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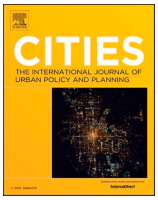

The role of dynamic managerial capabilities and organizational readiness in smart city transformation

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ABSTRACT

This study focuses on the dynamic managerial capabilities of smart city managers and the organizational readiness of a city administration required to drive smart city transformation. After reviewing the literature, we conducted semi-structured interviews with smart city managers in 40 smart cities. We identified five dynamic capabilities that effectively contribute to smart city transformation: seizing, sensing, innovation, integrative, and empowering capability. Our analysis also reveals that a city administration's organizational readiness plays a critical role in these transformative processes and relies on four factors: innovation readiness, resource readiness, a participatory and collective mindset, and strategic readiness. Based on our findings, we suggest a theoretical framework composed of 10 propositions that describe the mutual influences of these dynamic managerial capabilities and organizational readiness factors, together with their contributions to smart city transformation. We conclude with a discussion of the limitations and the implications for future research and practice.

1. Introduction

What does it take to make cities smart? Cities around the world are subject to rapid technological change, urbanization, environmental challenges, resource scarcity, and increasing and changing citizens' expectations. To better deal with these challenges and remain attractive for their stakeholders, cities are developing reliable and sustainable solutions (de Jong et al., 2015; Neirotti et al., 2014; Yigitcanlar, 2011). They are striving to become preferred places for business and workers, students, residents, and tourists and are aiming to be competitive regarding living, governance, security, health, and mobility. To this end, cities drive strategic change through a comprehensive modernization of their infrastructure, a redesign of their processes, structures, administrative culture, and services, using new and innovative technologies to remain competitive (Batty, 1990; Buck & While, 2017; Hodson & Marvin, 2007; Israilidis et al., 2021). The term *smart city* reflects this commitment and related efforts of cities to become fit and competitive in areas such as governance, human capital, economy, security, healthcare, environment, and living (Lara et al., 2016; Laufs et al., 2020; Lombardi et al., 2012).

While the smart city concept has become widely accepted in practice and in the literature (see, for example, Albino et al., 2015; Caragliu et al., 2011; Mora, Deakin, & Reid, 2019; Yigitcanlar et al., 2021), we still have a poor understanding of what it takes to become smart. Being able to provide sustainable solutions, deploy technological advances to solve or mitigate urban issues, strengthen the ability to adapt to fast-changing urban environments, and effectively serve people to meet their specific needs and demands is crucial for smart city transformation (Mora, Deakin, & Reid, 2019), but remains a challenge for many cities. Studies on smart cities suggest that building organizational and managerial capacities are decisive to meet these challenges and enable smart city transformation (Khan et al., 2020; Nam & Pardo, 2011b, 2014; Santinha & de Castro, 2010). Indeed, cities are engaging in capacity-building and are initiating projects to improve city governments' capability to deliver policy, fight climate change with ICT solutions, boost the cities' entrepreneurial culture, and to increase professionals' and citizens' knowledge, skills, attitudes, and behaviors in the effective use of digital devices (Dowling et al., 2021; Mora, Deakin, & Reid, 2019). These efforts are critical, since a lack of organizational and managerial capabilities is often a barrier to public sector modernization projects and causes them to fail (Gil-Garcia & Pardo, 2005; Schedler et al., 2019; Wilson & Mergel, 2022). Thus, a key challenge for cities is to build and cultivate the necessary capabilities to effectively embrace smart city transformation. To enhance our understanding, we suggest

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looking at the managerial capabilities and the organizational capacities required for smart city transformation.

First, there is a need to understand which skills smart city managers require to enable smart city transformation. Which capabilities do smart city managers perceive as decisive to operating in a very dynamic urban environment with not only technological trends, but also changing expectations and demands of key stakeholders, including citizens, businesses, and politicians? What do they require to be able to launch initiatives and projects that promote a modern, livable, and attractive city? In our view, the theoretical lens of dynamic capabilities provides a unique perspective to explore managerial capabilities required for smart city transformation. *Dynamic managerial capability* theory addresses managers' overall abilities to identify opportunities and threats, anticipate external change, and prevent organizational rigidity or inertia, so that organizations can continually learn, improve, and adapt so as to be effective and innovative (Teece, 2016). Although considerable research has been done on dynamic managerial capabilities generally (see, for a comprehensive review of the literature, Helfat & Martin, 2015), particularly of public sector executives (Carmeli & Tishler, 2004; Mazzucato & Kattel, 2020; Pablo et al., 2007; Piening, 2013; Ridder et al., 2005), there have been no empirical studies of smart city managers' dynamic managerial capabilities. This is surprising, since smart city managers' roles and responsibilities enable smart city transformation (Gupta et al., 2020; Michelucci et al., 2016), which requires them to understand the dynamics in a city environment as well as integrate, create, and reconfigure resources to cope with rapid changes. Against this background, we need to understand which dynamic managerial capabilities smart city managers require in order to manage smart city transformation.

Second, since strategic change can only be implemented as quickly and to the extent allowed by an organization's capacity (Teece, 2016), there is a need to understand which organizational capabilities are required for smart city transformation. The capacity to transform depends on an organization's capability to integrate, build, and transform its resource base, to innovate and swiftly implement new processes, products, or services, or modify or reconfigure existing ones that better match the changing environment (Adner & Helfat, 2003; Helfat & Raubitschek, 2018; Pavlou & El Sawy, 2011; Teece et al., 1997). We consider this by applying the concept of a city administration's *organizational readiness*. Readiness implies a high degree of fitness of the organization to change and a higher capacity to implement change (Armenakis et al., 1993; Cinite et al., 2009; Lokuge et al., 2019). Indeed, the research has described readiness factors that promote the organizational capability for innovation and change generally (Damanpour, 1991; Iacovou et al., 1995; Lehman et al., 2002; Lokuge et al., 2019; Weiner, 2009), particularly for public sector transformation (Mergel, 2018). For smart cities, while the importance of the organizational setting and a city administration's ability to support city transformation are well recognized (Bjorner, 2021; Gil-Garcia et al., 2015; Kumar et al., 2020; Mu et al., 2022; Nicolas et al., 2020; Santinha & de Castro, 2010), they have not yet been empirically addressed in the literature. Focusing on smart city administrations' organizational readiness would provide new insights into the organizational requirements for smart city transformation.

Against this background, our motivation for this focus on organizational and managerial capabilities is to explore what is required for smart city implementation. Specifically, we investigate which dynamic managerial capabilities and organizational capacities are perceived by smart city managers as critical for enabling smart city transformation and how, together, these capabilities influence smart city transformation. To achieve this, we interviewed 40 smart city managers from 40 smart cities. We thereby contribute to the body of smart city literature by deepening our understanding of the roles of smart city managers and organizational conditions in smart city transformation, as well as their underlying mechanisms.

In the following, we first review the literature on smart city transformation and managerial and organizational capabilities. We will then describe the study methodology and the procedures to collect and analyze the data. We subsequently discuss the roles of dynamic managerial capabilities and organizational readiness in smart city transformation. We then derive the concept *smart city transformation capacity* from our data, including the general characteristics necessary for smart city transformation. We conclude with a discussion of the implications for research and practice and point out the study limitations and some avenues for further research.

2. Theoretical background

2.1. Smart city

In the early 1990s, emerging information and communication technology (ICT) shaped the concept of smart city (Alawadhi et al., 2012). Taking a technocentric view, scholars have used terms such as *the intelligent city*, *the digital city*, or *the ubiquitous city* (Anthopoulos & Fitsilis, 2010; Komninos, 2002; S. H. Lee et al., 2008; Zheng et al., 2020). Only later did researchers begin to promote a more holistic view of the concept, including human, cultural, environmental, social, economic, and political aspects (Aguilera et al., 2017; Caragliu et al., 2011; J. H. Lee et al., 2014; Leydesdorff & Deakin, 2011; Zhao et al., 2021). Today, *smart city* stands for a wide variety of concepts and approaches to finding solutions for urban challenges and achieve, among others, global competitiveness, economic opportunities, enhanced livability, smart mobility, and environmental sustainability (Caragliu et al., 2011; Csukas & Szabo, 2021; J. H. Lee et al., 2014; Nicolas et al., 2020; Yigitcanlar et al., 2018).

After witnessing three decades of scientific research, *smart city* has become a catch-all concept (Angelidou, 2014; Zheng et al., 2020). Despite this growing interest, there is no agreed-upon definition (Mora et al., 2017; Mora, Deakin, Reid, & Angelidou, 2019). Various scholars have sought to define and conceptualize the smart city so as to create cohesion in research and practice (Chourabi et al., 2012; Hollands, 2008; Yigitcanlar et al., 2018). However, the research field is fragmented, and finding a unified definition remains a difficult task (Komninos & Mora, 2018). Analyzing the existing smart city literature, researchers have attempted to develop an integrative view to unify this highly fragmented research field (Albino et al., 2015; Appio et al., 2019; Chourabi et al., 2012; Gil-Garcia et al., 2015; Nam & Pardo, 2011a; Zheng et al., 2020). These analyses break down the smart city concepts into core characteristics, including a city's natural, physical, and ICT infrastructure, social inclusion, efficiency, sustainability, and social, cultural and business-led urban development (Albino et al., 2015; Gil-Garcia et al., 2015).

