Digital Transformation Strategies

Theoretical Foundations and Empirical Investigations

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Foreword

In the last years, our lives are lived more and more digital giving rise to the need of digital services and processes in work and private life domains. However, the question of where to start while enabling digital processes and services is still ubiquitous. With the rise of mobile technologies enabling individuals to work anywhere at any time, organizations had to adapt to new challenges and chances of digital transformation processes. To organize, structure and implement digital transformation processes, digital transformation strategies are an important mechanism. However, there is a significant theoretical and empirical gap in terms of how these strategies are developed and implemented for individuals and organizations. Kristina Lemmer addresses this gap and provides a striking piece of research that offers theory-driven foundations and the results of several empirical studies investigating digital transformation strategies for individuals and organizations.

This thesis is unique in many ways. It identifies digital transformation strategies for the individual and for organizations defining i.e., IT-related Boundary Tactics for the individual, structural features of digital transformation strategies for organizations, and IT-governance structures to support digital transformation processes in small-medium enterprises based on CEOs competences. Her results allow future research to investigate contemporary and emerging phenomena such as issues related to Artificial Intelligence and the transgressive use of technology. Methodological, Kristina Lemmer´s thesis combines well established approaches such as i.e., interviews, case studies, surveys, experiments, mixed method approaches and a longitudinal study. Scholars from related research areas, including management science, public sector research or psychology, can also benefit from these insights by using and adopting the results of this thesis for use in their domains. In addition, this thesis provides valuable insights and recommendations for action for practitioners, especially in public sector agencies.

Kristina Lemmer´s results contribute to a more sophisticated understanding of digital transformation strategies for the individual and organizations and is recommended to anyone who is interested in guidance in the digital age.

Siegen, October 2021 Prof. Dr. Dr. Björn Niehaves

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Abbreviations

AI	Artificial Intelligence
AIS	Association of Information Systems
AMCIS	American Conference on Information Systems
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
API	Application Programming Interface
BYOB	Bring Your Own Behavior
BYOD	Bring Your Own Device
CDO	Chief Digital Officer
CEO	Chief Executive Officer
CIO	Chief Information Officer
COLLA	International Conference on Advanced Collaborative Networks, Systems and Applications
COPE	Company Owned Personally Enabled
ECIS	European Conference on Information Systems
GIQ	Government Information Quarterly
GOPE	Governmentally Owned Personally Enabled
HICSS	Hawaii International Conference on Information Systems
IB	Innovation Behavior
ICIS	International Conference on Information Systems
IS	Information Systems
IT	Information Technology
MIS	Management Information Systems
PACIS	Pacific Asia Conference on Information Systems
PLS	Partial Least Square
PLS-PM	Partial Least Square Path Modeling
PMO	Project Management Office
RQ	Research Question
SC	Smart City
SEM	Structural Equation Modeling
SLR	Systematic Literature Review
SME	Small-medium enterprises
TAM	Technology Acceptance Model

TOE	Technology-Organization-Environment
UTAUT	Unified Theory of Acceptance and Use of Technology
WLC	Work-life Conflict

Part A

OVERVIEW

"Strategy without tactics is the slowest route to victory.
Tactics without strategy is the noise before defeat."

— Sun Tzu

1. Introduction

1.1. Digital Transformation Strategies

In 2020, the worldwide emergence of COVID-19 put pressure on individuals and organizations across the private and public sectors, especially governmental agencies, to digitally transform themselves (Datta & Nwankpa, 2021; Kumar et al., 2021). With lockdowns across Europe and the world, managers and employees were asked, whenever possible, to work from home. However, working from home was not a natural thing to do for many specific branches (i.e., health services, governmental agencies, or production companies). The normal life that we were used to, such as visiting theaters, zoos, and governmental agencies without an appointment or meeting friends, colleagues, or project partners, suddenly had to take place online. We were not yet completely ready to work and live virtually, resulting in added pressure on our society, space, and services.

How can we use this pressure as an opportunity for digital transformation (Mergel et al., 2019)? How can we digitally transform our work, lives, and surroundings? Luckily, we are all already transforming ourselves. Due to the emergence of consumer technologies (Gregory et al., 2018; Köffer, Anlauf, et al., 2015; Niehaves et al., 2012; Weeger et al., 2015), prior to the pandemic individuals were already available anywhere at any time due to the use of mobile devices at work and in their private lives, blurring the boundaries between the two domains.

By exploring several organizations, we noticed that the private and public sectors have taken on different digital transformation projects. However, governmentally agencies, in particular, have noticed that these projects often do not align with a common aim or goal and miss out on synergies across different transformation processes, thereby reducing their effectiveness and efficiency (Niehaves et al., 2019; Roeding et al., 2019c).

Aligning with previous research, this paper-based thesis strives to determine how we can support individuals and organizations within their individual digital transformation processes. According to Mergel et al. (2019), digital transformation processes as well as digital transformation strategies supporting transformation processes in private and public sector research have emerged over the last decade (Bharadwaj et al., 2013a; Hess et al., 2016a; Matt et al., 2015a; Meijer & Bolívar, 2016; Mergel et al., 2019; Mithas et al., 2013).

Although research on work–life conflict and digital transformation processes have gained increasing attention, previous research does not include various perspectives on the development and implementation of digital transformation strategies for individuals and organizations. Against this background, the overall objective of this paper-based thesis is the investigation of digital transformation strategies. Specifically, it seeks to provide a theoretical foundation to theorize, identify and conceptualize digital transformation strategies for individuals and organizations, providing an initial insight into specific contexts and methodologies for the implementation of digital transformation strategies.

1.2. Research Questions

With the emergence of consumer technologies (i.e., mobile devices such as laptops, smart phones, tablets), employees and citizens are available to work anywhere at any time (Gregory et al., 2018; Köffer, Anlauf, et al., 2015; Köffer, Ortbach, et al., 2015; Mokosch et al., 2015; Niehaves et al., 2012; Weeger et al., 2015), which gives rise to various challenges for individuals. Regarding the management of work and private life domains, when information systems are used, there is a need for strategies to cope with availability demands (Allen et al., 2014; Chesley, 2005; Cousins & Robey, 2015; Köffer, Anlauf, et al., 2015; Kreiner et al., 2009). Against this background, the first research question (RQ) focuses on understanding individuals' IT-related strategies and tactics to manage their boundaries between their work and their private lives (Jahn et al., 2016).

RQ 1: What kinds of IT-related strategies and tactics do individuals use to cope with the rising demands of digital transformation processes on their private and work lives?

A large amount of IS research focuses on strategies for information technology (IT), information systems (IS), and business purposes (Atkins & Lowe, 1994; Atkins et al., 2003; Shareef et al., 2012). During the last decade, digital transformation processes have become more important challenging organizations' IT and IS strategies. Due to the rise of mobile devices being used privately for work purposes and vice versa, organizations are forced to integrate this development into their own strategies and processes. Aligning to this background and the rising demand on digital transformation strategies (Bharadwaj et al., 2013b, 2013a; Hess et al., 2016; Matt et al., 2015; Mithas et al., 2013), this paper-based thesis is guided by the following second research question:

RQ2: How can the development process of digital transformation strategies for organizations (i.e., governmental agencies) be described?

Since RQ 1 and RQ 2 address the structure and concepts of digital transformation strategies for individuals and organizations, this thesis addresses special aspects of the implementation processes of digital transformation strategies. What do we need for the implementation of digital transformation processes? How can we implement new technologies such as artificial intelligence (AI)? And how does the role of organizations, especially governmental agencies, and cities in general, change due to digital transformation demands and pressures from external forces? Against this background, this thesis is guided by its third research question:

RQ3: How can the implementation of digital transformation strategies for individuals and organizations be supported?

1.3. Thesis Structure

This thesis, which is based on different research articles, is separated into two parts: part A and part B (c.f. Figure 1.1). Part A presents an overview of all research articles related to the proposed research questions. Part B includes all research articles in this thesis and covers 14 publications, which appear, have been accepted, or are currently under review in journals such as the Government Information Quarterly (GIQ) or Cities. 11 conference publications were presented at the International Conference on Information Systems (ICIS), European Conference on Information Systems (ECIS), American Conference on Information Systems (AMCIS), Hawaii International Conference on System Sciences (HICSS), Pacific Asia Conference on Information Systems (PACIS), Proceedings of the NeuroIS Retreat, and the International Conference on Advanced Collaborative Networks, Systems and Applications (COLLA) as well as book contributions such as chapters for “The Art of Structuring” or “Digitalization Cases II” published by Springer.

