case comparisons: Platform-features that contradict bureaucracy

4.2.3 Emerging organizational tensions

Two worlds are colliding: the rapid speed of digitalization and the municipality with its rules. (A1)

While the platform teams knew that the platform requirements for generativity and horizontal alignment conflicted with the bureaucratic structures, they were still surprised by the practical difficulties of overcoming this mismatch. The lack of alignment between bureaucratic structures and platforms surfaced as a pair of organizational tensions. First, internal collaboration among departments was obstructed by the bureaucratic principle of official competencies. Second, official secrecy kept municipality officers from pursuing projects with external partners that were not part of the official procurement and outsourcing process.

Official competencies obstructing internal collaboration

Convincing other municipal departments to collaborate on the platform proved difficult for the platform teams for two reasons. First, municipal government officers were mainly focused on their areas of expertise and their official roles. Our informants referred to these departmental separations as “silos”, as “there is a lot of resistance to working together” (G4). In the silo structure, every department had its own budget and its own internal processes. Therefore, the departments coexisted but were independent from each other. A senior officer from Stockholm explained:

What we saw as a challenge was [that] the city departments were not used to getting together to create common solutions to their common problems. (E3)

Members of the platform teams explained that other departments did not see a need to support the platform’s development. Data officers from Vienna suggested that this was due to the lack of an “official mandate” that required other departments to engage in the project. Departments that were not part of the platform team were often quick to state that “this is not our responsibility” (A5, C2). As each department was focused on its own function and area of expertise (A5), the joint development of use cases or applications for the platform seemed “intrusive” (A1).

Interestingly, many departments had started to develop their own platforms and did not understand why they should join a larger platform project (A4). Respondents from Stockholm and Barcelona explained that it was always a question of “funding and resources” (E1, G4). The departments were unwilling to contribute resources to a

project that they did not feel would directly support their functions. Some informants said that it was “typical” for “everybody [in their organization] to just do their own thing and not talk to each other” (A5, G5). One data officer explained that people were used to working with their own tools and technologies (G4). He emphasized that the organization needed a culture change to help people understand that integrated services inside a holistic system could support them instead of “making their lives harder” (G4).

The second issue related to internal collaboration was a lack of understanding of other departments’ needs, which became evident when the platform teams tried to create cross-departmental applications. One respondent stated that the fact that one department’s data could be of use to other departments was a “revelation” (E7) to many in the organization. The platform teams recognized that the development of use cases and demonstration projects for the platforms was a challenge of identifying the processes and needs of other departments rather than a technical challenge. In other words, the problem was more creative (i.e., to design solutions) than technical. As described by one data specialist:

Data, IT, and technology are not important. It is more important to understand what you are trying to do and what your needs are. (E2)

Consequently, the platform teams were caught in a difficult situation. They could not develop prototype applications that might convince departments to support the platforms because they did not know what the departments needed or “how they worked” (B3). At the same time, the departments did not approach the platform teams to request the development of a new application because they lacked an understanding of how the platform might deliver value to them (A2, C2). One data specialist, who was involved in multiple urban-platform projects, discussed the situation in the municipal government in Barcelona: “They have come to a screeching halt because they have a gazillion solutions, and no one talks to each other” (X3).

Official secrecy blocking external collaboration

External collaboration was impeded by organizational tensions regarding official secrecy. First, departments resisted sharing their data with other departments and external partners (D2). Due to their independent nature, the departments regarded their data “as their own assets” (G6) rather than a shared resource of the municipal

government. This caused problems for the platform teams, which were trying to create new solutions that required data inputs from multiple departments.

We call it 'data hugging'. People [inside the municipality] are hugging data because they do not see the purpose of others using their data. (D2)

A data specialist explained that some departments saw no reason to collaborate with external partners, as they thought “maybe we can build an application or maybe we can earn money from this” (D2). Another cause of resistance to sharing data was an unwillingness to accept standardized data formats. Some departments felt that because “we own the data, we can define how we share it” (E1). These tailor-made solutions for data formatting allowed each city to address the individual needs of its departments. However, they reduced the ability of technology companies to offer scalable, standardized solutions, thus making smart cities a less attractive business case for them. A representative of a large multinational technology company stated: “It is very difficult for us to support these cities in an efficient way” (G7).

For instance, Stockholm decided to use only a fraction of the functions embedded in its platform, which was designed by a large technology partner. A representative of the technology partner indicated that this decision created tension, stating “our whole approach to smart cities has changed” because “we could not implement a one-size-fits-all solution” (E5).

Second, the municipality departments were concerned about potential violations of data-privacy standards. One data officer stated that even when departments were convinced to share their data, they were unsure about compliance with data-privacy regulations: “The data that include interesting information are difficult to share” (G3).

The biggest challenge in relation to privacy regulations was that the aggregation of different types of open data could lead to breaches of privacy. A data and technology specialist explained that this “purple Lamborghini problem” prevented officers from sharing data with external partners:

When you know, for example, that Michael Jackson always visits a particular restaurant at a particular time and you observe that there is always a purple Lamborghini parked somewhere around that location, then you know that Michael Jackson drives a purple Lamborghini. (D2)

This statement highlights how the combination of seemingly impersonal data points can generate highly personal information. While this might seem like a minor problem given

people's willingness to share their data on social media, our respondents emphasized that the cities wanted to be perceived as "the good guys" (A5) with respect to data protection. They also wanted to set an example in data governance. The lack of legal frameworks created even more ambiguity, as the cities did not know which data they could share. After the European Union introduced the GDPR, a legal act that regulates data, this ambiguity was reduced, but many "shades of grey" (C7) remained. In Rotterdam, a special team of data-privacy specialists created to deal with the ambiguity adopted a conservative approach of advising their colleagues to refrain from publishing any "risky data" (D2). Consequently, the fear of misconduct regarding data privacy inhibited the flow of information between the municipal governments and external parties.

Moreover, the platform teams started to take back some of the tasks they had outsourced to technology companies because of inherent mistrust. Our respondents felt that they had to "ensure that the know-how is inside the city" (C5) and that they could control the locations of the servers storing the data. They suggested that private companies might "treat data privacy rather lightly" (B1), while cities had to ensure high standards of accountability with respect to data management. To this end, the cities went as far as blocking important private partners from their platforms. In Lyon, for example, an international software company that was unwilling to sign an agreement regarding data usage was blocked from accessing the software interface (B3). Table 7 provides an overview of the relevant quotes supporting these findings.