Although there is no agreement on one definition and conceptualization, there is consensus in the literature that *smart city*, first, concerns development and improvement. This is evident in various definitions and conceptualizations of smart city, which include words such as optimization, improvement, enhancement, or development (see, for example, Caragliu et al., 2011; Csukas & Szabo, 2021; Giffinger et al., 2007; Giovanni et al., 2021; Hall, 2000; Kumar et al., 2020; Marsal-Llacuna et al., 2015; Nam & Pardo, 2011a; Zhao et al., 2021). Second, this transformation is a dynamic, ongoing process created by testing new approaches and technologies to solve urban challenges and make a city a better place to life and work (Albino et al., 2015; Gil-Garcia et al., 2015; Nicolas et al., 2020).

In sum, there is broad consensus that *smart city* involves the continual improvement of a city. In this study, we focus on two of the enabling factors: a city administration's readiness for transformation and smart city managers' dynamic capabilities.

2.2. Dynamic managerial capabilities

Dynamic managerial capabilities are generally defined as managers'

capacity to undertake strategic and entrepreneurial activities toward strategic change and innovation (Helfat & Raubitschek, 2018; Teece et al., 1997). The term refers to the key role of public and private sector managers in appropriately adapting, integrating, and reconfiguring internal and external activities, resources, technologies, and competencies to match the requirements of a changing environment (Adner & Helfat, 2003; Helfat et al., 2007; Ridder et al., 2007; Teece, 2012; Teece et al., 1997). Dynamic managerial capabilities involve scanning, learning, and interpretive activities such as identifying changing customer needs and latent demands as well as observing the organization's environment and technological developments (*sensing capability*); taking strategic and business model decisions on how to create value for the customers and the organization (*seizing capability*); and reconfiguring organizational capacities to ensure the strategic renewal of the organization, as well as its resources and capabilities, so that it can continue to meet the changing expectations of the environment (*transforming capability*) (Helfat et al., 2007; Teece, 2016; Teece et al., 1997). Given the almost constant change and competitive pressure in the environments in which the various actors are involved, further dynamic capabilities become critical for value creation and value capture. This calls for decision-makers to come up with creative ideas relating to designing, creating, and introducing new and/or extending and improving existing products, processes, services and technologies (*innovative capability*) as well as thinking in terms of ecosystems, forming new alliances, striving for new strategic partnerships, and integrating and coordinating activities and technologies inside and outside the organization (*integrative capability* and *alliance capability*) (Helfat & Campo-Rembado, 2016; Helfat & Raubitschek, 2018; Kale et al., 2002).

In the public administration literature, scholars use *dynamic capabilities* both when exploring strategic approaches adopted at the organizational level (e.g., Luna-Reyes et al., 2020; Pablo et al., 2007; Piening, 2011; Piening, 2013) and at the managerial level (e.g., Carmeli & Tishler, 2004; Ridder et al., 2005). Similar to the private sector, dynamic capabilities as strategic efforts are important to continually adapt to changing circumstances, create opportunities for organizational advancement, test new procedures, and find new ways to improve service delivery in public administrations. However, unlike the private sector, routine shapes the work in the public sector more (Boyne, 2002). Thus, dynamic capabilities are not necessarily required everywhere. For instance, Guimarães et al.'s (2011) case study of the Superior Tribunal of Justice – Brazil's highest appellate court – illustrates that dynamic capabilities are hard to find in public administrations where tasks and activities are routine. Yet they are also critical in the public sector. Mazzucato and Kattel (2020) highlight the significance of dynamic capabilities to adapt to especially fast-evolving environments, for instance during the Covid-19 pandemic. A lack of dynamic capabilities in managing strategic processes and implementing new rules and practices in a day-to-day routine risks hindering rapid adaptation to needs and can lead to failures to achieve desired goals (Ridder et al., 2005).

Dynamic capabilities provide a useful analytical lens to study innovation and change processes in smart cities. As a dynamic and rapidly changing context, smart cites offer numerous opportunities for sensing, seizing, innovating, and transforming. For instance, in their field case study, Chong et al. (2018) investigate how a smart city – as an urban organization with dynamic capabilities – levers citizen engagement to enhance their capability to sense opportunities, and levers data analytics to identify solutions to their problems. Focusing on the smart city context, Linde et al. (2021) investigate how firms can develop dynamic capabilities to orchestrate ecosystem innovation, revealing the roles of sensing, seizing, and reconfiguring capabilities as critical for ecosystem innovation in smart cities.

These initial studies illustrate dynamic capabilities' relevance in the smart city context. However, we see room for empirical evidence on how smart city managers pursue development and which dynamic capabilities are perceived as critical in this process. Thus, new insights are required to understand dynamic capabilities employed by smart city managers to enable smart city transformation.

2.3. Organizational readiness

The capacity to strategically change is only partly the result of management capabilities. It also depends on an organization's ability to integrate, build, and transform its resource base, to innovate and implement new processes, products, or services, or to modify or reconfigure existing ones that better match the changing environment (Adner & Helfat, 2003; Helfat & Raubitschek, 2018; Pavlou & El Sawy, 2011; Teece et al., 1997). Strategic changes can only be implemented as quickly and to the extent that the organization's capabilities allow (Teece, 2016). We consider this, with the concept of *organizational readiness* for digital innovation, as our study's second theoretical pillar. Higher readiness indicates a lower aversion to innovation and a more successful innovation outcome (Armenakis et al., 1993).

In the general organizational and management literature, organizational readiness for innovation is whether and to what extent an organization has the necessary characteristics that facilitate and foster change and innovation. Numerous studies have been conducted on this, each highlighting similar factors that promote organizational innovation readiness. The most frequently reported factors include resource readiness, with particular foci on financial, human, and technical resources, cultural readiness, strategic readiness, IT readiness, and managerial attitudes to change (Damanpour, 1991; Iacovou et al., 1995; Lehman et al., 2002; Lokuge et al., 2019; Weiner, 2009).

In the public administration literature, there is a wide range of factors that enable and hinder innovation and transformation (Mergel, 2018). Scholars who focus on organizational readiness for change have highlighted similar factors as in the general organizational and management literature. For instance, the role of executives, their commitment to change, and their ability to communicate a compelling vision and mission, teamwork, the existence of appropriate regulations and policies, strategic planning, the role of organizational culture with open communication, cohesion and morale, and participative decision-making are revealed to be key factors for innovation and transformation (Cinite et al., 2009; Jones et al., 2005; Nelson et al., 1999).

To date, in the public administration literature, organizational readiness factors have not been explicitly addressed regarding smart city transformation. However, it is well recognized in the literature that organizational settings and a city administration's ability to help a city develop into a smart city are crucial (Gil-Garcia et al., 2015; Santinha & de Castro, 2010). For instance, an open and transparent government that allows and promotes citizen participation (Guenduez et al., 2020; Nicolas et al., 2020), government planning, and policy design as strategic efforts (Kumar et al., 2020), a city administration's technical capabilities regarding ICT infrastructure (Kumar et al., 2020; Nicolas et al., 2020), or the capability to collect and manage large volume of data from the sensor and IoT network as well as to share information across organizational boundaries (Yigitcanlar et al., 2022) have all been named key aspects of the capacity for smart city transformation.

In sum, organizational readiness has been explored in the general organization and management as well as in the public administration literatures. Although the smart city literature does provide evidence of organizational readiness's importance for smart city transformation, this has not yet been the focus of research. We set this focus by looking at a city government's organizational readiness, seeking to gain a deeper understanding of its importance in smart city transformation.

2.4. Conceptual framework

Dynamic managerial capabilities are of great significance in managers' decision-making, since they allow them to adapt their organizations to changing environmental conditions and to contribute to strategic change (Adner & Helfat, 2003; Helfat et al., 2007; Teece et al., 1997). We refer to dynamic managerial capability as smart city

managers' abilities and competencies to use their knowledge and expertise to sense and seize opportunities and to reconfigure organizational resources. We believe that these competencies impact on how smart city managers respond to the ever-changing city environment and foster strategic change toward becoming a smart city. Thus, we include individual smart city managers' dynamic capabilities as the first component of our conceptual framework.

Complementary to dynamic managerial capabilities, organizational readiness is a city administration's capacity to enable, advance, and implement smart city transformation as an organization. As studies have indicated (Kumar et al., 2020; Nicolas et al., 2020; Yigitcanlar et al., 2022), it takes government transparency, participatory governance, collaboration, resource availability and management, ICT infrastructure, skills, competencies, and strategic planning for a local administration to be able to implement smart city transformation. These capacities of a city administration allow and foster innovation and the implementation of new processes. In our view, smart city transformation and how arduous this is to achieve rely on a city administration's readiness for this undertaking.