All articles are published, accepted or currently under review as shown in Table 1.1. The articles are listed in chronological order. Aligned with Klesel (2019), papers in this thesis have not been modified in terms of their content. However, to show consistency with heading numbers, and table and figure references, all papers were reformatted in part B (Klesel, 2019). Furthermore, papers in part B were all developed, written, and published at different times.

Consequently, those papers deviate in terms of terminology and wording (i.e., digital strategies (i.e., Roeding, 2019) expressing the same as digital transformation strategies (Weigel et al., 2020)) (Klesel, 2019).

#	Citation	VHB[a]	IF[b]
P1	Jahn, K., Klesel, M., Lemmer, K., Weigel, A., and Niehaves, B. (2016). *Individual Boundary Management: An Empirical Investigation on Technology-Related Tactics*, presented at the 20th Pacific Asia Conference on Information Systems, Chiayi, Taiwan. (published)	C	
P2	Klesel, M., Lemmer, K., Bretschneider, U., and Niehaves, B. (2017). *Transgressive Use of Technology*, presented at the 38th International Conference on Information Systems, Seoul, South, Korea. (published)	A	
P3	Niehaves B., Roeding[c] K., Oschinsky F. M. (2019). Structural Features of Digital Strategies for Municipalities. In: Bergener K., Räckers M., Stein A. (Hrgs.) *The Art of Structuring*. Springer, Cham, S. 427-437. Online ISBN: 978-3-030-06234-7, https://doi.org/10.1007/978-3-030-06234-7_40, https://www.link.springer.com. (published)	(-)	
P4	Jahn, K., Kordyaka, B., Ressing, C., Roeding[c], K., Niehaves, B. (2019). *Designing Self-Presence in Immersive Virtual Reality to Improve Cognitive Performance - A Research Proposal*. Proceedings of the NeuroIS Retreat 2019, Vienna, Austria. (published)	(-)	
P5	Roeding[c], K., Jahn, K., Niehaves, B. (2019). *Better Burning than Burning Out – A Laboratory Experiment on the Impact of Training Work Avoidance on Psychological Detachment and Perceived Strain.*, 25th American Conference on Information Systems. Cancún, México. (published)	D	
P6	Roeding[c], K. (2019). *Digital Strategies as a Guideline for Digital Transformation Processes in Municipalities – A Literature Review*. In: Proceedings the 9th International Conference on Advanced Collaborative Networks, Systems and Applications (COLLA 2019), Rome, Italy. (published)	(-)	
P7	Roeding[c], K., Oschinsky, F. M., Klein, H. C., Weigel, A. Niehaves, B. (2019). *Would you like to Participate? Stakeholder Involvement in the Development Process of Digital Strategies for Municipalities*. In: Proceedings the 9th International Conference on Advanced	(-)	

	Collaborative Networks, Systems and Applications (COLLA 2019), Rome, Italy. (published)		
P8	Roeding[c], K, Jahn, K., Weigel, A., Niehaves, B. (2019). *Individualized Design: The role of individual boundary preferences on technology acceptance and work-life conflict*. 23rd Pacific Asia Conference on Information Systems (PACIS 2019), Xi'an, China. (published)	C	
P9	Weigel, A., Heger, O., Hoffmann, J., Roeding[c], K. (2020). *CEOs of SMEs: How IT-Governance compensates the Lack of Digital Competencies*. Proceedings of the 28th European Conference on Information Systems (ECIS), Marrakesch, Marokko. (published)	B	
P10	Schaefer, C., Lemmer, K., Kret, S., Ylinen, M., Mikalef, P., Niehaves, B. (2021). *Truth or Dare? – How can we Influence the Adoption of Artificial Intelligence in Municipalities?* 54th Hawaii International Conference on System Sciences (HICSS-54), Koloa, Hawaii. (published)	C	
P11	Schaefer, C., Lemmer, K., Weber, S., Kukula, P., Niehaves, B. (2021). LOHMAR | DIGITAL | FOR EVERYONE - The development process of a digital transformation strategy and its fields of action in Lohmar, In: Urbach, N., Röglinger, M. (Hrgs.) *Digitalization Cases 2*. Springer, Cham, S. (accepted)	(-)	
P12	Mikalef, P., Lemmer, K., Schaefer, C., Ylinen, M., Fjørtoft, S. O., Torvatn, H. Y., Gupta, M., Niehaves, B. (2021). Enabling AI Capabilities in Government Agencies: A study of determinants for European municipalities. *Government Information Quarterly*. (accepted and preliminarily published)	(-)	7,279
P13	Anthopoulos, L., Pourzolfaghar, Z., Lemmer, K., Siebenlist, T., Niehaves, B. (2021). Smart Cities as hubs: can this be their "ultimate" mission?. *Cities*. (accepted)	(-)	4,802
P14	Lemmer, K., Jahn, K., Chen, A., Niehaves, B. (2021). One Tool to Rule? – A Field Experimental Longitudinal Study on the Costs and Benefits of Mobile Device Usage in Public Agencies. *Government Information Quarterly*. (conditionally accepted with major revision)	(-)	7,279

[a] VHB-JOURQUAL3 (https://vhbonline.org/vhb4you/jourqual/vhb-jourqual-3/)
[b] IF (Impact Factor) according to the Journal Citation Reports released in 2020
[c] Due to change of name

Table 1.1 Overview of Research Articles

Aligned with Klesel (2019), this thesis is structured as follows: Part A provides an overview of all studies showing how they contribute to the proposed research questions. Part B presents the individual research papers included in this thesis (Klesel et al., 2019). In Part B, the research papers listed in Table 1.1 are structured in line with their research topics and questions. Figure 1.1 shows the structure of Part B, which comprises three main parts. The first shows papers related to RQ 1 and, therefore, inhibits all papers that contribute to digital transformation strategies for individuals (P1, P2, P5, P8, P14). The second part provides insights into strategies for organizations (RQ 2). Specifically, papers P3, P6, P7 and P11 contribute to digital transformation strategies for governmental agencies. In the third part, Implementing Strategies (RQ 3), various special cases are shown. Those special cases contribute to the implementation process of digital transformation strategies providing concepts and technologies that can be used (P4, P9, P10, P12, P13). P4 looks at how the cognitive performance of employees can be improved, whereas P9 analyzes the Chief Executive Officers' (CEOs) competencies and their influence on digital transformation processes in small-to-medium enterprises (SMEs). P10 and P12 contribute to the adoption of AI in governmental agencies, analyzing factors that influence the adoption and determine the capabilities of AI. P13 discusses the transformation of smart cities (SC) organized by governmental agencies toward hubs defining SC hub architecture.

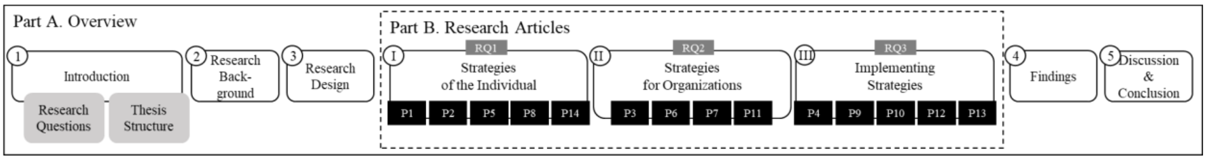

Figure 1.1 Thesis Perspective and Structure

Overall, the research papers in this thesis contribute to different levels of analysis and sectors (Figure 1.2). Papers in Part B, *I Strategies of the individual*, focus on employees in the private sector as well as the public sector, whereas papers in Part B, *II Strategies for organizations*, concentrate on the analysis of governmental agencies. Papers in Part B, *III Implementing digital strategies – Special cases, concepts, and technologies*, analyzes individual and organizational levels in both the private and public sectors.