<i>Official competencies obstructing internal collaboration</i>		<i>Official secrecy blocking external collaboration</i>	
<i>Focus on expertise and official roles</i>	<i>Limited understanding of other departments' needs</i>	<i>Resistance to data sharing</i>	<i>Concerns about privacy of citizens' data</i>
<i>Munich: Strong</i> "Collaboration is a difficult topic, because each department has its specific area of competence." (A5) <i>Lyon: Moderate</i> "We do not know all the processes in the city and some departments are developing their own platforms" (B3) <i>Vienna: Strong</i> "We are not used to collaboration here. We usually focus on our own official roles." (C1) <i>Rotterdam: Strong</i> "People are focused on their tasks and they do not have the resources to support us." (D2) <i>Stockholm: Strong</i> "We need to make people with different roles and different knowledge start working together." (E4)	<i>Munich: Strong</i> "Each city department decides what it really needs." (A5) <i>Lyon: Strong</i> "It is not easy to understand what the others need." (B4) <i>Vienna: Strong</i> "As long as we do not know what kind of data they need, we are having a hard time moving forward." (C4) <i>Rotterdam: Strong</i> "We have all these silos so we did not know which process fits everyone's needs." (D3) <i>Stockholm: Strong</i> "It is quite difficult to know what information you have that could be of use to someone else." (E8) <i>Santiago de Compostela: Strong</i> "If I knew exactly what the others were doing, then we would know in what direction we should move." (F1)	<i>Munich: Strong</i> "Many of those involved were asking: What do you want with our data?" (A5) <i>Lyon: Strong</i> "We don't want to share our data because we have to control it." (B3) <i>Vienna: Strong</i> "It is 100% city-owned, but they refuse to share their data with us because it is a trade secret." (C2) <i>Rotterdam: Strong</i> "They were really reluctant to share their data." (D2) <i>Stockholm: Strong</i> "Not many departments share data continuously." (E4) <i>Santiago de Compostela: Strong</i> "They did not know why they should share their data with us." (F4)	<i>Munich: Strong</i> "You need to check which data can be published and in which contexts. It is always about data privacy." (A3) <i>Lyon: Strong</i> "We have a separate citizen platform because we could not combine the private data with the other data on the data platform" (B1) <i>Vienna: Strong</i> "When you have real-time data, that is a whole new privacy issue." (C5) <i>Rotterdam: Strong</i> "We have no idea how we can deal with that—when you combine open data with open data and it suddenly becomes private information." (D2) <i>Stockholm: Strong</i> "They decided against publishing the data because of security concerns." (E7)

<i>Official competencies obstructing internal collaboration</i>		<i>Official secrecy blocking external collaboration</i>	
<i>Focus on expertise and official roles</i>	<i>Limited understanding of other departments' needs</i>	<i>Resistance to data sharing</i>	<i>Concerns about privacy of citizens' data</i>
<i>Santiago de Compostela: Strong</i> "Everyone does his or her own thing and nothing more." (F9) (F4) <i>Barcelona: Strong</i> "We need each other, but we all have different functions." (G1)	<i>Barcelona: Strong</i> "People inside the organization do not understand how their data can support other departments." (G5)	<i>Barcelona: Strong</i> "The biggest challenge is to convince the different departments to publish their data." (G5)	<i>Santiago de Compostela: Strong</i> "If you can connect that information, it violates data-privacy protections." (F4) <i>Barcelona: Strong</i> "Some officials are extremely risk averse. They only publish aggregate data, which is not very useful." (G6)

Table 7: Cross-case comparisons: Organizational tension

4.2.4 A temporary shift to non-bureaucratic governance

Breaking away from the ordinary

Have the courage to implement things and do not ask legal experts for permission—just do it and see what happens. (C4)

Informants indicated that platform team leaders decided to switch to a different mode of governance to resolve the two tensions. This non-bureaucratic governance was marked by informal collaboration among the city departments and an open network that included external partners.

To enable informal collaboration, the platform teams had to negotiate access to resources because they had “no official mandate” (A5) to give orders to other departments. Confronted with the long-established silo thinking, the platform teams focused on showing the other departments how they could benefit from the data platform. Ultimately, their aim was to develop and demonstrate “win-win situations” (C4) to ensure buy in. For example, the platform team in Barcelona, with the assistance of a business school, calculated how much time and money the municipality’s departments could save by sharing information with a central data repository on the platform. They asked the departments to invest some time and resources in harmonizing and standardizing their data in order to profit from considerably leaner processes in the future: “The role of the data office is to break through the municipal government’s silos to extract and derive value from data for all departments” (G4).

Another example was discussed by the senior director of the environment and health department in Stockholm, who was working on a smart-lighting project. The high-ranking city officials could not be convinced to collaborate because “the system had worked fine for 100 years” (E3). However, the director succeeded in convincing the city’s governing body to grant his team a small area in which to demonstrate the application of smart lightning using funds provided by the European Union. The demonstration won the local government over and it “decided to change most of the streetlights” (E3) because of the considerable energy savings. The informant summarized the new way of working: “We mostly work on persuading people from other departments to work with us.”

The second strategy that platform teams pursued to enable informal collaboration was to empower lower echelons by educating them. For example, they facilitated knowledge exchange among the different departments and organized workshops with “everyone in the room” (A1). This strategy of “educating the people” was possible because the

platform teams “did not have to ask the mayor for consent every time” (A5), which created flexibility. The platform teams “started with individuals who were motivated” (A5) to join the project. As most officers working in the municipality were not technical experts, the platform teams first made them visualize the technology, via simple Power Point presentations. Furthermore, to improve people’s acceptance of the platform, it was important to build an understanding of what it could be used for. The platform teams sought to demonstrate theoretical use cases in workshops, which highlighted the potential of the platform to improve the organizational workflow. After they established a basic understanding that the platform was an enabling tool and that the use cases were “feasible” (E2), people became more willing to engage. Empowered by their new knowledge and the informal working-group set-up, people started to develop their own ideas.

Some ideas could not be realized without involving external stakeholder groups, such as sensor providers and the “community” (A1) (i.e., citizens). Therefore, the platform teams started to foster an *open network* in order to engage external partners and citizens in value co-creation. For example, the platform team in Stockholm was “dependent on external consultants” (E4). Barcelona also chose to “open the ecosystem and have conversations with big and small companies” (G4). Our respondents described these collaborations as innovative and different from usual routines. This experimental mindset allowed them to “try out new things and find what worked” (D2) without having to face severe consequences for failure. In Munich, the platform team focused on collaborating with start-ups, which they perceived as more innovative than big companies (A5). Respondents from Rotterdam, Lyon, and Vienna described similar attempts to foster open networks.

The second important pillar of the open network was citizen engagement. For example, the platform team in Munich used a group of 15 citizens that emerged from citizen-participation events as a sounding board on issues related to data protection in the city.

The younger citizens were more open to sharing their data, while some of the older citizens had a lot of concerns, and emphasized that they did not want cameras or other kinds of surveillance (A5). Such community involvement was important for building trust between the municipal government and the public: “Trust is the key ingredient for getting stakeholders on board” (D5).

In Lyon, the inhabitants of the zero-energy buildings were open to the idea of sharing building-performance data (B1). Munich and Vienna stood out from the other the cities

because they engaged with their citizens via workshops and interviews. One data officer described Munich's approach:

We wanted to know what our citizens thought were important data points that we could measure using our sensors. They were interested in traffic and air pollution—they wanted to take the fastest and cleanest route to work. ... They did not want us to collect video-surveillance data. (A2)

In Vienna, workshops were held to establish acceptance for performance data collected from refurbished buildings. The municipal government collaborated with a local business to set up an open space near the refurbished buildings for discussions on the data-collection issue. Several workshops were held to explain how the data were collected and used. The space was open for walk-ins during specific times, and the municipal government used it to report developments and decisions directly to the citizens. Table 8 provides an overview of the relevant quotes supporting these findings.