Having examined our study's theoretical aspects, we present our conceptual framework in Fig. 1.

This conceptualization shapes our three primary purposes. First, we want to understand the dynamic managerial capabilities that are critical for smart city transformation. Second, we seek to explore which capacities of a city administration are just as relevant to it. Third, we want to outline the relationships between the three concepts and to link dynamic managerial capabilities and organizational readiness to the smart city transformation process. This will close theoretical gaps, strengthen our understanding of the organizational and managerial enablers of smart city transformation, and lay the foundation for future research. With this goal in mind, we ask:

RQ1. Which dynamic managerial capabilities do smart city managers perceive as critical for enabling smart city transformation?

RQ2. Which organizational capacities do smart city manager perceive as critical for enabling smart city transformation?

RQ3. How do managerial capabilities and organizational capacities influence smart city transformation?

3. Research design

For the purpose of this study, we used a qualitative multiple-case study (Eisenhardt, 1989; Yin, 2009). We applied an iterative research approach – going back and forth between theory and data to gain a rich, detailed understanding of managerial and organizational factors and their relationships to smart city transformation (Timmermans & Tavory, 2012). In the following, we provide detailed information about our data collection and analysis procedures.

3.1. Data collection

The data collection followed a mix of primary and secondary data, which – together – enhance validity through triangulation (Krefting, 1991). Following a purposive sampling approach (Emmel, 2013), we interviewed smart city managers (Bogner & Menz, 2009). Public servants who head the transformation in cities often hold different job titles (De Tuya et al., 2020). When looking for interviewees, we therefore paid attention to their own role definitions. We began our data collection by contacting the responsible smart city manager of each of the 102 smart cities listed on the IMD Smart City Index (2019). This very large number of cities allowed us to identify many potential interviewees. Further, several cities on the list had already been explored in previous studies (e.g., Caragliu et al., 2011; Fernandez-Anez et al., 2018; J. H. Lee et al., 2014; Mora, Deakin, & Reid, 2019; Nicolas et al., 2020), giving us confidence in our selection approach and allowing us to gain new insights in to these cities. We contacted our interview partners by e-mail (if an e-mail address was publicly available), by phone (if no e-mail address was available, but a phone number was), social media (LinkedIn), or via the cities' official websites. Using these approaches, we were able to recruit and then conduct 19 interviews with city managers from this initial list, each from a different city listed in the index. At the end of each interview, we asked the interviewee who they consider to be an appropriate additional interview partner from another city (Biernacki & Waldorf, 1981). In this way, we were able to interview another 21 smart city managers from 21 smart cities that were not on our initial list but who were considered by their peers as highly appropriate for our study. In total, we interviewed 40 smart city managers, each from a different city, in either English ($N = 21$), German ($N = 13$), or French ($N = 6$) from October 2019 until May 2020 – resulting in around 37 h of interview audio data. For an overview over the participating smart city managers, see Table A.1 in the Appendix. Our interviews took place either face-to-face where feasible, otherwise via Skype, and lasted on average 56 min. All interviews were recorded and then transcribed, resulting in 276,050 words.

The interviews followed a semi-structured interview protocol, with a combination of focused and open-ended questions (Leech, 2002; Rubin & Rubin, 2011). The open-ended questions were aimed at gaining an in-depth understanding of the dynamic managerial capabilities and

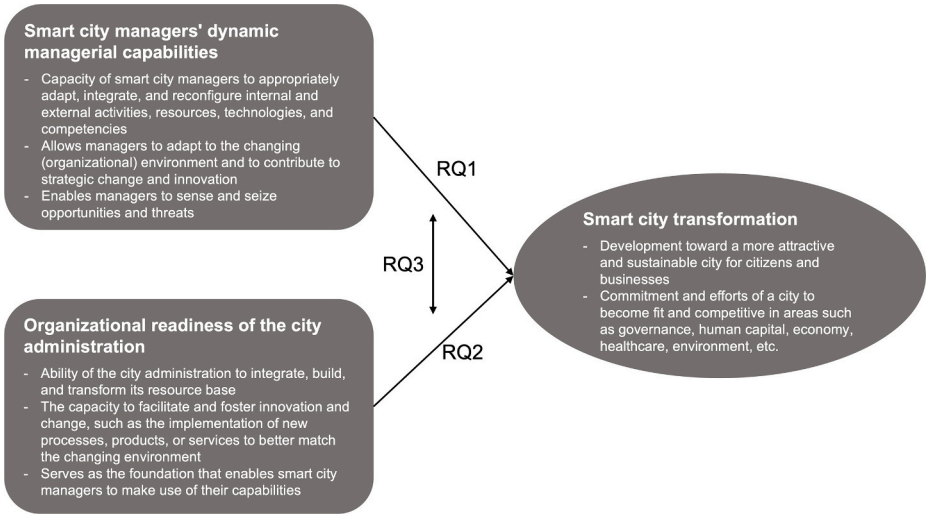

Fig. 1. Conceptual framework.

organizational capacities required to drive smart city transformation. We focused on the analysis of the following topic areas from the overall interview questions list:

- Topic I: Smart city transformation (sample question: *Does your city have a concrete smart city strategy with a vision and a guiding policy?*)
- Topic II: Dynamic capabilities of smart city managers in implementing the goals (sample question: *Can you describe the skills and competences a smart city manager requires in order to successfully implement the goals, and can you guide us through a concrete project?*)
- Topic III: Organizational readiness (sample question: *Which resources does a city administration require to implement a smart city strategy?*)

For the secondary data collection, we analyzed several supporting documents, including archival materials, policies, strategies, presentations, and brochures (Bowen, 2009). Where available, documents – particularly smart city strategies or policy documents – were collected

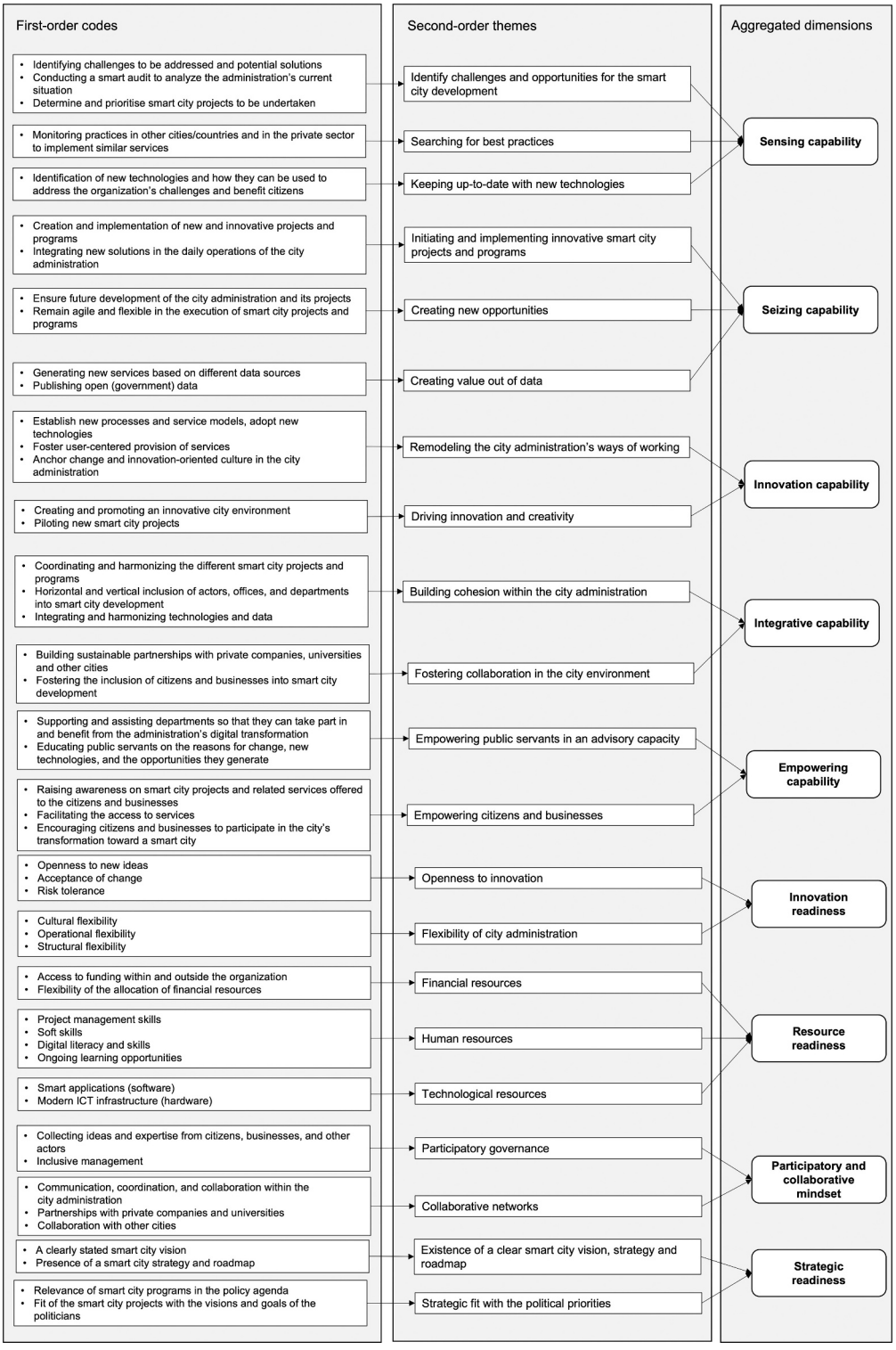

Fig. 2. Data structure.

through desk research and analyzed before the interviews, which provided background information and helped us prepare for the interviews. This enabled us to explicitly refer to specific topics or events and formulate questions, such as: *"Two years ago, your city published the smart city strategy, in which the topic of organizational development is considered particularly important for the city transformation. Which specific organizational factors have been addressed since then?"* Developing familiarity with the participants prior to the interviews was important to increase the results' credibility (Shenton, 2004).