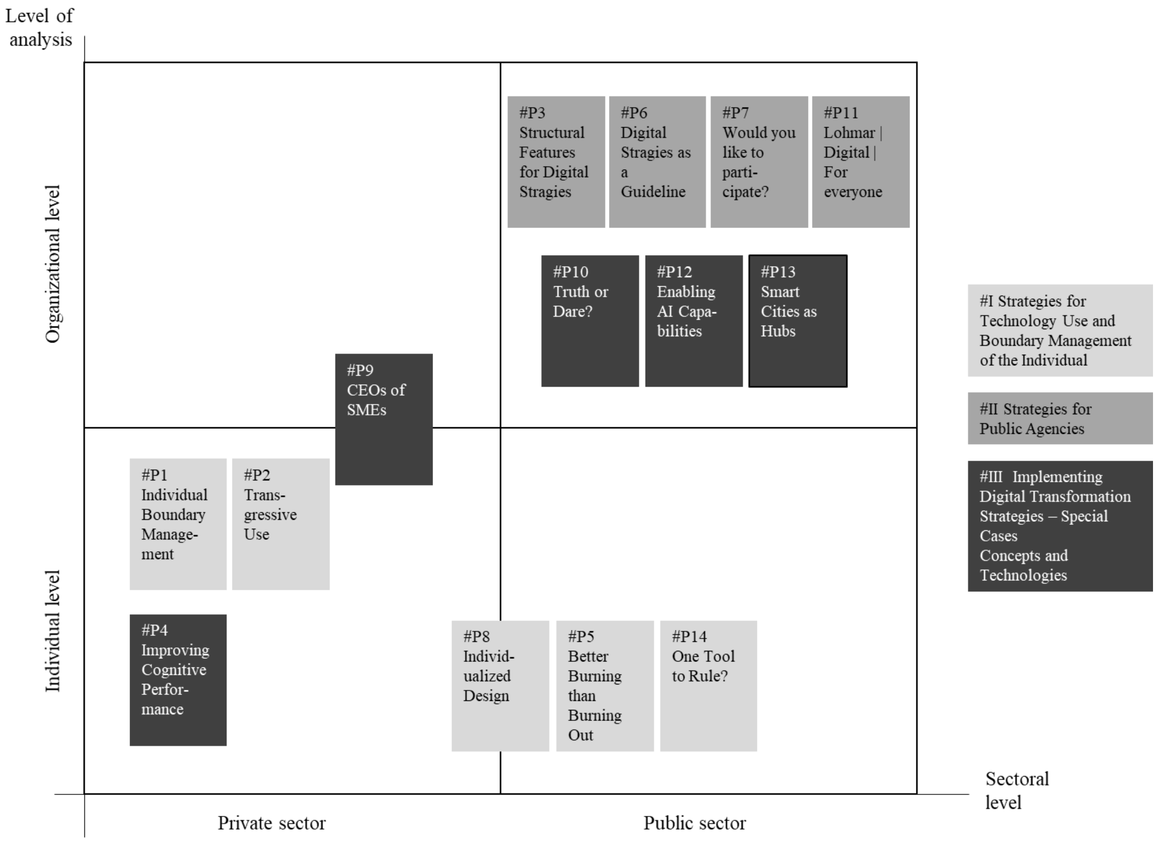

Figure 1.2 Structured Research Articles

2. Research Background

Strategies in Research and Practice. Over the last decade, both practice and academia have shown an increasing interest in strategies and their implementation (Bharadwaj et al., 2013a). Previous research has studied the phenomena of strategies, i.e., in management studies (Atkins & Lowe, 1994; Atkins et al., 2003; Mintzberg, 1978), IS research (Brown, 1994; Gottschalk, 1999) and public sector literature (Ask et al., 2008; Kim et al., 2008; Ojo et al., 2011; Shareef et al., 2012; Yoon & Chae, 2009). Three conceptions of the IS strategy were found by Chen et al. (2019) in their literature review. They described the term "IS strategy" in three ways: "(1) IS strategy as the use of IS to support business strategy; (2) IS strategy as the master plan of the IS function; and (3) IS strategy as the shared view of the IS role within the organization" (Chen et al., 2010, p. 233). Against this background and aligning with the research questions, this thesis subdivides the term "digital transformation strategy" into three sections: First, "digital transformation strategies for the individual"; second, "digital transformation strategies of organizations"; and third, special cases of implementing digital strategies (i.e., digital transformation competences, adoption, and capabilities of new technologies, and connecting people, services, and data with smart cities).

Strategies of the Individual. With the emergence of mobile devices (i.e., laptops, tablets, and smartphones), the strategies of individuals using IS are becoming more important, particularly the approaches to managing work and private life domains and coping with availability demands due to being able to work anywhere at any time (Jahn et al., 2016). Since IS research is an interdisciplinary field, previous studies on the subject are aligned with theories related to psychology, management science and the use of technology to study the behavior of individuals with mobile technologies.

In previous research, the underlying concepts used to explain this phenomenon relate to boundary theory. Research related to the boundary theory states there is a difference between boundary preferences, tactics, and styles (Jahn et al., 2016). Aligned to the structure of Jahn et al. (2016), boundary preferences are described as an "individual's preferences of either implementing or segmenting aspects of work and private life domains" (Jahn et al., 2016, p. 2; based on Kreiner et al., 2006). As individuals' preferences are defined by the desire for ideal boundary management, tactics are used to create their preferred style of segmentation or integration between their work and private life domains (Kreiner et al., 2009). "Whereas the boundary preferences refer to the integration or segmentation preference, the boundary styles refer to the actual enactment of integration or segmentation" (Jahn et al., 2016, p. 2; based on Kossek et al., 2012).

Aligning to Jahn et al. (2016), this paper-based thesis concentrates on extant literature that describes boundary management tactics using IT; Kreiner et al. (2009) describe a micro-category called "leveraging technology," a sub-category of behavioral tactics that is linked directly to the use of IT to manage boundary strategies (Jahn et al., 2016; Kreiner et al., 2009). Similarly, Duxbury et al. (2014) discovered that individuals are unable to separate the two domains due to a lack of self-discipline and self-control when using smartphones (i.e., Blackberry) (Duxbury et al., 2014; Jahn et al., 2016). Against this background, Köffer et al. (2015), explaining the intensified professional use of IT, found six technology-related aspects (dual use of company IT for private tasks, dual use of private IT for work tasks, remote access to work data, distinct devices for private and work purposes, separate private and business accounts and quality of company provided IT) (Jahn et al., 2016; Köffer et al., 2015). Cecchinato et al. (2015) observed the use of e-mail accounts across devices to manage boundaries in more detail, finding micro-boundary strategies in e-mail management (Cecchinato et al., 2015; Jahn et al., 2016).

Strategies for Organizations. Upon observing digital transformation strategies for organizations, we found a distinction between business strategies, IT strategies, and digital business strategies (Bharadwaj et al., 2013a; Chen et al., 2010; Mithas et al., 2013). Aligned to the structure of Niehaves et al. (2019), a business strategy is defined as a classic corporate strategy, summarizing an organization's visions and goals, and setting its path for a certain period of time (Chen et al., 2010). However, an IT strategy is characterized by a written project plan, supporting the goals of an organization through the application of IT (Atkins, 1994; Chen et al., 2010; Gottschalk, 1999;). In summary, a digital business strategy is intended to contribute to the value generation and competitiveness of the organization using digital resources (Chan & Huff, 1992; Niehaves et al., 2019). Thus, we define digital transformation strategies for organizations, especially governmental agencies, as "an organizational strategy formulated and executed by leveraging digital resources to create differential value to support or shape an organization's competitive strategy, its plan for gaining and maintaining competitive advantage. Summarized, we define it as a fusion of a traditional IT/ IS strategy with the business strategy of an organization in the digital age" (Roeding 2019, p. 34).

Implementing Strategies. To analyze special cases of implementing digital strategies, we first looked at previous literature related to digital transformation competences. As digital transformation competences are a key factor for the success of digital transformation processes, there are multiple studies in IS research (Chakravarty et al., 2013; Sambamurthy et al., 2003). For example, IS literature distinguishes between IT competencies, digital transformation capabilities and digital transformation competencies (Niehaves et al., 2021). These terms are often used synonymously to explain the same context (Niehaves et al., 2021). First, "IT competencies" describes both the knowledge of various aspects of the IT infrastructure of organizations and the skills of employees in selecting, procuring, configuring, and implementing IT (Chakravarty et al., 2013). The presence of IT competencies is classified as an important building block for process transformation within organizations to cope with digital transformation (Chakravarty et al., 2013; Niehaves et al., 2021; Sambamurthy et al., 2003). Second, the term "digital transformation capability" is used when describing the fundamental basis of digital transformation competencies, i.e., an organization's ability to manage the process of digital transformation (i.e., with digital solutions, digital concepts, and strategies) (Wiesböck & Hess, 2018). This definition reflects the skills of an organization; however, when using the term "digital transformation competencies," the focus is on the combination of employees' skills, expertise, and experience. According to Niehaves et al. (2021), digital transformation competencies are based on employees' knowledge, expertise, and experience of organizational structures and processes. However, digital transformation capabilities of an organization are formed by existing digital transformation competences, which evolve through the use of strategic decisions and digital concepts (Niehaves et al., 2021; Osmundsen, 2020; Peppard & Ward, 2004).