<i>Informal collaboration</i>		<i>Open network</i>	
<i>Bargaining for resources inside the organization</i>	<i>Empowerment of lower echelons</i>	<i>Value co-creation with external partners</i>	<i>Citizen engagement</i>
<i>Munich: Strong</i>	<i>Munich: Strong</i>	<i>Munich: Strong</i>	<i>Munich: Strong</i>
“We had to ensnare the other departments to get them to share their data.” (A1)	“We educated the others in our workshops and you could watch them becoming experts themselves.” (A3)	“We collaborated a lot with start-ups because we thought they were much more innovative than we were.” (A5)	“We continuously talk with the community and they tell us what kind of data they would like to have.” (A1)
<i>Lyon: Strong</i>	<i>Lyon: Moderate</i>	<i>Lyon: Strong</i>	<i>Lyon: Strong</i>
“It is not a big technical challenge, but you need to discuss and explain ‘why.’” (B2)	“The platform is pedagogical. For example, we try to explain how to build a HTTP request.” (B3)	“Our role was at the interface of the private and public sector. We built strong personal connections with experts of the respective companies and that allowed us to participate in each step of the process.” (B1)	“We currently have 1,000 citizens testing the concept.” (B3)
<i>Vienna: Strong</i>	<i>Vienna: Strong</i>		<i>Vienna: Strong</i>
“We needed to get everyone on board.” (C4)	“We educate and train our people. Otherwise, they do not know what to use the platform for.” (C7)		“We are building new dashboards to help visualize more data.” (C6)

<i>Informal collaboration</i>		<i>Open network</i>	
<i>Bargaining for resources inside the organization</i>	<i>Empowerment of lower echelons</i>	<i>Value co-creation with external partners</i>	<i>Citizen engagement</i>
<i>Rotterdam: Strong</i> "Internally, convincing needs to be done." (D5)	<i>Rotterdam: Strong</i> "We really educate the municipality staff on what is coming." (D7)	<i>Vienna: Moderate</i> "We extended our OGD program so we could exchange more data with external parties." (C5)	<i>Rotterdam: Strong</i> "We want citizens to become active and to use the platform." (D1)
<i>Stockholm: Strong</i> "You have to have something you can offer the departments, so they see value in the platform and join the project." (E1)	<i>Stockholm: Strong</i> "We held many workshops until everyone could see the value of the platform." (E1)	<i>Rotterdam: Strong</i> "It is really valuable to set up public-private collaboration." (D5)	<i>Stockholm: Moderate</i> "There are many initiatives about data sharing and open data for citizens." (E7)
<i>Santiago de Compostela: Strong</i> "You have to convince them to do something this way or that way." (F4)	<i>Santiago de Compostela: Strong</i> "I got people to sit down and talk about smarter strategies for the city." (F9)	<i>Stockholm: Strong</i> "People could then vote on this proposal. There it was—the co-creation and democracy process." (E2)	<i>Santiago de Compostela: Strong</i> "We need to give citizen participation more value through our e-administration." (F16)
<i>Barcelona: Moderate</i> "We need to build these capabilities internally at the city level." (G4)	<i>Barcelona: Moderate</i> "We organized workshops with people from different departments to help them understand the different needs." (G6)	<i>Santiago de Compostela: Moderate</i> "We will solve this in collaboration with other cities" (F2)	<i>Barcelona: Strong</i> "We are running conversations, workshops, and conferences because the data are a public infrastructure." (G4)
		<i>Barcelona: Strong</i> "We had workshops with external partners like big companies and start-ups." (G6)	

Table 8: Cross-case comparisons: Non-bureaucratic governance

4.2.5 Institutionalization: The engine of bureaucracy

The temporary switch to non-bureaucratic governance, which was characterized by informal collaboration and open networks, allowed the platform teams to resolve the tensions related to official competencies and official secrecy. The bottom-up solutions developed through informal collaboration among the lower echelons became formalized and, subsequently, institutionalized within the municipal bureaucracy. An important method for embedding new roles and processes in the bureaucratic organization was to record them in writing. Moreover, official support from the highest levels of the municipal hierarchies had to be established (C7): “You need to make sure that the politicians support you because they also have the power to block you.”

The new roles and processes could guide and coordinate interactions, thereby allowing the platform team to break from the established routines of “going up the hierarchies to get support and down the hierarchy to collaborate with other departments” (A2). In fact, the development of the platforms and their ecosystems gradually moved the platform teams from a peripheral, “alien” (A2) position within their organizations to center stage. In general, all municipal governments developed new data governance roles (data officers or data stewards) to ensure harmonization and standardization of new processes [e.g., “data gatekeeper” (Munich), “data steward (Vienna),” “data advisor” and “process owner” (Rotterdam)].

Moreover, data protection and data quality were ensured through clear accountability by the development of new governance rules describing access rights to the data stored on the platform. In all of the municipal governments, only the data owners had unlimited rights to access the data. Other departments that needed data for their operations had the next level of access. External users could access the data only after submitting a request. Municipality officers with formal expertise in data management had to check whether the external parties’ requests fit with the precisely defined data-usage rules. For example, Munich developed its “data gatekeeper” concept in collaboration with a leading research institution. In this regard, it provided detailed guidelines about data classifications, data formats, data ownership, and access rights. Table 9 provides an overview of the relevant quotes supporting these findings.

Formalization

<i>Record new rules, roles, and processes in writing</i>	<i>Development of clear accountability</i>
<i>Munich: Strong</i> “The data gatekeeper describes the whole data management process.” (A2)	<i>Munich: Strong</i> “We are responsible for the access management of the platform and accountable in cases of misconduct.” (A5)
<i>Lyon: Strong</i> “We have many new processes to ensure that the data gets to the platform.” (B3)	<i>Lyon: Strong</i> “The city is accountable for data quality and data privacy.” (B2)
<i>Vienna: Strong</i> “We have a new role, so-called ‘data stewards,’ in each department and a new data-standardization process.” (C7)	<i>Vienna: Strong</i> “The departments are responsible for delivering the data in the correct format.” (C4)
<i>Rotterdam: Strong</i> “We have a new role called ‘process owner.’” (D2)	<i>Rotterdam: Strong</i> “It is my responsibility to develop technical solutions inside the organization.” (D3)
<i>Stockholm: Strong</i> “We had some organizational changes, like creating a new department for that.” (E4)	<i>Stockholm: Moderate</i> “One department is now responsible for the data.” (E4)
<i>Santiago de Compostela: Strong</i> “We have a new, strict data-standardization process.” (F4)	<i>Santiago de Compostela: Moderate</i> “We cross-reference the data before we publish it because we are responsible if it is not correct.” (F9)
<i>Barcelona: Strong</i> “First of all, we created a data office because it did not exist yet.” (G4)	<i>Barcelona: Strong</i> “Managing the platform is now the data office’s responsibility.” (G2)

Table 9: Cross-case comparisons: Institutionalization

5. Discussion

Through this inductive multiple-case study I sought to contribute to the ongoing debate about the “changing nature of bureaucracy” (Kornberger et al., 2017, p. 181) by documenting a process of organizational adaptation in bureaucratic municipal governments. In this section, I first summarize my key findings. Second, I build on my cross-case findings and existing literature, to discuss my findings and their implications for research. Third, I suggest avenues for future research and consider limitations of this study. Lastly, I propose implications for practice and develop a managerial framework.

5.1 Summary of key findings

In this study, I examined how municipal governments adapt their bureaucratic structures to accommodate the decentralized governance of urban platforms. I sought to address a recent call from organizational scholars to study public organizations (Arellano-Gault et al., 2013) to gain a better understanding of the changing nature of Weberian bureaucracy (Kornberger et al., 2017) under the influence of decentralized management approaches (Lounsbury & Carberry, 2005) and data-driven technologies (Kitchin & Moore-Cherry, 2020). Based on empirical data from seven municipal governments in Europe, I show that smart-city platforms simultaneously challenge and reinvigorate bureaucratic organizations. I also describe how the lower echelons steer organizations towards an adapted form of bureaucracy by first experimenting with new ways of working and then institutionalizing some of those methods as new governance rules. Some platform features (e.g., data centralization and system integration) reinforce the bureaucratic principles of impersonal authority and efficiency. Other features related to managing the ecosystem (i.e., generativity and the alignment of stakeholders) create tensions within municipal governments (i.e., official competencies and official secrecy). To address these tensions, the platform teams temporarily switched to non-bureaucratic modes of governance, which allowed them to navigate uncertainty and experiment with new ways of working. The subsequent documentation of those new processes enabled the establishment of new organizational rules for platform- and ecosystem-based collaboration.