3.2. Data analysis

For the data analysis, we used the qualitative data analysis software QSR Nvivo12 (2018). The data analysis had three steps:

In the initial coding step, we sought to identify key concepts and key patterns related to each research question. Following a grounded theory approach (Gioia et al., 2013), we inductively coded our interview data. Specifically, to identify first-order codes, we focused on which abilities smart city managers consider relevant for their roles and responsibilities in the transformation of cities, and which organizational factors they consider critical for smart city transformation. In this analysis step, various terms, codes, and categories emerged, a process Strauss and Corbin (1998) call open coding. In regular meetings, we discussed and compared the coding results (Brink, 1993). This allowed us to consolidate the coding approach and to avoid considerable differences.

In a second coding step, applying axial coding (Strauss & Corbin, 1998), we tied together the codes formed in the initial coding stage into categories and identified emerging patterns. In regular meetings, we reviewed and merged the first-order codes into broader categories, representing major themes (Corley & Gioia, 2004). We used the literature on dynamic managerial capabilities and organizational readiness to make sense of our data. Going back and forth between the data and the literature, we gradually developed factors that identify distinct dynamic managerial capabilities of a smart city manager and organizational readiness of a city administration. Fig. 2 shows the data structure, with 49 first-order codes and 21 second-order themes that support five aggregate dynamic capabilities and four aggregate organizational readiness categories.

In the third analysis step, to build our theoretical framework, we related the emerging concepts from our data to the literature. We used causation coding to identify the links and causalities between the categories we had identified and integrated them in a graphic model to plot the flow of antecedent variables, mediating variables, and outcomes (Saldaña, 2013). Specifically, we examined whether there is a relationship between the managerial and organizational factors and smart city transformation and, if so, how it concretely manifests in our data. We reread the transcripts and discussed potential links, considering the literatures on dynamic managerial capabilities, organizational readiness, and smart city transformation. This helped us to further refine the theoretical framework and increase our results' theoretical sensitivity (Corbin & Strauss, 1990). Fig. 3 shows the resulting theoretical model. In Table 1, we provide quotes to illustrate our model's underlying propositions, while Table A.2 in the Appendix provides specific example quotes that reflect smart city transformation's dynamism.

4. Findings

We present our results by first outlining the five dynamic managerial capabilities for smart city transformation we identified in our analysis: sensing, seizing, innovation, integrative, and empowering capability. Second, we present the four organizational factors that explain a public administration's readiness for smart city transformation: innovation readiness, resource readiness, a participatory and collaborative mindset, and strategic readiness. The data structure presented in Fig. 2 summarizes these results as first-order concepts, second-order themes, and – based on the second-order themes – aggregated theoretical and empirical concepts we derived from the analysis.

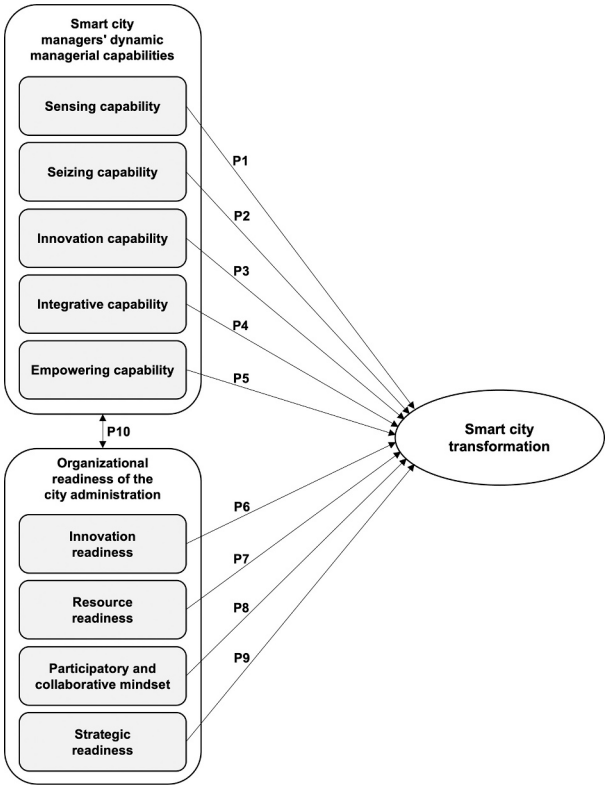

Fig. 3. Managerial and organizational factors enabling smart city transformation.

4.1. Dynamic managerial capabilities for smart city transformation

4.1.1. Sensing capability

Our data reveals that *sensing capability* includes identifying challenges and opportunities within the city context, monitoring emerging issues, new trends, and best practices from other cities, and keeping up-to-date with new and innovative technology for smart city transformation. Our analysis shows that sensing activities are integral to smart city managers' jobs, as articulated in the following interview quote:

> A big part of my position is meeting with my colleagues and just talking with them and, through conversations, hearing what their challenges are. And then when I meet, it's kind of parking these challenges on one side of my computer and then I'm meeting with vendors and trying to better understand what their products are able to do and help address these challenges that my colleagues fight.
>
> (interviewee 25)

For smart city managers, sensing involves continually monitoring project opportunities and best practices in other cities and analyzing what works and what does not:

> I try to first identify a set of services that works well in other cities, that have been proven to work, and then start implementing all of this already and then look at how it works.
>
> (interviewee 16)

However, many smart city managers stress the importance of not simply copying solutions from other cities, but considering local city-specific conditions:

> I've always said that cities should not be replicating — each city should not be replicating what another city is doing. So for example I

Table 1
Overview over the propositions.

Propositions	Sample statements from the interviews
P1: *Smart city managers' sensing capability positively affects smart city transformation.*	*"It's about where or how technology could support us in our intentions to make the city smart, and here, I mean, the whole digital transformation is very much a broader field than technology as such, it has to do with the organization and the ways we work… Here I am in this role, just to identify what could be done, which technologies have the potential to simplify and improve processes and, at the end of the day, to increase the quality of life of the city's population." (interviewee 3)*
P2: *Smart city managers' seizing capability positively affects smart city transformation.*	*"We need to take advantage of the small windows of opportunity that appear from time to time. So, I think we're an agile team, we're small and we try to grasp opportunities as they come… Now my main focus is to turn the city into an innovation platform. We are working on our program. Basically, we want to fund forty to fifty pilot projects in the city that make use of the city's infrastructures to develop new technologies and to create better services for the citizens." (interviewee 33)*
P3: *Smart city managers' innovation capability positively affects smart city transformation.*	*"To me, smart city is about creating the circumstances of collaborative innovation that address wicked urban challenges. So, creating the space for radical thinking about solutions is pretty much part of what we want to do." (interviewee 28)*
P4: *Smart city managers' integrative capability positively affects transformation.*	*"I have the lead on the smart city topic and I am the contact person for all the actors related to this topic, the initiation and coordination of smart city activities, the consulting and support of the departments and areas in smart city projects, so the other departments can come to us, we lead the smart city project portfolio. So to speak, all the projects that are somehow related to smart city, monitoring of trends and opportunities, networking on a local, national, and international level, building and maintaining a partner network, these are also part of it, and then controlling the innovation credit, external communication regarding smart city and also internal communication." (interviewee 8)*
P5: *Smart city managers' empowering capability positively affects smart city transformation.*	*"I think a lot of my work is about how we build the capabilities, the skills, how we make sure that when there's an opportunity, we can actually enable it and do something about it." (interviewee 15)*
P6: *Innovation readiness positively affects smart city transformation.*	*"We are looking to foster a lab environment in the district so that we can encourage these experiments and socialize the idea of innovation in government and become a leading innovative city." (interviewee 40)*
P7: *Resource readiness positively affects smart city transformation.*	*"To have digital IT development-related projects… money and smart decisions related to money are absolutely vital [for smart city development]". (interviewee 27)*
P8: *A participatory and collaborative mindset positively affects smart city transformation.*	*"We are serviced by vendors who help support our infrastructure, whether that be the telephone systems or the radio systems. So then, as you move up the scale and into how we deliver services, there are times where we use third parties to help us deliver services, whether that's ecology with contracting with garbage services and that sort of thing… I would say, really, they're not contractors, they're our partners, and with these programs around innovation that are probably the biggest catalyst." (interviewee 13)*
P9: *Strategic readiness positively affects smart city transformation.*	*"I think the most important challenge really is the adoption of the strategy… What we're trying to do here is develop a strategy that is city needs-led and demand-driven, which means… a people's smart city." (interviewee 38)*
P10: *Dynamic managerial capabilities and organizational readiness are positively correlated.*	*"When I refer to smart city, or rather to digitalization, on the one hand it's a matter of setting up the administration in digital form internally. On the other hand, it's a matter of preparing the city ecosystem for the digitalization… However, I face three challenges in particular. One is the administration's culture, in which people are creatures of habit and struggle to embrace change. The second one is the legal aspect, meaning what is allowed or not, and the last one is the technical aspect regarding how things can be done, and data can be accessed." (interviewee 20)*