Aligning with previous IS research regarding the development of digital competences, we also focused on research related to the adoption and capabilities for implementing and using new technologies. In their study, Hall and Khan (2003) described the adoption of technology as the "choice to acquire and use a new invention or innovation" (Hall & Khan, 2003; Schaefer et al., 2021a, p. 2348). Considering the fact that organizational, cultural, and legal issues need time to change, this process of diffusion or "the process by which something new spreads throughout a population" (Hall & Khan, 2003; Schaefer et al., 2021a, p. 2348) and adoption can take years. However, previous research has concentrated on the adoption of IT innovations and have presented models used for organizational level analysis such as the Diffusion of Innovation

Theory (Rogers, 1995) and the Technology–Organization–Environment (TOE) framework (Hameed et al., 2012; Schaefer et al., 2021a).

Schaefer et al. (2021a) agree that the adoption of technology is multidimensional, and many factors need consideration, demonstrating that the TOE framework can be used to theoretically examine different aspects of IT deployment in organizations (Pumplun et al., 2019). In addition, research on the adoption of innovative technologies (i.e., big data) using the TOE framework has already proven to be useful in organizations (Alsheibani et al., 2018; Schaefer et al., 2021a).

Aligned with Hameed et al. (2012) and Rogers (1995), the TOE framework considers technological, organizational, and environmental dimensions (Hameed et al., 2012; Rogers, 1995; Schaefer et al., 2021a). First, the technological context describes all of the technologies relevant to an organization, outside as well as within (Schaefer et al., 2021a). This suggests that even new external innovations and technologies can reveal new possibilities for an organization. Second, the organizational context refers to an institution's characteristics and resources, such as internal structures and processes (Schaefer et al., 2021a). Third, the environmental context contains external influences from the environment, i.e., pressure or competition from industry or regulatory frameworks (Pumplun et al., 2019; Schaefer et al., 2021a).

For new technologies, such as AI, transformation potential has been a topic of much discussion, both in literature and practice (Dwivedi et al., 2019). As technology has taken significant leaps in enabling AI development, AI is gaining momentum and becoming an essential part of organizational operations and everyday life (Desouza et al., 2020; Mikalef et al., 2021). As the development of AI technologies accelerates, interest in such technologies also grows (Pan, 2016). According to Russel and Norvig (2015), AI can be characterized by a system that mimics cognitive functions and can perform carry-out-tasks with human-like and rational behavior (Russell & Norvig, 2002). However, AI technologies are used, i.e., in the context of speech recognition, machine translation, computer vision, machine learning, and robotics (Eggers et al., 2017). These technologies hold a multitude of possible benefits depending on their application. Schaefer et al. (2021a) suggest that AI applications are linked to the effectiveness of work, freed-up high-value work, and improved decision making (Eggers et al., 2017), leading to improved organizational performance.

3. Research Design

3.1. Overview

In this thesis, various research methodologies were used. The method to use was determined based on the proposed research questions, with the aim of benefiting from the strengths of the method to answer the identified research question. This thesis includes five major methodological approaches: a systematic literature review, qualitative research in the form of single and multiple case studies, quantitative research using surveys and experimental studies, a multi-method approach with point-in-time and longitudinal studies, and conceptual studies. Table 3.1 provides an overview of the research methodology and the underlying datasets used to fit the objective of each research article.

	#	Objective and Method	Dataset	Reference
I Strategies of the Individual	P1	Using methods from Grounded Theory, we explored IT-related boundary tactics that individuals use to meet their preferences of integrating or separating their private and work lives.	Qualitative, 15 interviewees.	Jahn et al. (2016)
	P2	An explorative qualitative study was conducted and analyzed, according to Grounded Theory, to define sub-dimensions of transgressive use. Data from multiple case studies including service and manufacturing industry were collected.	Multiple case study, qualitative, 67 interviewees.	Klesel et al. (2017)
	P5	A laboratory between-subject experiment with two groups was proposed to test the effect of avoidance training for work or private life on perceived strain, psychological detachment from work and work approach bias.	Quantitative, experiment, suggested 128 participants.	Roeding et al. (2019a)
	P8	Proposing a 2 x 2 between-subject experiment using an online survey, we wanted to extend the theory of IT-related boundary tactics by showing which design options can be beneficial along different boundary preferences between work and private lives.	Quantitative, experiment, suggested 128 participants.	Roeding et al. (2019b)

	P14	Explorative multi-method approach conducting a field experiment with quantitative and qualitative data to understand the effect of mobile device usage on the innovation behavior and work-life conflict of employees.	Multi-method approach, qualitative and quantitative, longitudinal field experiment, 56 interviews at 3 points in time, 251 respondents at 13 points in time.	Lemmer et al. (conditionally accepted with major revision)
II Strategies for Organizations	P3	Explorative multi-method approach of qualitative and quantitative research using multiple case studies of qualitative and quantitative content analysis, qualitative process analysis combined with expert interviews to analyze structural features of digital strategies for municipalities.	Multi-method approach, qualitative and quantitative, 21 strategies, 7 expert interviews, 145 respondents.	Niehaves et al. (2019)
	P6	Systematic literature review to show the development of digital strategies guiding digital transformation processes.	Systematic literature review covering 12 journals and 218 papers.	Roeding (2019)
	P7	Explorative multi-method approach of qualitative and quantitative research using multiple case studies of qualitative and quantitative content analysis, qualitative process analysis combined with expert interviews to analyze stakeholder involvement in the development process of digital strategies in municipalities.	Multi-method approach, qualitative and quantitative, 21 strategies, 7 expert interviews, 145 respondents.	Roeding et al. (2019c)
	P11	Explorative case study to analyze the development process of a digital transformation strategy and its fields of action in Lohmar.	Case study research with the city of Lohmar.	Schaefer et al. (2021b)
III Implementing Strategies	P4	Proposing a 2 x 2 between-subject experiment in immersive virtual reality using heart rate and electrodermal activity to propose to assess the strength of self-presence.	Quantitative, experiment, suggested 128 participants.	Jahn et al. (2019)
	P9	Using methods from Grounded Theory, we explored in a qualitative study the influence of Chief Executive Officers (CEOs) competences on the digital	Qualitative, 20 interviewees.	Weigel et al. (2020)

	transformation of SMEs analyzing IT-governance structures.		
P10	Using methods from Grounded Theory, we explored, using qualitative interviews, influencing factors for the adoption of AI in municipalities.	Qualitative, 10 interviewees.	Schaefer et al. (2021a)
P12	Conducting an online survey in Germany, Norway, and Finland, we analyzed determinants enabling AI capabilities in European governmental agencies.	Quantitative, 93 respondents.	Mikalef et al. (2021)
P13	Based on a funded project in Lohmar we conceptualized a smart cities transformation process to hubs for data, services, people and material flow, where various stakeholders can connect. The smart cities hub architecture is proposed.	Conceptual study	Anthopoulos et al. (accepted)

Table 3.1 Overview of Research Methodology and the Datasets Used

3.2. Literature Review

When exploiting a new research field, a common method comprises honoring previous research. This appreciation can consist of the analysis of prior knowledge (vom Brocke et al., 2015, 2009; Webster & Watson, 2002). With this in mind, previous literature aligned to the research field being explored is analyzed to formulate research questions and to differentiate new research ideas from the previous research. Accordingly, a systematic literature review (P6) was conducted for the present thesis to shed light on the development process of the term and concept of digital transformation strategies in IS and public sector research (Bharadwaj et al., 2013b, 2013a; Hess et al., 2016; Matt et al., 2015; Ross et al., 2017).

Systematic Literature Review (P6). To address RQ 2, the development of digital transformation strategies in IS and public management research was examined. With the evolution of digital transformation processes comes the need to cope with new technologies within organizations (Bharadwaj et al., 2013a). One way to cope with this situation is through the development of digital transformation strategies (Bharadwaj et al., 2013b, 2013a; Hess et al., 2016; Matt et al., 2015; Ross et al., 2017). Accordingly, we investigated how digital transformation strategies developed over time in IS and public sector research. In accordance with our research objective, we conducted a systematic, but selective, literature review. We included a senior scholar basket of eight journals (European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems, MIS Quarterly) and top journals for public sector research (Government Information Quarterly (GIQ), Journal of E-Government Research, Transforming Government: People, Process and Policy, and Information Polity) using the keywords "digital strategy," "IS strategy," and "IT Strategy" in all fields (Roeding, 2019). Those keywords led us to further keywords "digital business strategy," "smart city strategy," and "e-government strategy," which we also used in our research. Based on 218 articles, we obtained insights on how digital transformation strategies developed over time. We were able to show that both literature streams justify a fusion between business and IS strategies leading to new concepts and capabilities that can support the development process and monitoring of digital transformation strategies for governmental agencies (Roeding, 2019).