5.2 Implications for research

This dissertation makes several contributions to the empirical literature on smart cities, the organizational literature on the changing nature of Weberian bureaucracy, and the literature on platforms and ecosystems. My first contribution is to the smart-city literature on urban-data platforms (Appio et al., 2019; Coletta et al., 2019; Kitchin & Moore-Cherry, 2020). I provide a description of an overarching process that encompasses the “accidental unfolding”¹⁴ of platforms (Coletta et al., 2019) as primarily an organizational matter (i.e., bureaucracy has to adapt to integrate platform governance) rather than a technology matter (i.e., technology dictates the project’s shape and fate). The results may appear counterintuitive because the centralized control of municipal governments appeared to assist the implementation of urban platforms in the cases I studied. I showed that municipal government officials understood the value proposition behind a central platform because it seemed to reinforce the key bureaucratic principles of impersonal authority and efficiency. Moreover, the hierarchical structure allowed for the eventual adoption of data standards across the organization, which prevented data mismanagement. This centralized control might have prevented the fragmentation and poor coordination observed in prior smart-city initiatives, such as those in Boston and Dublin (Coletta et al., 2019; Kitchin & Moore-Cherry, 2020). The above might seem to suggest that the cities followed a top-down approach to becoming “smart” (Mora, Deakin, & Reid, 2019). However, my findings show that while the higher echelons approved the projects, they did not define exact strategies or roadmaps. Instead, the projects became grass-roots efforts driven by lower echelons that initially experimented via internal and external engagement and, subsequently, institutionalized new governance rules.

Second, my examination of platforms and ecosystems in smart cities contributes to ongoing conversation about the changing nature of Weberian bureaucracy (Byrkjeflot & du Gay, 2012; Courpasson, 2000; Greenwood & Lawrence, 2005; Kornberger et al., 2017). My data suggest that changes in modern government bureaucracies could be driven by formal rational (zweckrational) actions to reclaim power. Weber (1921/1976, p. 129) noted that one reason for the superiority of bureaucracies is technical knowledge. However, with the rise of digital technologies, the technical knowledge currently

¹⁴ The implementation of platforms was termed “accidental” because human and serendipitous interactions shape the design. Thus, the platform is not implemented top-down. Rather implementation is conducted in an iterative manner, which can change the outcome of the platform compared the initial vision.

shaping our world primarily lies with private firms. This situation encourages the upper echelons of government bureaucracies to take rational action, such as launching smart-city projects, and thereby engage with new forms of organization (i.e., platform governance). Interestingly, although the municipal governments were keen to collaborate with external technology partners, they were careful not to hand over control and to ensure that technology did not “interfere” in the shaping of society and democracy in the urban sphere. The emphasis on building new technical capabilities, internalizing previously outsourced technical tasks, and protecting urban data from the grip of technology companies suggests that the aim of regaining power through technical knowledge can shape changes in modern bureaucracy.

Moreover, I contribute to work on the changing nature of Weberian bureaucracy by highlighting the paradoxical roles of lower-echelon bureaucrats as change agents and preservers of bureaucratic values. A paradox can surface when organizations are embedding distinct institutional logics (Besharov & Smith, 2014). The organizational tensions of internal collaboration versus official competencies and external collaboration versus official secrecy appear to entail a paradox between stability and change (Farjoun, 2010). When the rational-oriented decisions of higher-echelons bureaucrats develop smart-city platforms reached the lower echelons of the municipal governments, the latter faced opposing logics. A vibrant ecosystem requires open interfaces and an absence of hierarchical control, while bureaucracies are governed through hierarchical principal-agent relationships. To navigate these paradoxical tensions, lower-echelons officers switched to rational-oriented actions—enabling internal collaboration and opening their organizations’ interfaces—which were not in accordance with bureaucratic practice. Subsequently, these actions were recorded and translated back into bureaucratic practice through formalization (Heugens, 2005), which I find in our context to be enabling rather than coercive (Adler & Borys, 1996). The resulting governance structure managed the ecosystem and tightly controlled the data (via new institutionalized rules and processes) but remained open to external data contributions. Furthermore, relationships with ecosystem partners were not managed through aligned incentives in the form of joint value propositions (Adner & Kapoor, 2010; Jacobides et al., 2018), but through contractual relationships or license agreements, which suggest tight control mechanisms. Thus, I find that lower-echelons officers simultaneously serve as changes agents and as preservers of municipal government bureaucracy. I document the development of a new form of “platform-

assisted bureaucracy” that not only includes novel processes for coordinating internal and external collaboration but also maintains stability through tight controls.

My third contribution is to the platform-governance literature highlighting the organizational tensions associated with generativity (Tilson et al., 2010; Wareham et al., 2014; Yoo et al., 2010a; Zittrain, 2008). Platforms and ecosystems draw on the capabilities of a heterogeneous and diffuse pool of autonomous and specialized firms to provide services to the diverging needs of a broad set of heterogeneous users (Cennamo & Santaló, 2019). My findings indicate that the bureaucratic principle of documenting and institutionalizing calculable rules can support platform managers’ efforts to govern the quality and coordination of complementors. More specifically, platform companies can develop general rules that apply to all complementors. Those rules can be derived from early experimentation and learning, and they can be grounded in the bureaucratic practice of generating a collective organizational memory from which best practices can be derived. The consistent application of these rules limits case-by-case judgements and perceptions of unfair treatment. Platform managers can also use formalization as a governance tool that offers complementors an opportunity to educate themselves on best practices and experiences. These best practices can be made available as meta-information in application programming interfaces (APIs) or on a shared-knowledge basis. Consequently, impartial rules and formalization can serve as governance mechanisms that simultaneously enable stability and change.

5.3 Implications for future research

My research was motivated by the new conceptualization of smart cities as platform-based ecosystems (Appio et al., 2019). While my study provides empirical insights into how bureaucratic organizations adapt their governance mechanisms to incorporate platforms, I encourage additional research on the effects of digital technologies on municipal governments. Specifically, I believe that future research could benefit from investigating how the management of the ubiquitous information flows stemming from a sensor-enhanced infrastructure shapes bureaucracy.

Relatedly, organization scholars acknowledge that organizational identity can foster or impede change (Dutton & Dukerich, 1991; Zilber, 2002). My findings suggest that bureaucracies can renew themselves because certain traditional values, such as efficiency and rationality, echo some of the promises made by novel technologies. I

believe that the smart-city phenomenon offers an opportunity to study how bureaucracies manage the broader tensions between identity and change, and to examine which elements of bureaucratic organizations allow them to sustain themselves over time. I therefore encourage additional research in this area.

Researchers have further called for more investigations of public organizations (Arellano-Gault et al., 2013). While my dissertation seeks to answer this call, I recommend more research on municipal governments in the context of smart cities. I suggest that researchers could study municipal governments and their conflicting internal logics by approaching them from a hybrid organizations perspective (Battilana & Dorado, 2010; Besharov & Smith, 2014; Jay, 2013; Pache & Santos, 2013). A recent study suggests that logic hybridity can be sustained over time by maintaining stable forces and continuously developing novel approaches to manage the competing logics (Smith & Besharov, 2019). Future research could investigate whether this also holds for public hybrid organizations and whether bureaucratic organizations support or contradict this approach to reconciling conflicting demands.