know that in Greenwich and in Milton Keynes, they're doing a lot of work on smart driverless cars, that kind of stuff. We're not doing that. I don't think we've got the right city environment to be able to do that … Let them crack on with that, and we will learn from them and pop in at the point where they have whatever conclusion, they're competent and we can perhaps look to adopt that here in the future.
(interviewee 38)

To identify and prioritize projects to be undertaken in their cities, smart city managers use their formal and informal networks and work closely with various stakeholders. One interviewee stated that:

> We have a group of stakeholders who represent government, academia, industry, and the community. We ran a series of workshops both within the organization and with external stakeholders to understand and identify what technology might mean for us as a city.
> (interviewee 22)

As noted by interviewee 22, also using new and innovative technologies such as the Internet of Things (IoT), sensor systems, geospatial technology, or big data analytics that provide the technical framework to implement smart city projects can be a solution to the challenges that arise. Identifying these technologies forms part of smart city managers' sensing capability:

> I look at what solutions are out there, which challenges we face as an organization, see where technology can help toward these.
> (interviewee 34)

4.1.2. Seizing capability

A second dynamic capability we identified in the interview data is the *seizing capability*, which reflects smart city managers' abilities to act on and pursue opportunities. All smart city makers emphasized the need for entrepreneurial thinking so as to exploit and seize new opportunities. In the smart city context, this includes the initiation and implementation of smart city programs and related smart city projects that focus on creating public value:

> Every year we get to decide which projects we want to do that will create the most value, or where we see technology addressing or delivering the most value. We do projects across themes, like mobility, energy efficiency, environmental controls, citizen engagement, and digital services, but it is more of an internal transformation that needs to happen.
> (interviewee 17)

IoT, open data, smart grids, smart street lighting, chatbots, or communication platforms are also among the most frequently mentioned projects in our data. In this context, smart city managers' ability to integrate

and upscale individual technologies that have been successfully tested in a particular smart city project were often addressed in the interviews. Thus, new projects must be realized and new solutions need to be integrated into a city administration's daily activities. Realizing new opportunities is critical to ensure the future development of a city, and agility and speed are required to execute smart city projects:

> We lean a lot on the concept of windows of opportunity. We have a strategy, but we have learned that the world changes very quickly and the strategy is there, but we need to take advantage of the small windows of opportunity that appear from time to time. So, I think we are an agile team, and we try to grasp opportunities as they come.
>
> (interviewee 33)

In our interview data, the seizing capability in the smart city context further includes the value creation from digitally and administratively collected data. Our data reveals that smart city managers either get the administration itself to generate new services from the data or open the data to other actors, such as startups, to stimulate innovation and foster transparency.

> My first task was to draw up a digital strategy and now to coordinate its implementation and ensure following up on this strategy. Also, I personally am also piloting certain projects […] For example, we have created a digital platform where citizens can interact with others in the city, give feedback and personal opinions.
>
> (interviewee 3)

4.1.3. Innovation capability

Our data analysis revealed that almost all the participants consider *innovation capability* to be a dynamic capability that is necessary to drive innovation and creativity in a city. Innovation capability is closely linked to the interrogation of existing standards, rules, and beliefs, breaking with the past, and coming up with new ideas as well as trying new approaches and creating new perspectives. In sum, innovation capability refers to smart city managers' abilities to rethink the ways public administrations work. As a smart city manager noted:

> You need to rethink your own working process at the municipality.
>
> (interviewee 32)

The analysis of the interview data reveals that the improvement of existing processes and services as well as the development of new processes and service models, the adoption of new and innovative technologies that are user-friendly, resource-efficient, and scalable are key components of smart city managers' innovation capability:

> We are changing the experience of interacting with the government and making sure that services are readily available and in the quickest, simplest possible way to citizens.
>
> (interviewee 14)

> We have got a project at the moment that is just rationalizing the cemetery service. What that is designed to do is reduce the number of forms that people wishing to have people buried or cremated fill out.
>
> (interviewee 23)

Often mentioned in the interviews were the implementation of a single touchpoint and 24/7 services, the introduction of end-to-end process design from the user perspective, as well as simplifying, digitalization, automation, eliminating silos, and ensuring the flow of data across departments and agencies. Smart city managers seek to create an innovation-friendly city environment. Common topics frequently mentioned in this context are the provision of open data for innovation, the creation of innovation hubs, the adoption of innovation-friendly regulations, and the anchoring of a culture that is favorable to innovation. The following quote illustrates how diverse smart city managers' responsibilities are in driving innovation:

> My role includes the initiation of ideas and concepts for smart city projects in our city, such as innovation funds, an innovation box, innovation fellowships, among others, in collaboration with other departments.
>
> (interviewee 41)

4.1.4. Integrative capability

Prominent themes in our data are: coordinating and harmonizing various smart city activities, projects, and programs, creating platforms to promote cooperation with private companies, universities or other cities, the inclusion of new technologies and data across departments, fostering citizens' involvement in the design of smart services, and the horizontal and vertical integration of departments and agencies in a smart city transformation. We call this *integrative capability*, the importance of which two smart city managers describe as follows:

> We decided to adopt a completely integrative approach to drive the overall smart city development.
>
> (interviewee 1)

> We are the ones who coordinate the digital transformation, we are the ones who give insights. We are the ones who need to have a vision.
>
> (interviewee 27)

Integrative capability plays a key role in a city's development, since it is necessary to establish alliances and cooperation with various actors. As highlighted by interviewee 17, *"[in the smart city context] innovation only happens through collaboration."* Our data shows that integrative capability and related negotiation and mediation skills bring together different internal and external actors and initiate and promote sustainable partnerships with the aim of building a smart city ecosystem. This is illustrated by the following quotes:

> My duty is heading this whole team so that there are of course a lot of these kind of management duties, and discussing and negotiating with various stakeholders, and keeping also the relationship not just at the city level, national level, but also international level.
>
> (interviewee 37)

> Every actor in the context of the smart and digital city who has some product, who has some idea, who wants to sell us something or enter into some kind of cooperation with us, who wants to submit a project together with us or set up a joint venture or make a public-private partnership, who, so to speak, will first land on my desk.
>
> (interviewee 21)

As interviewee 28 points out, a collaborative approach is particularly necessary to address challenges for which no simple solution exists:

> There's a bunch of wicked challenges, as in any city, and that's increasingly the solutions are equally complex and non-obvious, and no one individual organization or one individual method is going to come up with adequate solutions.
>
> (interviewee 28)

4.1.5. Empowering capability

Empowering capability is the last dynamic capability evident in the interview data. It refers to smart city managers' abilities to empower different actors involved in or affected by a city transformation. In the interviews, empowerment refers to both actors in the administration (civil servants), regardless of whether or not they are involved in the smart city projects, and to external actors (almost exclusively citizens and businesses). Concerning the former, smart city managers emphasize the need to begin empowering within the city administration:

> We need to first look within ourselves and to make sure that we support our staff and our teams in this change in culture. It will make and/or break the success of the implementation.
>
> (interviewee 15)

> So, we are currently working on implementing the governance structure. So, getting a really sound governance structure in place and having people understand their role and their value added to the process.
>
> (interviewee 25)

Empowering public servants is important for smart city transformation, because they should not just passively participate in or even oppose a transformation process, but should actively support and contribute to it. They see their role in empowerment not in telling others what to do, but in advising them in the transformation process:

> I saw it as my role to empower other departments, not tell them what to do, but to work with them and have us honestly provide a lot of digital support services.
>
> (interviewee 35)

A second group of actors in our data are citizens and businesses. We found that smart city managers inform citizens and businesses about smart city projects, raise awareness about related services offered to them, and facilitate their access to these services:

> We have different initiatives, different activities to create awareness in the service, on the importance of the smart city projects and of the integration of data, analytics, and so on.
>
> (interviewee 29)

Smart city managers also encourage the citizens and businesses to become involved in the transformation of their city by participating in individual smart city projects, expressing their wishes and preferences, providing feedback on existing services or contributing to the design of new ones. A smart city manager states:

> I try to give people certain topics for action, certain options for action, so that they can act accordingly themselves. And this is certainly something they only learn when they themselves get involved in such projects, then no project is imposed on anyone, but they are part of the project, and this helps.
>
> (interviewee 20)

4.2. City administrations' organizational readiness for smart city transformation

4.2.1. Innovation readiness

The interview data reveals that a city administration's readiness for smart city transformation is predominantly determined by its general attitude to change. We label this *innovation readiness*. We found consensus among the interviewees that becoming a smart city means that the city administration must be open to new ideas and to doing things differently. An interviewee puts it:

> There are many people who want to continue doing work in a way that they know works. But we need to be innovative and we need to catch up in a big way because technology has really driven a lot of change, especially in the way that our citizens are expecting services to be delivered.
>
> (interviewee 15)

A recurring theme in the data related to innovation readiness is a city government's ability to take risks and to have a culture of dealing with mistakes. Yet "governments and bureaucracies are fairly risk-averse." (interviewee 15). Two interviewees support this:

> People need to have the courage to try things out, to take risks, but to also declare them as a pilot project that can also fail, so I think this culture of making mistakes is perhaps something that is still too little developed in the administration.
>
> (interviewee 8)

> That there's a leadership group who is willing to take risks, willing to experiment, and willing to see things tested but failed. I thought that it's very difficult in a political environment to invest public money into a project that has failed. That's not often accepted well by leadership or politicians. So, we're leaning to go for the safe option, and the safe option is very rarely the solution you're looking for.
>
> (interviewee 28)

Smart city managers share the view that risk-aversion limits innovation. A positive and open mindset in a city administration to innovation is seen as necessary for smart city transformation. Our analysis shows that the readiness to innovate relates to the need to overcome fears and increase the acceptance of change in city administrations:

> We have to take away people's fear of the transformation, because there are many who deal with this issue every day, who live in their own world and perhaps have fears and anxieties, and they may also build up resistance to these changes, and we have to take away these fears and enable our organization to be ready for new models, for new ways to create value.
>
> (interviewee 1)

The smart city managers also emphasize that innovation readiness requires a city administration to be flexible on a cultural level (i.e. by allowing its organizational culture to evolve toward data-driven, citizen-oriented innovation), on an operational level (i.e. by encouraging swift execution of projects and learning from failures), and on a structural level (i.e. by creating innovation teams and becoming an agile institution). For instance, interviewee 3 explains that:

> I'm not sure if anyone could have predicted ten years ago what is possible today, and from that point of view it is simply also important that we create structures to be able to react to such things. […] Organizations should become more agile and especially city administrations.
>
> (interviewee 3)

Our analysis also shows that city administrations must set up the necessary infrastructure such as innovation hubs, incubators, testbeds, and so on, to encourage innovation. Such infrastructure can further help *"consult the population when developing the city's services to better meet the needs of the population."* (interviewee 7).

4.2.2. Resource readiness

Resource readiness is the second organizational factor we identified in our data. There is a shared understanding among the interviewees that smart city transformation requires "an administration that can provide resources for transformation in addition to day-to-day business," since "digital transformation is largely determined by the available resources." (interviewee 1). These resources include, above all, the technical infrastructure that enables a smart city transformation and forms its foundation. Smart city managers pointed out that they will foster development and improve services "once the technological infrastructure is in place, meaning when the city has access to the technologies that will also enable this." (interviewee 15). Our analysis shows that resource readiness further encompasses flexibility concerning financial resources. Access to funding from inside and outside a city administration as well as budget allocation flexibility provide a sound monetary basis for smart city transformation:

> But we are not a super-wealthy city, so financial resources are harder to come by.
>
> (interviewee 25)

Our analysis reveals that a city administration's readiness for smart city transformation also depends on whether it has human capacity:

> If I got a lot more money today, I wouldn't know what to do with it, because I also need the human capacity to pursue all these projects. (interviewee 2)

Our analysis indicates that city administrations require various skills and competencies, including technical skills for understanding, analyzing, and harnessing the data collected from innovative sensors and IoT technologies, but also project management skills, soft skills (e.g. teamwork, multidisciplinarity), digital literacy, and an openness to ongoing learning. For instance, a smart city manager emphasizes technical and ethical skills:

> We also require data scientists and data ethicists. These skills are very hard to get from the private sector. We have to train them. (interviewee 23)

Another smart city manager points out the required analytical and social skills:

> So, you need good analytical and social skills. I think what is very important, especially regarding innovation in the city, is transparency toward the citizens and the parties involved. We need someone who is able to talk, for example, with regular citizens or with companies, and who is social, and at the same time knows what kind of information and expertise one can get from where. (interviewee 32)

4.2.3. A participatory and collaborative mindset

Our data shows that appreciating and incorporating stakeholders' ideas and expertise as well as partnering and cooperating with them is critical for a city administration's organizational readiness. We call this *a participatory and collaborative mindset*. Participation emphasizes the importance of involving internal and external actors and their ideas and expertise in a city's transformation process. For instance, interviewee 31 describes how they promote citizen participation:

> We have an online platform for citizen participation that also allows the inhabitants, the citizens, to be in contact with the city. They can either react to projects that are subject to consultation or propose their own initiatives. We also have an online participatory budget, so people can propose projects, which are then submitted to the citizens ' vote to find out which ones will be selected. (interviewee 31)

Our data reveal that a collaborative mindset is reflected in the capacity to establish cooperation and partnerships with companies and universities, or the ability to collaborate with other smart cities. The following quotes illustrate such collaboration with external actors:

> Cities need to join forces with other cities, with other partners, because you can't do it alone. You actually need all the important players in a city and beyond to connect and exchange experiences and learn from one another. (interviewee 9)

> We work very closely with universities. We've done lots of funding with them on smart cities and start to look at AI and machine learning from an IoT perspective and we've also put in some bids around 5G technology as well. (interviewee 34)

A collaborative mindset is further reflected by a city administration's capacity to facilitate communication and collaboration between departments and to overcome the silo mentality. Interviewee 21 points out the importance of cooperation with internal actors:

> It needs much more cross-sectoral integration, so to speak, because this city is still very monarchy-like in its sectors and silos and the different sectors simply cooperate very little. But that's where the future lies. (interviewee 21)

4.2.4. Strategic readiness

Finally, a city administration's readiness for smart city transformation includes *strategic readiness*. We identified two common themes: the existence of a clear smart city vision and the strategic fit with pre-existing political priorities. A clear smart city vision and a defined strategy is required among others "to gain credibility" (interviewee 39), "to identify fields of action" (interviewee 33), "to identify projects" (interviewee 39), to "develop a strategy that is needs-led and demand-driven" (interviewee 39), to create a "common understanding" (interviewee 28) with partners, "to get support at a leadership level to make the change" (interviewee 13) and "in order to improve, kind of beautify, how the city approaches the challenges" it faces (interviewee 25). Further, strategic readiness relies on smart city initiatives and projects fitting the political agenda and being consistent with the political elite's vision and goals. We call this strategic fit, and it is illustrated in the following quote:

> The target of our work is really in line with the mayor's initiatives, which are housing, homelessness, clean streets, and mental health. (interviewee 13)

Another smart city manager affirms that:

> It was important that the issue of digitalization be anchored in the new strategy, and the politicians have decided, as one of five key points, to include smart city in this overall policy strategy 2030. (interviewee 11)

5. Toward a theoretical capability framework of smart city transformation

In this section, we integrate and synthesize our findings (as described above) with the literature and propose a capability framework for smart city transformation (see Fig. 3). We present representative interview quotations that support our framework's propositions in Table 1, while Table A.2 (see the Appendix) provides quotations that illustrate the dynamism of a smart city transformation.

Smart city transformation is a challenging and ongoing process. As shown in Table A.2, for smart city managers, becoming smart means "*to evolve as a city*" (interviewee 38), "*to improve the city*" (interviewee 14), "*optimizing the value creation process*" (interviewee 1), "*to be more efficient*" (interviewee 29), "*to be close to citizens*" (interviewee 8), "*to maintain and further expand equal opportunities and our high quality of life, to promote the sustainable development of our city, and to position it as a location for innovation and business*" (interviewee 40), and to "*become a globally leading, resilient, future-ready, and equitable city.*" (interviewee 15). To do so, smart city managers "*keep looking for problems and… keep dealing with them.*" (interviewee 24). Smart city transformation implies continual improvement, i.e. the city's services, processes, competencies, or technologies are constantly adapted to the new expectations and demands of citizens and businesses. From this perspective, our analysis implies that a *smart city* is a goal direction that is never reached, but continually aspired to and worked toward. This understanding of smart city transformation is in line with the different conceptualizations of smart city that emphasize continual optimization, improvement, or enhancement of citizens' services, processes, participation, environmental sustainability, efficiency, and quality of life in a city in order to become more attractive and competitive (see, for example, Albino et al., 2015; Caragliu et al., 2011; Chen, 2010; Giffinger et al., 2007; Hall, 2000; Nicolas et al., 2020; Yigitcanlar et al., 2018).