A summary of the systematic literature review is described in Table 3.2.

	P6 (Roeding, 2019)
Objective	Concept review
Type of review	Systematic literature review
Fundamental theory	Digital strategies
Considered outlets	12 journals (senior scholar basket of eight in IS and journals for public sector research)
Number of considered studies	218
Analysis	Structured classification of the development of digital strategies in IS and public sector literature
Main contribution	Development of digital strategies in IS and public sector literature

Table 3.2 Overview of the Literature Review

3.3. Qualitative Studies

Qualitative research methods are often used to analyze new phenomena, emerging concepts and when developing new theories. In IS research in particular, qualitative methods are used to develop new theories based on observed phenomena. For this reason, previous research often uses qualitative methods such as the Grounded Theory (Corbin & Strauss, 1990; Gioia et al., 2013; Gioia & Chittipeddi, 1991; Gioia & Pitre, 1990; Glaser & Strauss, 1967; Urquhart et al., 2009; Urquhart & Fernández, 2013) or case study research (Yin, 2013). Both approaches focus on the development of new concepts and theories. However, there exists a difference in relation to their interviewees. While the Grounded Theory and its introduced methods can be applied across different types of interviewees ´, case study research is often based on data from multiple sources. This allows the various perspectives of interviewee groups to be present while developing new concepts and theories (Yin, 2013). Table 3.3 gives an overview of the qualitative studies presented in this thesis.

	P1 (Jahn et al., 2016)	**P2** (Klesel et al., 2017)	**P9** (Weigel et al., 2020)	**P10** (Schaefer et al., 2021a)
Primary Objective	Description of IT-related boundary tactics	Theory development	Description of CEOs competences	Description of influencing factors for the adoption of AI in municipalities
Technique	Methods based on Grounded theory	Case study research	Methods based on Grounded theory	Methods based on Grounded theory
Data	15 interviews	67 interviews	20 interviews	10 interviews
Contribution	Collection of individual IT-related boundary tactics using mobile devices	Conceptual model for a new conceptualization of technology use	Collection of CEOs competences and their influence on SMEs and their digital transformation processes	Collection of influencing factors for the adoption of AI in municipalities

Table 3.3 Overview of Qualitative Studies

Grounded Theory Approach (*P1, P9, P10)*. In this thesis, Grounded theory was used to explore and examine the phenomena that previous research lacks a solid and well-established theory for. To apply the Grounded theory, methods from Glaser and Strauss (1967), Corbin and Strauss (1990), and Gioia et al. (2013) were used. Regarding the manifold use of individual IS (P1), the competences of CEOs for digital transformation processes (P9), and for influencing factors for the adoption of AI in governmental agencies (P10), the use of the Grounded theory allowed the identification of emerging concepts.

Case study research (P2). To propose a new concept explaining the use of individual IS, a case study research was conducted (P2). In this research article, two cases (MANUFACTURE and SERVICE) were used to investigate the use of technology beyond the boundaries of work and private life domains (Klesel et al., 2017). The cases differed in their contextual aspects (i.e., industry, number of employees, and distribution) but were similar in their IS Governance. Both cases, MANUFACTURE and SERVICE, applied corporately-owned-privately-enabled (COPE) strategies for the use of IS in their organizations.

3.4. Quantitative Studies

The aim of quantitative studies is to test the hypotheses of proposed research models. In four research articles (P4, P5, P8, P12) structural equation modelling was used to analyze the effects in the proposed research models, testing the hypotheses. Papers P4 and P5 proposed their data collection via a laboratory between-subject experiment, whereas papers P8 and P12 used surveys. More details on the quantitative studies in this thesis are presented in Table 3.4.

	P4 (Jahn et al., 2019)	**P5** (Roeding et al., 2019a)	**P8** (Roeding et al., 2019b)	**P12** (Mikalef et al., 2021)
Primary Objective	Hypothesis testing	Hypothesis testing	Hypothesis testing	Hypothesis testing
Technique for Analysis	Structural equation modeling	Structural equation modeling	Structural equation modeling	Structural equation modeling
Data Collection	Laboratory between-subject experiment	Laboratory between-subject experiment	Survey	Survey
Data points	128	128	128	93

Table 3.4 Overview of Quantitative Studies

Survey Data (P8, P12). To test the hypothesized paths of the underlying proposed research models, papers 8 and 12 used questionnaire-based survey data. Survey-based studies allow for the generalizability of outcomes and are easy to replicate while enabling the concurrent inclusion of several factors (Pinsonneault & Kraemer, 1993). P8 proposes an effect of boundary preference design and automaticity on perceived usefulness and work–life conflict, moderated by an individual's boundary preferences. Although P8 proposes a 2 x 2 between-subjects experiment, the study is completely survey based. Survey data from 128 participants were to be collected using analysis of variance (ANOVA) and covariance-based structural equation modeling (ANCOVA). For the structural model, the application of a path modeling technique, i.e., partial-least-square (PLS,) was proposed. According to Henseler et al. (2016), this technique is suitable for hypothesis testing in complex research models (Henseler et al., 2016). P12 shows the effects of different determinants enabling AI capabilities in governmental agencies. Based on survey data from 93 respondents, we built on a PLS structural equation modeling (PLS-SEM) analysis to determine the research model's validity and reliability. The dataset includes Chief Digital Officers (CDO) (65%) and IT managers/directors and operations managers (35%) across Germany (22% of respondents), Norway (71% of respondents), and Finland (7% of respondents). The largest proportion of companies (35%) had been using AI for two years. A smaller proportion (9%) had done so for more than four years.

Laboratory experiments (P4, P5). With the experimental research, we aimed to explain theoretical interdependencies and cause–effect relationships. While experimental approaches explain effects that are directly related to a treatment (i.e., a cause), experiments are suggested for explaining causal relationships. P4, P5 and P8 have an experimental approach. However, only P4 and P5 are explicitly laboratory experiments as P8 describes a completely survey-based experiment. P4 examines in a laboratory 2 x 2 between-subject experiment the causal effect of physical feedback systems and avatar design in the context of self-presence on cognitive performance in an immersive virtual reality. High cognitive performance is associated with high physical feedback and a high intelligent embodiment in a virtual body. Self-presence strengthens the effect of avatar design on cognitive performance. Paper P5 investigates the causal effect of avoidance training on perceived strain, psychological detachment from work and the work approach bias. Conducting a laboratory 2 x 2 between-subject experiment, we hypothesize that "work avoidance training leads to lower perceived strain, higher psychological detachment and lower work approach bias than private life avoidance training" (Roeding et al., 2019a, p.2). We propose the analysis of the data using two one-way ANOVAs to analyze the effect of perceived strain and psychological detachment. A 2 x 2 ANOVA should be conducted to assess the differences for approach biases.

3.5. Multi-Method Studies

In this thesis, three studies (P3, P7, and P14) were conducted that mainly integrate qualitative and quantitative approaches. The aim of these three studies was to derive a theoretical model based on qualitative data to quantitatively test the proposed concepts and hypotheses. An overview over the multi-method studies is provided in Table 3.5.

	P3 (Niehaves et al., 2019)	**P7** (Roeding et al., 2019c)	**P14** (Lemmer et al., conditionally accepted)
Primary Objective	Description of structural features of digital strategies	Description of stakeholder involvement in the development process of digital strategies	Analysis of the influence on mobile devices on innovation behavior and work-life conflict of public agencies employees
Technique for Analysis	Methods based on Grounded theory, qualitative and quantitative content analysis, qualitative process analysis combined with expert interviews and descriptive analytical methods	Methods based on Grounded theory, qualitative and quantitative content analysis, qualitative process analysis combined with expert interviews and descriptive analytical methods	Methods based on Grounded theory, and descriptive analytical methods
Data Collection	Qualitative and quantitative content analysis, expert interviews, survey	Qualitative and quantitative content analysis, expert interviews, survey	Interviews and surveys
Data Points	21 strategic documents, 7 expert interviews, 145 respondents	21 strategic documents, 7 expert interviews, 145 respondents	56 interviews at 3 points in time, 251 respondents at 13 points in time
Contribution	Conceptual model of structural features of digital strategies	Conceptual model of structural features of stakeholder involvement in the development process of digital strategies	Conceptual model of the influence on mobile devices on innovation behavior and work-life conflict of public agencies employees

Table 3.5 Overview of Multi-Method Studies

P3 and P7 are based on the same dataset but focus on different variables and constructs of the dataset (c.f. Table 3.5). Both studies are based on the qualitative and quantitative content analysis of 21 strategic documents from international smart cities, seven expert interviews with developers of strategic documents from the analyzed 21 smart cites, and survey data from 145 respondents of North-Rhine Westphalia governmental agencies in Germany. To analyze the collected data, different methods from qualitative and quantitative studies were chosen. For the analysis of the 21 strategic documents, qualitative and quantitative content analysis and qualitative process analysis were used. We also used methods based on grounded theory, especially for coding the seven expert interviews. Descriptive analytical methods (i.e., relative frequencies) were used to analyze the quantitative data. P14 analyzes the influence of mobile devices on employees' work–life conflict and innovation behavior within governmental agencies. To understand how mobile device use changes employees' work behaviors over time, a longitudinal multi-method analysis, consisting of surveys and interviews, was conducted over a period of 12 months. P14 is based on 56 interviews at three points in time in combination with 251 respondents of a quantitative survey at 13 points in time. To analyze the data from P14, methods based on the Grounded Theory for qualitative data and descriptive analytical methods for quantitative data were used.