In a similar vein, I encourage future research to study organizational tensions in public organizations from a paradox angle (Jay, 2013; Lewis, 2000; Smith & Lewis, 2011). In my findings, I describe how lower-echelon bureaucrats deal with paradoxical tensions (i.e., persistent contradictions between interdependent elements; Schad et al., 2016). However, my dissertation does not engage with or employ paradox theory as a meta-theoretical perspective (Schad et al., 2016). Therefore, future research could focus on investigating how individuals deal with paradoxical tensions that arise in smart-city projects. As smart-city projects are influenced and shaped by the individuals who are involved in the project (Kitchin et al., 2016), it is crucial to understand how paradoxical tensions influence individuals' decisions and behavior.

My dissertation limits its focus on municipal governments in central Europe. Since the smart city is a global phenomenon (Lee et al., 2014), I encourage researchers to replicate my study in other cultural contexts. Gaining a better understanding on the different organizational structures of governments, and whether the socio-cultural context is as influential as we believe, is an important avenue for future research towards building a more holistic understanding of smart cities.

My findings further imply that decision-making by bureaucratic officials was driven by struggles over power. Officials inside municipal governments have wanted to reclaim their "right to the city" (Lefebvre, 1968; Shaw & Graham, 2017) since platform

businesses like Uber, AirBnB and Google have disrupted life in cities. Moreover, platforms pursue strategies that enable the creation of “winner-take-all” (WTA) markets (Cennamo & Santalo, 2013), eliminating all potential competition. Thus, I encourage research that empirically investigates whether power dynamics in cities have shifted.

While my research focuses on developing generalizable patterns across cases (Eisenhardt & Graebner, 2007), I did not engage in detailed empirical assessments of each city. Therefore, I suggest more in-depth ethnographic studies of successful smart cities and failed projects (e.g., Zuzul, 2019). In that way, more empirical insights about the strategies that lead to successful outcomes, and what contingencies they are based on, can be generated. In addition, I encourage network analyses of the different stakeholders involved in the smart city. This helps to derive the most important nodes of the networks and might identify important stakeholders that have so far been overlooked by research.

5.4 Implications for practice

Despite the observed tensions, my findings empirically underline the notion that “bureaucracies are not hostile to innovation and flexibility” (Farjoun, 2010, p. 216). My findings present the ways in which platforms enhance bureaucracy, and how lower-echelon bureaucrats engage in some forms of experimentation. Therefore, an important managerial implication is that managers should try to overcome thinking in false dichotomies. Instead, managers should adopt a duality perspective, accepting the twofold nature of objects without separation.

Bureaucracy is associated with stability, and represents predictability, reliability, and continuity. In contrast, platforms represent change and are associated with adaptability, flexibility, new knowledge and innovation (Farjoun, 2010). In the context of smart cities, mechanisms associated with change trump those associated with stability. However, stability enables change and adaptability, and vice versa (Farjoun, 2010). Consequently, managers are ill-advised to readily dismiss bureaucracy and what it represents because they believe that bureaucracy impedes change. Duality enables managers to draw from “the best of both worlds” to develop governance mechanisms that match their intended outcomes. Therefore, I draw from my findings to develop a managerial tool (i.e., a 2x2 matrix) that promotes duality in four organizational archetypes.

The Bureaucracy-Platform-Duality (BPD) framework

According to my findings, there are two features of platforms that enhance bureaucracy, and two features of bureaucracy that contradict platforms, thereby creating organizational tensions. From a managerial perspective, this implies that managers can harness bureaucratic values such as transparency, clear rules, and centralization to design platform governance. My findings further help to develop managerial practices that can be applied to navigate organizational tensions. However, not all bureaucracies are alike, and neither are all platforms. To derive more impactful managerial implications, I therefore first develop four archetypes by turning to the literature.

I suggest that there are two polar types of bureaucracy, and two polar types of platforms. First, it is known that even networked, horizontal, flat, individualistic, and flexible organizations exhibit some features of bureaucracy; these organizations are so-called “soft bureaucracies” (Courpasson, 2000). Their counterpart is what I call “strong” bureaucracy. “Strong” bureaucratic organizations exhibit many of the key characteristics of Weberian bureaucracy (administration of rational-legal authority,

hierarchy, rules, rationality, official competencies, and official secrecy). Second, it is well-established in the platform literature that a platform can be implemented as a technological architecture. However, not all digital platforms evolve into platform organizations that create value based on (two-sided) network effects (De Reuver et al., 2018; Gawer, 2014; Parker et al., 2016). I can therefore discern two different kinds of platforms: a platform as a technological architecture, and a platform as an organizational structure that enables value creation and innovation.

The combination of these two dimensions and their subdimensions allows me to develop a visualization that is quite common in managerial frameworks: the ubiquitous 2x2 matrix. My framework depicts four different archetypes of organizations that result from implementing platforms in bureaucratic organizations and is depicted in Figure 15. Before I describe each type of organization, here is a brief explanation of the framework's dimensions: low level of bureaucracy stands for "soft" bureaucracies, while high level represents "strong" bureaucracies. Low pervasiveness of the platform model means that platforms are adopted as a technological architecture. High pervasiveness of the platform model stands for platform organizations that use their platform for value creation and innovation.

Level of bureaucracy	High	Weberian bureaucracy with platform infrastructure (e.g., Bosch)	Weberian bureaucracy with platform-based value proposition (e.g., municipal government of Munich)
	Low	Soft bureaucracy with platform infrastructure (e.g., SAP)	Soft bureaucracy with platform-based value proposition (e.g., Apple)
		Low	High
		Pervasiveness of platform model	

Figure 15: Managerial framework for platform implementation in bureaucratic organizations

Weberian bureaucracy with platform-based value proposition

I call an organization that exhibits many key characteristics of Weberian bureaucracy (i.e., high level of bureaucracy) and adopts a platform as a means of organizing (i.e., high pervasiveness of platform model) a “Weberian bureaucracy with platform-based value proposition”. A prime example of this archetype is the municipal government of Munich. The main goal of these organizations is the administration of rational-legal authority. The implementation process of the platform model is shaped by the ethos of bureaucracy, which remains untouched. The rules which will govern the platform organization are thus the same or similar to the rules that governed the bureaucratic organization prior to the implementation process. This is in line with the findings of Kornberger et al. (2017), who observed the translation of bureaucracy-opposing logics into bureaucratic and administrable objects. In their case, the radical vision of openness underlying open government was translated into open government *data*.

My findings highlight the flexibility of lower-echelon bureaucrats to experiment with platform-organizing due to the clear and well-established rules of the bureaucracy. The upside of the high level of bureaucracy is the adaptability of the bureaucratic organization due to the process of the written file, which institutionalizes change. However, the downside is that interfaces with external partners are tightly controlled and officials inside the bureaucracy try to manage the multilateral relationships with their “complementors” via contractual arrangements. While this adheres to the bureaucratic model of control, it fails to enable generativity. According to my findings, managers who are responsible for driving platform-thinking in these organizations need to overcome the ethos of official secrecy and the siloed operations of officials inside the organization.

In order to navigate these challenges, managers can focus on the following. First, managers need to ensure the support of higher-echelon officials and actively empower lower echelons. This empowerment can be in the form of dedicating resources to a project whose outcome is not yet defined. Senior officials could also support overcoming official competencies by convincing their senior peers to support interactions between different departments. Second, managers involved in innovation projects can benefit from creating a separate unit (i.e., structural ambidexterity; see for example Tushman et al., 2002) where fast failure is a means of supporting an iterative process. Bureaucracy cherishes official secrecy because it does not want the outside world to see its mistakes (Weber, 1921/1976). However, if there is a unit that works independently from the official bureaucracy, the ethos of official secrecy might be less

of a concern. Third, as highlighted by my findings, lower-echelon officials created new rules to support the implementation of their projects. Thus, empowerment also means trusting that lower-ranking officials will execute the official orders without harming the bureaucratic institution. Consequently, constant reports and control might not lead to the best results. Instead, managers should rely on the bureaucratic model of control and its clear rules, which ensures good governance.