Smart city managers' dynamic managerial capabilities and a city government's organizational readiness form two pillars of smart city transformation. In line with the dynamic capabilities perspective (Helfat et al., 2007; Teece et al., 1997), our framework proposes that smart city managers' capabilities around sensing, seizing, innovating, integrating, and empowering are necessary for city administrations to drive smart city transformation. Our analysis provides empirical support that these capabilities positively affect smart city transformation (P1 to P5). Specifically, *sensing capability* is needed to scan a city's external environment, analyze diverse information, and interpret the technological and societal developments. Smart city managers need *seizing capability* to exploit the potentials of new and innovative technologies, adopt innovative smart city projects, respond to citizens' existing needs, better utilize the collected digital and administrative data, remain agile in the implementation of smart city programs, and generate additional services based on data.

As highlighted in the previous section, smart city managers further require *innovation capability* in order to design innovative digital processes, establish citizen-oriented services, and design new service delivery models, test and experiment with groundbreaking technologies, initiate and implement innovation hubs, create an innovative city environment for startups, anchor change and an innovation-oriented culture in the city administration, and continually adapt to the internal and external environments.

Integrative capability of smart city managers allows them to coordinate and harmonize different smart city activities, mediate between actors, combat the silo mentality in a city administration, and include the needs and expectations of citizens and other actors. Our study further revealed that they require *empowering capability* to facilitate and encourage citizens and other public servants to get involved in a smart city transformation, and to form a local ecosystem that includes multiple stakeholders.

Moving toward organizational readiness, studies emphasize that organizational readiness is critical to adapt to a changing environment (Damanpour, 1991; Lehman et al., 2002; Lokuge et al., 2019; Weiner, 2009). We find supporting evidence that a city administration's organizational readiness positively affects smart city transformation – thus, it is our framework's second pillar (P6 to P9). Specifically, our data indicates that a city administration's *innovation readiness* is needed so that new ideas can unfold, new technologies can be experimented with, and new approaches can be tried. Our data reveals that cities are taking a systematic approach and are building innovation units and creating an innovative environment, all of which positively impact on smart city transformation. Further, smart city transformation requires that a city acquire or train the right (soft and/or hard) skills and competencies, to build a modern IT infrastructure, and to provide adequate financial support to initiate and implement smart city projects. Our analysis showed that *resource readiness* – a city administration's ability to flexibly use human, technical, and financial resources – is widely recognized as a necessary foundation for handling a city transformation's challenges. Our analysis also highlights the importance of *a participatory and collaborative mindset* in a city administration, since no one actor alone can successfully drive the transformation. Smart city transformation requires collaboration among and participation by the internal actors (e.g. the different departments and employees) and the external actors (e.g. citizens, companies, and research institutes). Building and nurturing partnerships and alliances from the ideation to the implementation of smart city initiatives contributes to a better understanding of needs and expectations, brings together different competencies, promotes knowledge exchange, connects actors, and builds a smart city community that agrees on the transformation's goals and addresses them together. Finally, since the various actors involved in smart cities attribute different meanings to the overall city concept (Giovanni et al., 2021), having a clear smart city vision with concrete strategic goals and a roadmap is critical, so as to create a shared understanding among all the involved actors of the reasons for, the goals of, and the action plan of a smart city transformation. In this way, *strategic readiness* helps in the sensemaking phase, reduces uncertainty, and creates coherence. It also forms the legitimacy basis for smart city initiatives by putting the smart city on the political agenda (Frischknecht et al., 2020).

Based on our analysis, we propose that there are interplays between smart city managers' dynamic capabilities and a smart city administration's organizational readiness (P10). The facilitating and constraining interplays between organizational capacities and managerial capabilities are well known in the literature (Adner & Helfat, 2003; Helfat et al., 2007; Helfat & Martin, 2015; Ridder et al., 2007; Teece, 2007), and are also evident in our data. On the one hand, smart city managers' sensing, seizing, innovating, integrating, and empowering capabilities contribute to a city administration's capacity for smart city transformation. Through their work, they strengthen a city administration's ability to develop smart city policies, to be open, inclusive, and collaborative, and to work with individuals and organizations on challenges and appropriate solutions to bring innovation and improvements into the city. On the other hand, smart city managers' activities are embedded in and influenced by a city administration's organizational context. While strategic and resource readiness facilitates the move toward change and necessary adaptations, an innovation-resistant and siloed city administration hinders smart city managers' efforts.

In sum, the proposed framework reveals the significance of managerial capabilities and organizational capacities for smart city transformation and clarifies their interplays.

6. Discussion and conclusion

This study expands the understanding of which dynamic managerial capabilities smart city managers require and which organizational capacities city administrations require for smart city transformation. Analyzing the interviews with smart city managers allowed us to identify a wide range of factors, all of which are perceived as prerequisites for a smart city transformation. Our study makes theoretical contributions and has implications for research and practice.

6.1. Theoretical contributions

This study contributes to the theory development of the smart city concept in three ways:

First, we contribute to recent research that has begun to sharpen the focus on dynamic capabilities that are relevant in highly dynamic environments such as cities (Chong et al., 2018; Gupta et al., 2015; Nicolas et al., 2020). Our study goes beyond existing reflections, identifying sets of practices of five distinct dynamic managerial capabilities that support cities' transformation toward more service orientation, citizens' participation, sustainability, and increased competitiveness and attractiveness.

We extend Teece et al.'s (1997) framework of sensing, seizing, and transforming by providing a more nuanced view of the dynamic capabilities in the smart city context. This is particularly evident when looking at the practices set to strategically shape smart city transformation. We highlight the various capabilities required of smart city managers, which go beyond everyday routines or best practices, confirming and further refining existing factors and identifying entirely new capabilities, such as the empowering capability, which becomes more relevant owing to the specifics of the smart city context. As our results show, this capability is particularly important, because the achievement of smart city objectives such as sustainable urban development or modernization of public administrations also rely on the participation and capabilities of other key stakeholders. Overall, we contribute to the discussion on dynamic capabilities in the literature by demonstrating that dynamic managerial capabilities of smart city managers are crucial for smart city transformation.

Second, we empirically demonstrate city governments' organizational readiness and its role in smart city transformation, contributing to

both the smart city literature and the broader literature on public sector development. We derived 23 organizational readiness factors for city government in four broad categories that conceptualize organizational readiness for smart city transformation. Thus, our analysis contributes to the research by elucidating the links between city government readiness and smart city transformation. Organizational readiness indicates whether an organization has the necessary basis for innovation and change (Armenakis et al., 1993; Lehman et al., 2002; Lokuge et al., 2019). We show that this is an integral part of transformation efforts and argue that it also requires special attention in smart city transformation. Our conceptualization of organizational readiness provides relevant factors and indicators to better understand and assess what smart city transformation requires. We provide an empirical basis for theory-building to develop factors for smart city transformation. These factors and illustrative indicators can also serve as a blueprint for deriving organizational readiness factors for research on other (digital) change processes and projects in the public sector. Thus, our findings also serve as a descriptive basis for further research into development in the public sector. In general, we hold that research into organizational readiness can help us to better understand the difficulties of development and provide the necessary organizational adaptations.

Third, our study proposes a theoretical framework model by integrating a city administration's organizational readiness and smart city managers' dynamic capabilities and linking them to smart city transformation. Our findings confirm these factors' strategic roles in the smart city transformation process. To become smart, city administrations must make the necessary preparations relating to strategy, technology, human resources, processes, customer orientation, or partnership – so that they are ready. While organizational readiness provides a solid basis for smart city transformation, smart city managers' dynamic capabilities are required to adopt to the changing environment and to drive the transformation. Our results suggest that both aspects strongly interact and reinforce each other. Overall, our study indicates that smart city transformation relies on both organizational capacities and managerial capabilities.

6.2. Practical implications

The dynamic capabilities we identified can help smart city managers to understand which skills and competencies they need to keep their city on the development path toward a smart city. They can use our framework to challenge and improve their current practices as well as to identify whether they lack specific competencies that support smart city transformation. In this regard, our framework can also be considered for recruiting smart city managers, since it clarifies the skills they require in order to fulfill their roles and responsibilities.

Further, we hold that understanding the dynamic managerial capabilities and organizational readiness must form an integral part of the curriculum for public servants, since it defines a set of organizational and managerial requirements for smart city transformation.

Our framework also draws smart city managers' attention to city governments' organizational readiness, which affects both their work and smart city transformation. Strategic transformation toward a smart city can only be implemented as quickly as the capacity and capabilities of a city administration allow. Especially when a city administration's organizational readiness is low, smart city managers will need to invest significant efforts into creating the necessary organizational conditions. They should be aware that a city government's organizational readiness also impacts on their work. Some interviewees noted that their initiatives often struggle or even fail because a city administration's organizational readiness is very low and much work is needed to build it in the first place. By conceptualizing organizational readiness for smart city transformation, we provide relevant factors and indicators to better understand and evaluate action fields for developing a city administration's readiness for smart city transformation. Based on our results, decision-makers in public administration can conduct readiness assessments and can reflect on and adapt to specific organizational needs. Based on this, they can derive concrete measures for smart city transformation. Our results can help create a more solid foundation for smart city initiatives and urban development.