3.6. Conceptual Studies

The conceptual studies presented in this thesis combine various qualitative research methods to investigate a real-world phenomenon and develop a theoretical concept or framework to explain it. After defining the research objective, the qualitative data used to define the research scope was collected by conducting interviews and gathering documents, research articles, and vendor information. The collected data was analyzed using methods from Grounded theory and through qualitative and quantitative process analysis. Table 3.6 provides an overview of the conceptual studies in this thesis.

	P11 (Schäfer et al., 2021b)	P13 (Anthopoulos et al., accepted)
Objective	Concept review	Concept review
Research process	Observation and documentation of the process over 18 months	Collecting different types of strategies and documents in research and practice
Main contribution	Analysis of the development process of Lomar's digital strategies and their fields of action	Conceptualization of smart cities transformation to hubs for data, services, people, and material flow

Table 3.6 Overview of the Conceptual Studies

P11 describes a concept review and analyzes the process of developing a digital transformation strategy in the city of Lohmar over a period of 18 months. During this time, documents relating to city development, strategic documents of the region of Lohmar, workshops and interviews were conducted to develop Lohmar's digital transformation strategy. We were allowed to take part in this development process and thus observe and document each step undertaken by Lohmar. P11 describes the development of Lohmar's digital transformation strategy as a process and shows an example of the implementation of the field of action of mobility in more detail. Against this, P13, which is also a concept review, proposes a conceptualization for the transformation of smart cities into hubs for data, services, people, and material flow. This concept is proposed based on the analysis of different types of digital transformation strategies, smart city documents and vendor information related to smart cities research and implementation. Based on this knowledge, a concept for smart cities as hubs is proposed and will be implemented by the city of Lohmar as part of one of its funded smart city projects "Smart Cities made in Germany" by the Federal Ministry of the Interior, Building and Community of Germany in 2020 (https://www.bmi.bund.de/SharedDocs/pressemitteilungen/DE/2020/09/-smart-cities.html) (Anthopoulos et al., accepted).

4. Summary of Major Findings

4.1. Overview

Regarding the three research questions proposed, the core results of this paper-based thesis will be presented here. This section is divided into three underlying sections with each section aligning with one of the proposed research questions and presenting the major findings of the research papers that belong to the proposed research questions and sections (c.f. Figure 1.1). Section 4.2 focuses on the strategies of individual explaining strategy tactics of individuals using IS in their work and private life domains (P1, P2, and P14). Section 4.3 concentrates on strategies for organizations and describes the structural features, development processes and participatory elements of digital transformation strategies (P3, P6, P7, and P11). Section 4.4 provides an overview of findings belonging to research RQ 3. It shows special cases of implementing digital transformation strategies by addressing topics such as the increase of individuals' cognitive performance, CEOs' digital transformation competences, AI adoption and capabilities, and smart cities as hubs (papers P9, P10, P12, and P13).

4.2. Strategies of the Individual

For RQ 1—*What kinds of IT-related strategies and tactics do individuals use to cope with the rising demands of digital transformation processes on their private and work lives?* —we first look at the conceptualization of individual IT-related boundary tactics (P1). Second, we show how such strategies can develop over time resulting in a transgressive use of technology (P2). Third, the effect of technology use over a period of 12 months is shown describing the effect of mobile technology on employees' work–life conflict and innovation behavior (P14).

Conceptualization of individual IT-related boundary tactics (P1). Previous research differentiates between two domains—work and private life—of an employee, which need to be balanced. These two domains can be integrated, separated, or mediated by the individual using IS (Allen et al., 2014; Ashforth et al., 2000; Clark, 2000; Kreiner et al., 2009; Nippert-Eng, 1996). Mediation or a blurring of boundaries due to mobile technologies occurs more often than not, meaning that work and private life domains cannot be separated completely (Chesley, 2005; Köffer, Anlauf, et al., 2015).

Focusing on IS research, previous research shows that the blurring of boundaries due to the use of mobile devices can affect employees' general wellbeing (Chesley, 2005; Duxbury et al., 2014; Köffer, Anlauf, et al., 2015). For instance, Chesley (2005) shows that blurring work and family boundaries can have negative consequences as negative forms of spillover are linked to increased distress and lower family satisfaction. Köffer et al. (2015) also identifies that the use of mobile devices intensifies the blurring of boundaries between the work and private life domains. However, Duxbury et al. (2014) undertook a longitudinal case study of smartphone use by 25 professional knowledge workers. Their results indicate that successful boundary management depends on the development of strategies and tactics to manage the device prior to adoption and one's ability to adapt strategies in relation to concerns at home and work (Duxbury et al., 2014).

The increased use of mobile devices for work and private life purposes shows the importance of analyzing strategies and tactics with IT to manage those boundaries (Jahn et al., 2016). P1 shows six specific individual tactics to meet three types of proposed strategies and preferences (integration, separation, or mediation) for managing one's work and private life boundaries. Table 4.1 gives an overview of six IT-related individual tactics to address an individual's boundary preferences.

Individual tactic	**Primary objective**	**Examples for technological implementation**
Physical detachment	separation	Leaving technology at work when at home; turning work-related technology off when at home or turning technology silent or on vibration.
Automatic response		Using an answering machine; sending e-mail-notifications for e-mails that arrive after hours or on vacation.
Pull Information	mediation between integration and separation	Actively looking up new messages and phone calls without being informed just in time.
Boundary App		Possibility to change actively within the same technology between home and private life domains.
Push Information	integration	Being informed just in time about incoming messages and phone calls.
Dynamic Filtering		Setting up filters that let notifications of specific individuals come through.

Table 4.1 Overview of Individual Tactics (Source: Jahn et al., 2016)

In summary, we identified two major IT tactics for each of the three primary objectives—separation, integration, and mediation—which allow individuals to maintain their boundary preferences. As these preferences are located on a continuum (Ashforth et al., 2000; Nippert-Eng, 1996), our six individual tactics can be reallocated across the continuum of boundary preferences and their technical implementation (Figure 4.1).

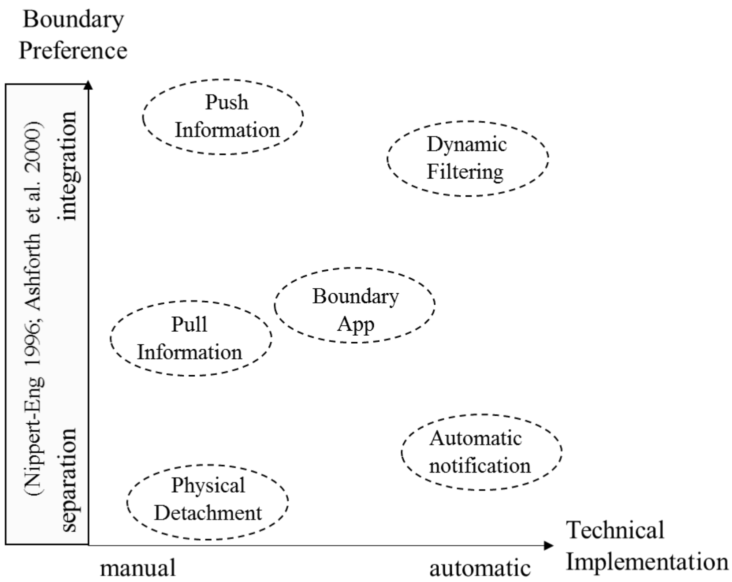

Figure 4.1 IT-related Boundary Tactics (Source: Jahn et al., 2016)

Transgressive Use of Technology (P2). Following the approach of strategies and tactics to adapt technology use along the boundary preferences of employees, we asked the question, "How can the use of technology to blur boundaries and to manage transgressive use be conceptualized?"