Soft bureaucracy with platform-based value proposition

I call an organization with low level of bureaucracy that adopts platforms as a means of organizing a “soft bureaucracy with platform-based value proposition”. In this case, the ethos of bureaucracy is less pertinent to organizing. The goal of these organizations is innovation and collaborative value creation. Thus, the technological architecture and organizational logic of platforms determine the structure and governance of the organization. Since organizations with low pervasiveness of bureaucracy are “soft bureaucracies” (Courpasson, 2000, p. 154), political decisions are centralized while jobs and activities are decentralized. This centralization of decision-making power is in line with the centralization of control and the decision-making rights of platform providers and platform sponsors. Furthermore, bureaucracy was designed to reduce heterogeneous behavior of individuals (Courpasson, 2000; Kornberger et al., 2017; Weber, 1921/1976). Consequently, platform managers can draw from bureaucratic principles when designing governance mechanisms that balance the generativity tension (Cennamo & Santaló, 2019; Tilson et al., 2010; Wareham et al., 2014). An example of this type is the “government as a platform” approach suggested by O’Reilly (2010) (i.e., government provides data on a platform to nurture a vibrant ecosystem). A less intuitive example from the private sector is Apple. In the past, Apple decided to develop its operating system internally without opening its interfaces for outside developers. Microsoft on the contrary decided to open its innovation for external developers, allowing Microsoft to become the market leader at the time (Parker et al., 2016). Today, Apple is an undisputable leader in innovation. However, the company runs its platform and complementor ecosystem based on clear and explicit rules (O’Reilly, 2010). Furthermore, Apple has refrained from opening its technology platform to outside developers and continues to actively manage and curate the offerings on its platform (Cusumano et al., 2019; O’Reilly, 2010; Parker et al., 2016). Thus, soft bureaucracy with platform-based value proposition is characterized by rule-based interactions and

centralized decision-making, with interfaces that are less standardized and more closed compared to other organizations.

The power of clear rules as a means of reducing uncertainty and heterogeneity of outcomes is supported by my study's findings. Therefore, the managerial implications for such organizations are to foster the bureaucratic values of transparency and predictability, to enable stability inside the platform core. In these types of organizations, authority is not so much linked to the level of the hierarchy. Rather, authority is ensured by building a strong ethos of internal values. Therefore, it is important that these rules are communicated to external complementors. Thus, rules should be simple and designed in a way that complementors *choose* to obey because they consider it the most rational way to create value (Courpasson, 2000). That means that especially best practices should be translated into design rules, which can guide future app developments. While the platform core is surrounded by a constantly evolving ecosystem, my findings further suggest that managers can institutionalize organizational change by creating a collective organizational memory, which reaches outside the boundaries of the organization. This can be achieved by providing additional information on the platform's interfaces to ensure that developers adhere to the design standards cherished by these companies. Moreover, managers can improve transparency for the platform's ecosystem by publishing examples of applications that were deleted from the platform.

Soft bureaucracy with platform infrastructure

I refer to an organization with a low level of bureaucracy that adopts a platform as technological architecture as “a soft bureaucracy with platform infrastructure”. This type of organization is also based on the concept of “soft bureaucracy” (Courpasson, 2000). Here, efficiency is the main goal of the organization. This aim is supported by the centralized data structure and modularization (Baldwin et al., 2000) of activities. Governance is primarily data-driven, based on KPIs and other performance indicators. The platform as technological architecture supports the networked structure of the organization, while creating a holistic overview of all activities inside the organization. An example of this type of organization is the software company SAP. SAP conducts most of its activities in a networked structure, while power is centralized in the hands of the executive board. Whereas SAP is growing an ecosystem of software developers to enable technology innovation, the company's business model still relies heavily on

selling software-as-a-service and licensing their ERP software suite. Hence, SAP's business model does not primarily depend on enabling transactions between third parties, since revenues can be generated without relying on network effects. Furthermore, due to the platform-based technological infrastructure, SAP has developed a dashboard to visualize all the organization's relevant activities. This allows the executive board and the board of directors to conduct their meetings in a so-called "digital boardroom" which consists of a large screen presenting different visualizations of company information. Moreover, SAP's leaders can generate automatic reports within seconds due to the horizontal integration of all company data on a central platform.

Based on my findings, this archetype is the ideal representation of how bureaucracy and the platform's digital architecture nurture each other. Remembering that control and power are centralized in soft bureaucracies (Courpasson, 2000), the centralization of data on the platform enhances bureaucratic control. Furthermore, my results highlight the fact that platforms enhance bureaucracy by supporting impersonal authority and efficiency. Managers that face complex challenges should thus try to generate answers based on data analysis and be transparent about how they reach their decisions. This enhances trust in leadership because it grounds their decisions in the impersonal authority of data. Furthermore, my findings suggest that bureaucratic officials value efficiency. In soft bureaucracies, where orders are not executed in a top-down manner, it is therefore crucial to understand where interfaces between data silos need to be created, and how these interfaces should be designed. The danger of a networked organization might be that several units are working on the same problem without knowing about each other. Managers can increase efficiency by creating interfaces between these groups, harnessing the modular architecture of platforms.

Weberian bureaucracy with platform infrastructure

The fourth archetype is called "Weberian bureaucracy with platform infrastructure" and describes a bureaucratic organization that implements a platform as technological infrastructure. In this type of organization, impersonal authority and efficiency are perceived as even more valuable because the bureaucratic ethos is more prevalent. Thus, the digital platform truly becomes a pacemaker of bureaucratization. However, the technological features of the platform will be translated into bureaucratic practice.

Officials inside these organizations support the implementation of the platform because it fosters impersonal authority.

An example of this type of organization is the German company Bosch. Bosch is divided into four divisions based on business sectors (mobility solutions, industrial technology, consumer goods, and energy and building technology). Moreover, Bosch is based on a hierarchical system of superordination and subordination with official titles and positions demarcating the rank in the hierarchy. Bosch is run as a limited liability company and a member of the Bosch family holds a seat on the company's board of directors. In addition, by incorporating the company as a limited liability company, Bosch's leadership is not forced to disclose as much information to its shareholders compared to public companies listed on the stock exchange. Around 94% of the company are owned by a charitable trust, which represents the Bosch family, and the remaining ownership is held directly by the Bosch family (Robert Bosch GmbH, 2021). Consequently, Bosch seems to cherish values such as official secrecy (i.e., by controlling which information is presented to external partners), centralized decision-making by senior members of the organization (i.e., the Bosch family) and official competencies (i.e., dividing the company into four separate organizational divisions). This makes Bosch a modern example of an organizations that represents some of the core values of Weberian bureaucracy. Bosch's business model is not based on a platform, but the company utilizes data platforms and operating systems that are based on a platform infrastructure (e.g., Windows) to run its internal operations. Notably, Bosch is one of the most innovative and entrepreneurial companies in the world, which underlines that bureaucratic organizations do not impede innovation by default.