6.3. Limitations and directions for future research

While our understanding of dynamic managerial capabilities and organizational readiness as well as their interplays in smart city transformation processes is far from complete, we provide first insights in this research field. Some issues were not addressed, which offer opportunities for future research. We will now describe three study limitations and suggest some avenues for future research.

First, we sought to advance the research into management's role in smart city transformation process. However, we did not integrate managerial decisions into our model. Dynamic managerial capabilities are applied by smart city managers to achieve desired outcomes. However, we did not analyze how these capabilities are applied and which capabilities are perceived to be critical for the transformation process from smart city managers' perspective. The concept of dynamic managerial capabilities could help to explain differences in managerial decisions. Further, since managerial decisions operate on an organization's capacity base, i.e. its resources and capabilities (Adner & Helfat, 2003), differences between smart city administrations' organizational readiness likely lead to differences in smart city managers' decisions. To include greater attention to smart city managers' roles in smart city transformation, it will be of great interest to investigate which capabilities smart city managers apply in which ways and with what outcomes, depending on the organizational resources and capabilities available to them.

Second, we did not consider any of the following elements, which are considered decisive for understanding dynamic managerial capabilities. The managerial capabilities literature (see, Helfat & Martin, 2015; Teece, 2016) focuses on three core underpinnings of dynamic managerial capabilities: (1) managerial cognition, which structures and guides decision-making; (2) managerial social capital, which is seen as vital for an organization's access to information and resources; and (3) managerial human capital – as managers' past experience, skills, and knowledge – assist them in their dynamic capabilities. A number of strategic management studies provide empirical evidence that differences in managerial cognition, managerial social capital, and managerial human capital are associated with differences in strategic decisions (see for an overview, Helfat & Martin, 2015). Smart city managers also have different backgrounds and expertise, or rely on different information. Less experienced smart city managers may not have the same capabilities and knowledge to manage the smart city transformation process as experienced smart city managers. Thus, owing to differences in the core underpinnings of dynamic capabilities, smart city managers are likely to differ in their strategic decisions. We trust that studies on these elements will provide a more complete understanding of smart city managers' capabilities and activities in making their cities and their services smarter.

Third, we focused on smart city managers. However, smart city transformation cannot be achieved by one person alone. It depends on and is influenced by other actors and factors. For instance, smart city transformation requires teamwork and various capabilities, which any one person is unlikely to possess. Thus, city administrations require a combination of different competences and skills (e.g. technical, conceptual, and analytical) in order to implement a smart city transformation process. We focused on one smart city manager per city, while other public servants also work on projects related to smart city managers, such as CIOs implementing digitalization projects. By focusing on organizational readiness, we considered this and emphasized that skilled employees are needed as an organizational resource in order to be ready for a smart city transformation. However, our results only show the tip of the iceberg. Further, smart cities are collaborative ecosystems,

where not only governments but also universities and industries (triple helix structure) (Leydesdorff & Deakin, 2011) as well as citizens and civil society organizations (quadruple helix structure) are involved and work together to drive smart city transformation (Mora, Deakin, & Reid, 2019). For a smart city transformation to be successful, these urban stakeholders must also be integrated. We show that smart city managers' integrative capabilities have a critical role in this process. However, we did not explore how smart city managers interact with the various urban stakeholders and how they involve them in smart city transformation. These facets remain to be explored in future studies. Also, smart city transformation and thus both organizational readiness and dynamic capabilities are further influenced by contextual factors, such as a city's size or the regime type (Meijer et al., 2016); these could be included in future research.

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CRediT authorship contribution statement

Ali Asker Guenduez: Conceptualization, Supervision, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. **Ines Mergel:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

Table A.1
List of the participating smart city managers.

City/Region	Interviewee's official title	Language	Duration	Medium
Boston	Chief Digital Officer	English	44 min	Google Meet
San Francisco	Chief Information Officer	English	50 min	Skype
Singapore	Government Chief Digital Technology Officer	English	44 min	Skype
Washington	Chief Technology Officer	English	45 min	WebEx
Toronto	Smart City Manager	English	43 min	WebEx
Dublin	Smart Dublin Lead	English	68 min	Skype
Estonia	Global affairs director	English	74 min	Zoom
Auckland	Head, Innovation	English	45 min	Skype
Zurich	Head, Smart City	German	35 min	Phone
Vienna	Head, Smart City	German	36 min	Phone
Taipei	Lead Taipei Smart City Management Office	English	52 min	Skype
Geneva (canton)	Head, Information Systems and Digital	French	65 min	Phone
Wellington	City Innovation Lead	English	54 min	Skype
Hong Kong	Chief System Manger	English	30 min	Skype
Zug	Project Manager Smart City	German	67 min	Phone
Bern	*E*-Government Lead	German	69 min	Phone
Philadelphia	Smart City Director	English	38 min	Phone
Heidelberg	Head, Mayor's Department	German	54 min	Phone
Tampere	Director, Smart Tampere Program	English	66 min	Skype
Stuttgart	Head, ICT Department	German	46 min	Phone
Nice	Director, project Smart City	French	146 min	Phone
The Hague	Chief Information Officer	English	66 min	Phone
Lausanne	Head of Digital Transformation Department	French	56 min	Phone
Bradford	Head of Enterprise Architecture and Information Services	English	46 min	Phone
Winterthur	Head, Smart City	German	59 min	Face-to-face
Region of Brussels	Smart City Manager	French	85 min	Skype
Ulm	Head, Digitalization Office	German	49 min	Phone
Leeds	Smart City Lead	English	65 min	Skype
Uster	Chief Digital Officer	German	71 min	Face-to-face
Finland-Eastland	Head, Smart City Finland-Eastland	English	32 min	Skype
Karlsruhe	Head, IT Department	German	53 min	Phone
Belfast	City Innovation Lead	English	63 min	Skype
St. Gallen	Chief Digital Officer	German	69 min	Face-to-face
Lisbon	Director, Lisbon Urban Management and Intelligence Center	English	38 min	Phone
Zaragoza	Smart City Program Manager	English	51 min	Skype
Geneva	Head of IT	French	45 min	Phone
Leicester	Head, Smart City	English	70 min	Skype
Region Rhein-Neckar	Head, Digitalization and E-Government	German	48 min	Phone
Strasbourg	Director, Project Digital Transformation	French	51 min	Phone
Baden	Head, Digital Management	German	49 min	Phone

Table A.2
Representative quotations for smart city transformation objectives.

"We've always got to evolve as a city. You could say we've always had to be smart. That's just today's buzzword, I think, and it will continue. New technology will come on in ten years' time. I don't think we're going to say that's it, the job's done, we are now a smart city because something new will be around the corner, and we'll be saying how can we improve it even further. We've got different challenges. We'll have to look at how we can address those challenges in the future. So yeah, that's what I want to tell you." (interviewee 38)
"We want to continue to be the city with the highest quality of life in the world, but in a more or less CO^2-free city, meaning we want to be an environmental model city that gives people the highest quality of life, and this will probably work in the future with the use of a great deal of innovation and a great deal of digitalization, this is our vision for the future." (interviewee 21)
"We want to be close to citizens, we see ourselves as a service provider and organize the processes as efficiently as possible, also for citizens, so that they do not have to queue somewhere for hours, but that they also have other channels to interact with the city administration." (interviewee 8)
"We try to become more efficient by using this aided decision-making by AI or machine learning." (interviewee 27)
"I can tell you that we have a strong interest in optimizing the value creation process behind a public service, focusing on the question of how customers actually perceive such a service, what kind of journey they have, what they want at all, what do they want and where, and that we can work on the maturity of our digital services so that we can develop and improve them." (interviewee 1)
"Our vision is to become a globally leading, resilient, future-ready, and equitable city, our smart city." (interviewee 15)
"Our goal through the digital transformation is to maintain and further expand equal opportunities and our high quality of life, to promote the sustainable development of our city and to position it as a location for innovation and business." (interviewee 40)
"We need to be a smart city. We need to be more efficient, because the resources that we have are scarce. We need to be more proactive and use these resources better." (interviewee 29)
"It's constantly iterating their processes, so not kind of being stagnant, thinking that as long as this process works, we're not going to adjust it, but instead to constantly rethink the process based on the continuous data we're collecting." (interviewee 25)
"What we do is we keep looking for problems and… we'll keep dealing with them." (interviewee 24)
"We do extensive user testing in everything we launch. As we launch [a new service], we get feedback, we keep taking it to a point where it gets better with every single release… We just want to keep listening and figuring out what's the best way to affect our stakeholders, whether it's employees, whether it's citizens, whether it's the community, as we engender all the things we find to improve the city." (interviewee 14)

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