Building upon previous studies, especially in IS research, technology use has been studied for several decades (Barki et al., 2007; Barkin & Dickson, 1977; Ginzberg, 1978). Various accepted theories investigate technology use with an aim to understand technology-related use behavior (i.e., the technology acceptance model and its extensions) (Davis et al., 1989; Venkatesh et al., 2003, 2016) and post-adoption theories (Bhattacherjee & Premkumar, 2004; Karahanna et al., 1999).

In our study, one interviewee describes the use of mobile devices to manage work and private life domains as follows:

> *"I am completely aware of the changes that have taken place in the last couple of years. The invention of the smartphone, e-mails and iPads changed our whole life significantly. Of course, we are not only working at our (office) desks anymore when doing administrative work tasks, but rather we are working while on the way to or sometimes from home." (SM04) (Klesel et al., 2017, p.6)*

Combining our findings from the interviews and transferring them back into research (i.e., Bagayogo et al., 2014), we recognize the transgressive use of technology as "a combination of individual IS and a rich use of technology" (Klesel et al., 2017, p.7). Aligning with previous IS literature on technology use (Bagayogo et al., 2014; Barki et al., 2007; Burton-Jones & Straub, 2006), our conceptualization of transgressive use supports a multi-dimensional perspective. As Figure 4.2 shows, we suggest using the individualization of IT as a second dimension. Based on this finding, we define transgressive use as follows:

> *"Transgressive use of technology is a rich form of technology use behavior, in which technology is mainly de-contextualized, i.e., private technology is used for business-related aspects and vice-versa" (Klesel et al., 2017, p.7)*

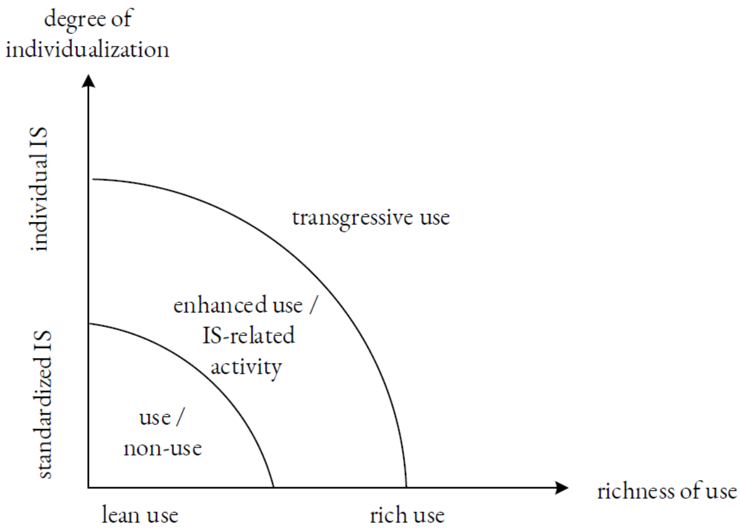

Figure 4.2 Transgressive Use of Technology (Source: Klesel et al., 2017)

The dimensions that comprise the transgressive use of technology are provided in Figure 4.3. Transgressive use of technology, which we describe as multidimensional constructs consisting of the degree of individualization and richness of use, comprises four underlying dimensions. The degree of individualization can be structured according to the degree of individual IS (referring to the underlying technology) and boundary spanning (extent to which an individual is accessible within their work and private life domains), whereas richness of use is described as the degree of intensity (amount and frequency of technology use) and exploration (innovative ideas of an individual while completing a task with technology). Those four dimensions on their own are studied in detail in the literature. Transgressive use aims to see those four separate dimensions of technology as one construct to explain individuals' use of mobile devices, blurring boundaries between their work and private lives.

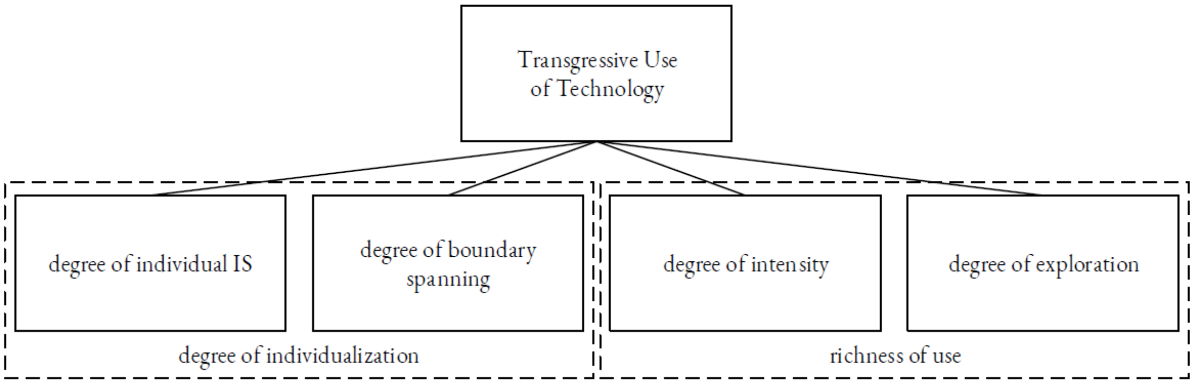

Figure 4.3 Dimension of Transgressive Use of Technology (Source: Klesel et al., 2017)

The effect of mobile devices on work-life conflict and innovation behavior (P14). With the previous studies of this paper-based thesis in mind, we formulated the following question: What effect does transgressive use due to mobile devices (i.e., tablets) have on an individual's work–life conflict and innovation behavior? By conducting a longitudinal multi-method analysis consisting of surveys and interviews over a period of 12 months, we analyzed 56 interviews at three points in time, in combination with 251 respondents of a quantitative survey at 13 points in time, to investigate the effects of mobile devices on employees' use behavior. Aligned with the previous research in the private sector, we found that governmentally-owned-privately-enabled (GOPE) mobile devices tend to allow employees in the public sector to blur the boundaries between the two domains, which prompts the start of transgressive use behavior (aligning to the results of P2). Due to the use of a control group, which presents governmental agency in general, we were able to show that mobile devices reduce work–life conflict while increasing employees' innovation behavior, especially when work demands are high (Figure 4.4, Figure 4.5, Figure 4.6, and Figure 4.7). Innovation behavior is, therefore, defined as an employees' freedom of choice regarding the technology (hardware and software) they want to use for different specific work tasks (Köffer, Ortbach, et al., 2015). Innovation behavior can be compared to the fourth dimension of transgressive use, describing the degree of exploration in the richness of use.

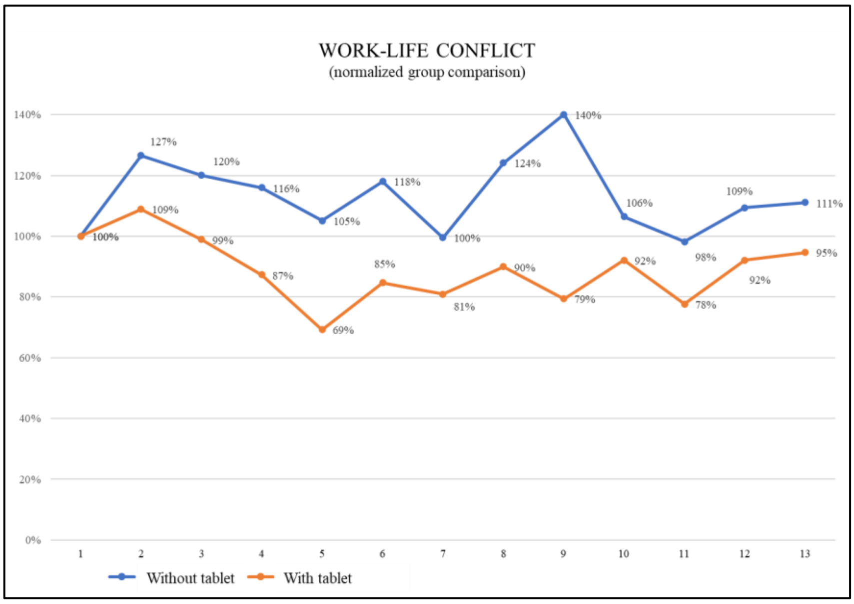

Figure 4.4 Work-life conflict, normalized group comparison (Source: Lemmer et al., conditionally acceptd)

To see the changes that are separate from normal organizational developments but can be compared to the entire organization (represented by the control group, group 2 “without tablet” [blue line]), we conducted time normalization to remove group differences, i.e., we set the starting value of the indices per group at the starting time to 100 by dividing each value by the group-specific value in t = 0. Thus, the subsequent indices represent the relative value-per-group compared to the starting time (Figure 4.4 and Figure 4.6). Both groups were normalized to allow us to calculate the changes that occurred with the implementation of tablets. In doing so, the pre-experimental value represented the relationship with the pre-value of Figure 4.4 and Figure 4.6, resulting in an index for WLC and IB (WLC Index and IB Index) (Figure 4.5 and Figure 4.7).