My findings imply that managers can make the centralization of the IT infrastructure more accepted inside their organizations by emphasizing how the centralization of data and data-driven decisions supports impersonal authority. Furthermore, they can highlight the importance of a unified IT landscape and better control mechanisms because these enable efficiency. However, data sharing might be an issue in these organizations due to official secrecy and official competencies creating an impasse inside the organization. Managers therefore need to carefully design technological interfaces whose aim is to "make people's lives easier" and not to diminish their roles. Furthermore, managers should address data sharing concerns by emphasizing that the data are only shared internally and should come up with potential win-win scenarios. Data standardization further plays an important role because a lack of standardization can impede efficiency and leads to the perception that the old IT system is better than

the new one. The data format should be simple, and instead of creating internal standards, data should be standardized so that it can be shared with outside partners. Moreover, managers should think of the different departments (or silos) as modules. Applying a modularity-lens might allow managers to create simple processes, where each module's operations become standardized in a way that they support other modules. This might further reduce silo-thinking inside the organization by underlining how each department's operations serve a greater good, and that this purpose is shared with other departments.

Overall, I suggest that the managerial BPD framework supports the design of governance mechanisms in municipal governments and larger private organizations. The framework is intended to enable managers to overcome false dichotomies and to instead draw from bureaucracy and platform design logics to align internal mechanisms with intended outcomes. Ultimately, transparency, centralization and stability are core values that are shared both by bureaucratic organizations and the much-discussed platform organizations.

6. Conclusion and outlook

Wherever cities have appeared, they have generated innumerable innovations—including writing, philosophy, religion, money, music, kingdoms—as well as war and conquest.

(Clos, 2018, p. 25)

The aim of this dissertation has been to investigate the organizational challenges that arise in bureaucratic municipal governments while adopting a “government as a platform” approach. This entails organizing complementors around a municipality-run, platform-based ecosystem to enable technology-driven urban entrepreneurship. Motivated by calls for more empirical investigations of public organizations (Arellano-Gault et al., 2013) and the missing knowledge regarding digital technology’s influence on bureaucracy (Lounsbury & Carberry, 2005), I have sought to address the following research question: *How do municipal governments adapt their bureaucratic governance to accommodate the decentralized governance of urban platforms and their ecosystems?*

Due to the lack of empirical studies on this phenomenon, I used grounded, inductive methods (Eisenhardt, 1989; Glaser & Strauss, 1967) to cross-examine seven bureaucratic municipal governments in Europe. I collected a rich and longitudinal dataset from multiple data sources. My main source was a collection of 76 semi-structured interviews conducted between 2017–2020, in which informants from the seven European municipal governments described their perceptions of the encounter between their organizations’ hierarchical bureaucracies and the decentralized, non-hierarchical platforms. They explained how lower-echelons bureaucrats served as both change agents and guardians of bureaucracy by institutionalizing change without contradicting key bureaucratic principles. I develop a process that shows how some platform governance mechanisms reinvigorate and simultaneously contradict bureaucracy. During this process, lower-echelon bureaucrats apply non-bureaucratic governance mechanisms that allow them to circumvent an organizational impasse. This impasse is caused by the bureaucratic principle of official secrecy, which impedes loosely coupled interactions with external partners, and official competencies, which prevents internal collaboration.

My findings offer valuable insights into the changing nature of Weberian bureaucracy and the valuable role of formalization in enabling stability and change in platform-based ecosystems. I make three key contributions to three different literature streams.

First, I contribute to the empirical literature on smart cities by providing a counterintuitive insight into the effects of data-driven technologies on municipal government (Coletta et al., 2019; Kitchin & Moore-Cherry, 2020). Contradicting past research, I find that technology does not dictate the organizational structure and governance. Rather, bureaucracy adapts to integrate the “government as a platform” approach into its existing structures. Second, I offer empirical insights into the changing nature of Weberian bureaucracy (Byrkjeflot & du Gay, 2012; Courpasson, 2000; Greenwood & Lawrence, 2005; Kornberger et al., 2017). My process highlights the paradoxical role of lower-echelon bureaucrats as the preservers of bureaucracy and change agents. Third, I offer empirical contributions to the literature on platform governance (Cennamo & Santaló, 2019; Tilson et al., 2010; Wareham et al., 2014) by suggesting that bureaucratic principles can support stability inside the platform core, thereby enabling greater generativity.

Moreover, I draw from my findings to develop managerial implications. I build a 2x2 matrix-framework that maps the combination of polar types of platforms with polar types of bureaucracy. The framework helps managers make strategic choices regarding governance design depending on their organizational structure and offers solutions to potential governance challenges that arise from tensions between bureaucracy and platforms. I further encourage a dualistic mindset to overcome false dichotomies. A false dichotomy, such as bureaucratic and organic structure, might lead managers to approach governance design as an either-or decision. However, managers can build more transparent and efficient organizations by embracing bureaucratic values.

Overall, my dissertation has provided an exciting opportunity to investigate municipal organizations from the inside. By revisiting Weber’s nearly century old writings and examining the comparatively young fields of smart-city and platform literature, I have been able to draw from the past and the present to contribute to building a better future.

A crucial question regarding the future of urban spaces is how the recent events have impacted our long-term vision of smart cities. Exactly 15 months after the World Health Organization (WHO) first announced a “pneumonia of unknown cause” on December 31st 2019 (WHO, 2021), people remain absent from once crowded city centers and busy business districts. According to a Stanford survey conducted in June 2020, 42% of the

U.S. labor force is working from home (Stanford News, 2020). Shortly before, in May 2020, Twitter announced that it will offer its employees the option to work from home forever (Forbes, 2020). The COVID-19 pandemic has accelerated the speed of digitalization, forcing businesses, governments, educators, and individuals to create new technology-based solutions and workarounds to continue “life as usual” as well as possible. As a result, the share price of the video communications company Zoom skyrocketed, overtaking the oil giant Exxon Mobile in market value (Business Insider, 2020). These developments enable new opportunities for the global workforce as work is no longer tied to a physical place. Therefore, central business districts and office buildings in cities seem less relevant for the creation of economic value. However, cities have been the locus of innovation because they create physical proximity that enables serendipitous encounters of people and ideas. Therefore, we need to ask: Where is the locus of innovation in a post-pandemic world and can municipal government-run platforms emulate and connect people and ideas to continue driving innovation from the heart of our global cities? Can digital technologies replace physical proximity with digital proximity?

An example of how digital technologies can uncouple the physical world from the digital world are virtual power plants. Despite the infrastructure-dependent nature of the energy industry, the IoT in combination with digital platforms enable individuals and large utility companies to co-create value by sharing resources (Palmié et al., 2021). This provides an opportunity for cities to increase energy efficiency without having to invest in large-scale infrastructure. Further, the COVID-19 pandemic has demonstrated that countries like China and South Korea, which used digital technologies to track the movements of their people, were more successful in containing the disease than European countries, which chose to protect their citizens’ data privacy.

This consideration of ends and means, along with the choice between preserving values and promoting technological progress, will shape the future of our cities.

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Appendix I: Development of smart city research over time

Figure 16 displays the rise of smart city research and related concepts over the past decades.

Note: Source Web of Science, Accessed 08.03.2021. The following figure displays scientific publications that contain terms related to the smart city phenomenon in their title. The search string was as follows: **TOPIC:** (smart city) *OR* **TOPIC:** (intelligent city) *OR* **TOPIC:** (wired city) *OR* **TOPIC:** (digital city) *OR* **TOPIC:** (ubiquitous city) *OR* **TOPIC:** (innovation city)

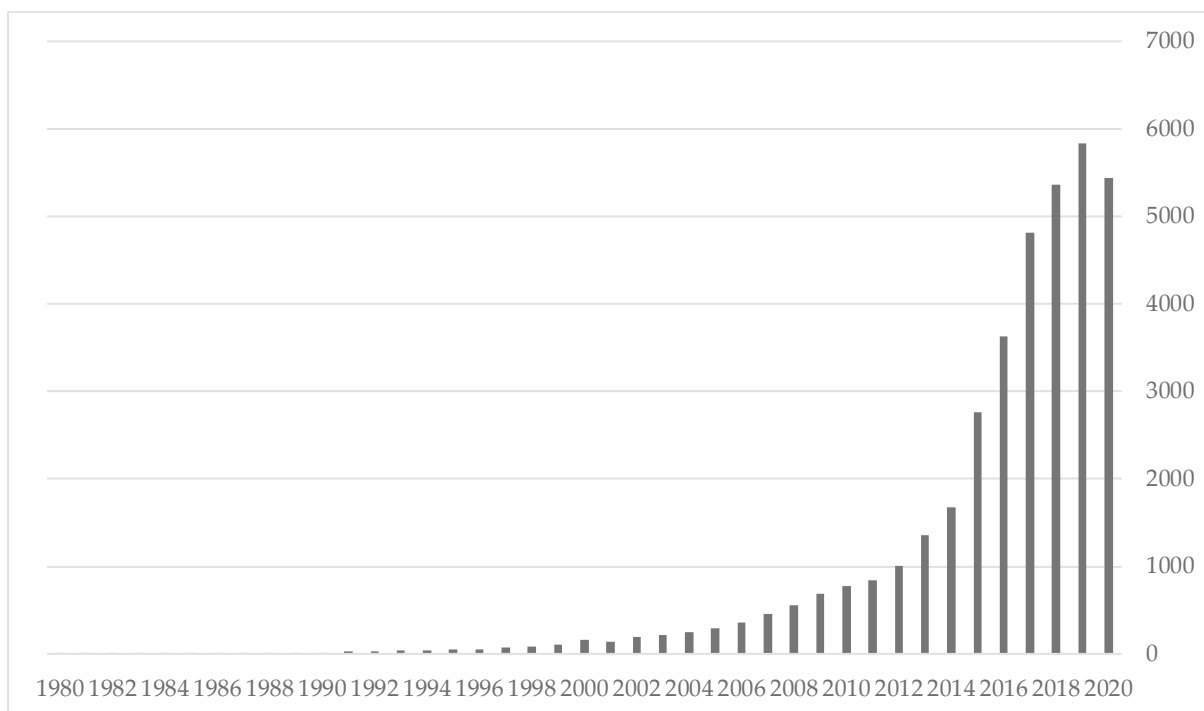


*Figure 16: Scientific publications count
Contains "smart city" or "intelligent city" or "wired city" or "digital city"
or "ubiquitous city" or "innovation city" in their title*

Appendix II: Interview guideline for semi-structured interviews

Notes regarding the interview guideline: This is the latest version from April 2020. The interview guideline has been continually updated during the iterative process of data collection, data analysis, and going back to literature.

Open-ended main question	Check – Memo for potential follow-up questions	Notes
What is your role in the project?	Main affiliation City or private company Role description	
How did you decide to implement a platform in your city?	Use cases Infrastructure – Sensors History of the platform: Did the city already have some digital legacy?	
How do you perceive the collaboration between the different city departments / the city and private companies?	Other departments Private companies Who builds the technology for the platform? External collaborators	
Are there any new collaborations?	Workshops City silos breaking open	
Where do you get your data from?	Sensors- in the public / private Data from other departments Data from private companies	
Who can access the platform?	Interfaces Open interfaces Open data Licenses	
Who decides what happens on the platform?	Control Decision making Leadership	

What governance measures did you implement?	Changes over time? Why did they choose certain governance measures and not others?	
What were the main difficulties that you encountered?	Data sharing Data privacy Financials / Business Case Control Data ownership	
How are you dealing with sensitive data?	Data privacy	
What is the vision for the future of the platform?	Innovation? Data sharing with other cities	
Is there anything else that we might have missed?		

Résumé Charlotte-Katharina Lekkas

Education

- 2017 – **Ph.D. in Management (area of concentration: Business Innovation) at the**
2021 **University of St.Gallen (Switzerland)**
Supervisor: Prof. Dr. Oliver Gassmann, Co-Supervisor: Prof. Evangelos Souitaris, PhD.
- 2013 – **M.Sc. in Management and Technology at the Technical University Munich**
2016 **(Germany)**
Areas of specialization: Finance & Electrical Engineering
One semester at *Université Paris Dauphine*, France.
- 2010 – **B.Sc. in Management and Technology at the Technical University Munich**
2013 **(Germany)**
Areas of specialization: Finance & Electrical Engineering

Work Experience

- 2017 – **Research Associate and Project Manager at the Institute for Technology**
Present **Management (University of St. Gallen, Switzerland)**
In my role as Research Associate, I independently developed and executed research projects focusing on platforms, smart cities, organizational design, circular economy, and innovation. I supported teaching activities and supervised several Bachelor and Master Theses.
As a Project Manager, I led the research and business model consulting in an EU-funded project about smart cities. I conducted several Design Thinking workshops and developed a handbook on smart city business models. I also led a team of 2-3 research assistants.
- 2017 – **PhD student in the Technology & Innovation – New Ventures &**
2021 **Technologies department (SAP, Switzerland)**
I conducted multiple tasks related to product management and new product innovation, ecosystem management, and business development. I was responsible for developing and conducting Design Thinking workshops with SAP customers and SAP stakeholders as well as building, maintaining, and managing a community of relevant stakeholders of the SAP ecosystem.
I supported the Head of SAP Industry-University Collaboration Munich in developing and implementing a collaboration between SAP and a world-leading

partner university in Germany. I further took on responsibility for specific workstreams.

I conducted research and worked in white papers on steering and decision-making in the future of work.

- 2010 – Various internships and working student positions at SIEMENS Bank GmbH
2016 (Analyst for Infrastructure Investments), MEAG AG (Analyst for Infrastructure Investments), BonVenture (Analyst for Social Venture Capital Investments), and the Commonwealth Bank Australia, Sydney (Equities Analyst).

Extracurricular Activities

- 2018 – **Member of the Board at the Doctoral Network (DocNet) of the University of**
2020 **St.Gallen**

I was responsible for financing, sponsoring, overall management and administrative tasks in my role as Vice President. In my role as event manager, I organized the DocNet Annual Symposium. I acquired speakers, acquired sponsoring from key stakeholders, planned and executed the event.

Papers

- 2021 Palmié, M., Boehm, J., **Lekkas, C.-K.**, Parida, V., Wincent, J., & Gassmann, O. (2021). Circular business model implementation: Design choices, orchestration strategies, and transition pathways for resource-sharing solutions. *Journal of Cleaner Production*, 280, 124399.
- 2019 **Lekkas, C.-K.**, Kloeti, K., Palmié, M., & Gassmann, O. (2019). Handbook Smart City Business Model Innovation – A 2019 report on challenges and opportunities for Business Model Innovation in Smart Cities, *Deliverable No. 8.4.1 to the European Commission* <https://www.smarter-together.eu/file-download/download/public/1035>.

Conference Contributions

- 2019 **Lekkas, C.-K.**, Bencsik, B., & Boehm, J. (2019). Fighting the right windmills: An extended view on business model impediments for the energy transition. *R&D Management Conference (RADMA)*. Paris.
- 2019 **Lekkas, C.-K.**, Boehm, J. (2019). Openness and governance of innovation platforms in non-traditional platform industries. *XXX ISPIM Innovation Conference*. Florence.