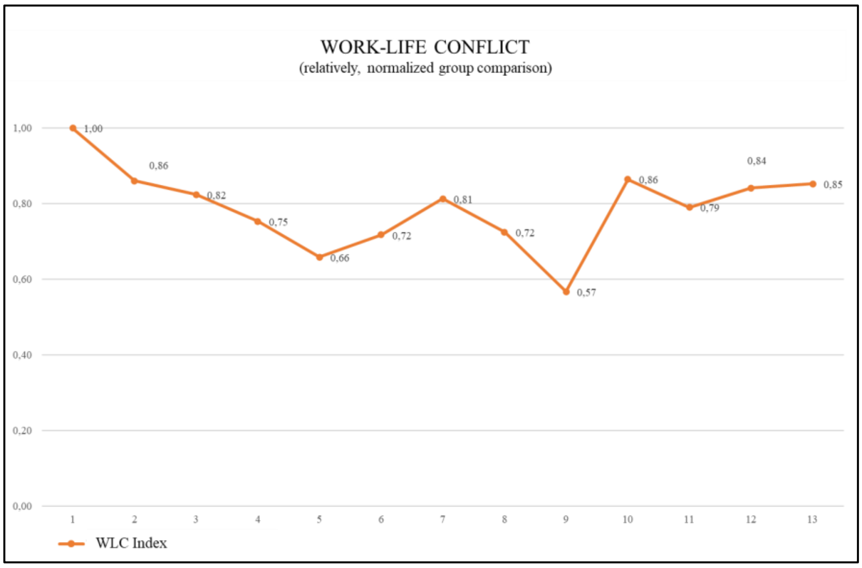

Figure 4.5 Work-life conflict-Tablet-Factor; relatively, normalized group comparison (Source: Lemmer et al., conditionally accepted)

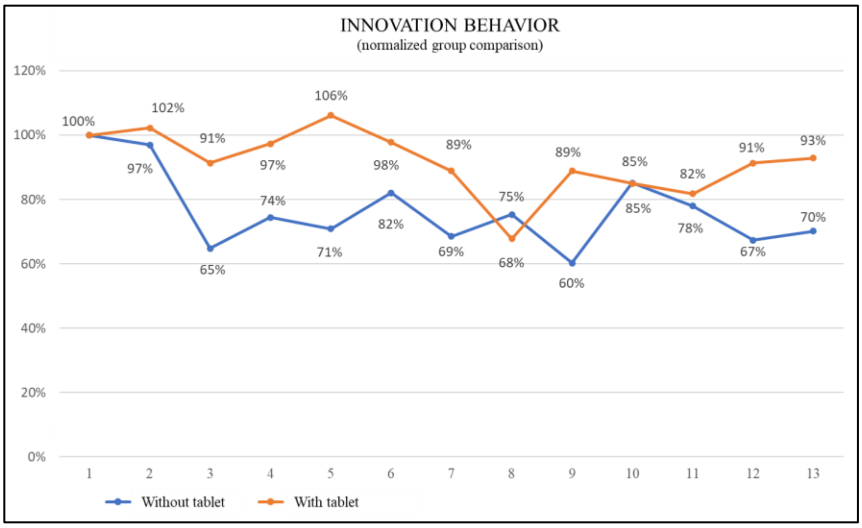

Figure 4.6 Innovation behavior, normalized group comparison (Source: Lemmer et al., conditionally accepted)

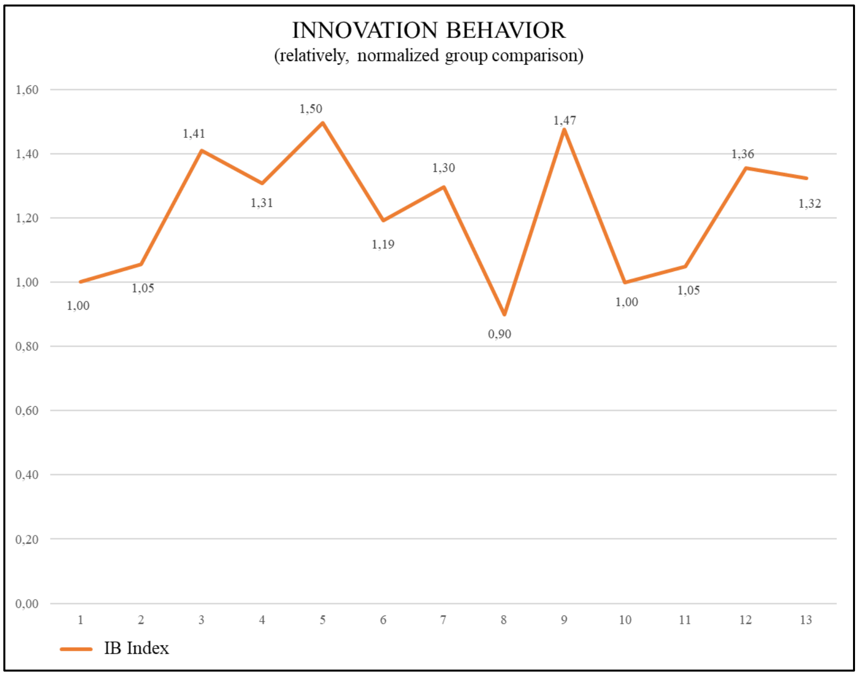

Figure 4.7 Innovation behavior; relatively, normalized group comparison (Source: Lemmer et al., conditionally accepted)

The following qualitative interview excerpts support our quantitative findings.

> *"(...) only the fact that I can take my work everywhere, meaning that I have all or most of it anytime with me using the tablet. I can always use the contacts on my tablet. This means that my work is no longer only attached to the office. I am able to work anywhere at any time, between meetings. This is a relief."* (Interviewee 8, 2nd interview) *(Lemmer et al., conditionally accepted)*

> *"In the field, meetings can sometimes finish a little earlier. Then I have an hour sparse until I meet the next client. During this time, it does not make sense to go back to the office. Using the tablet, I can sit in my car and dictate notes from the last meeting, (...) afterwards, I send my notes to my business mail account so I can open them later in the office (...). With this optimized process work becomes easier for me and I am able to visit more clients." (Interview 2, 2nd interview). (Lemmer et al., conditionally accepted).*

Summarizing the quantitative and qualitative data shows that, even though work demands are high, the ability to work anywhere at any time using mobile devices across domains can help employees keep their work–life conflict low while increasing their innovative behavior and get their work done.

Concisely, this paper-based thesis found six IT-related boundary tactics (physical detachment, automatic response, pull information, boundary app, push information, dynamic filtering) along the three boundary strategies of integrating, segmentation, or mediation of work and private life domains (P1). Furthermore, the use of technology across domains that lead to a blurring of boundaries, was conceptualized as transgressive use of technology (P2), which defines the coherent view of individualization and richness of technology use based on previous research (Bagayogo et al., 2014; Barki et al., 2007; Burton-Jones & Straub, 2006). Conceptualizing transgressive use identified four dimensions (degree of individual IS, degree of boundary spanning, degree of intensity and degree of exploration) of use behavior. Against this background, the development of individual strategies and transgressive use behavior was analyzed over a period of twelve months (P14) with the implementation of tablets into the work processes of governmental agency employees. Due to employees developing their own strategies for using tablets for work processes, we show that transgressive use behavior can reduce work–life conflict while increasing innovation behavior when work demands are high.

4.3. Strategies for Organizations

Considering RQ 2—*How can the development process of digital transformation strategies for organizations (i.e., governmental agencies) be described?*—we first look at the conceptualization of digital transformation strategies (P3). Second, we show how digital transformation strategies have developed over time in IS and public sector research (P6). Third, the participation of various stakeholders throughout the development process of digital transformation strategies is discussed (P7). Finally, P11 provides an overview of the development process of the digital transformation strategy of the city of Lohmar by exploring the process over a period of 18 months (Schaefer et al., 2021b).

Structural features of digital transformation strategies (P3). When exploring digital transformation strategies, especially in the governmental sector, the following question arose, "What are the key structural features of a digital transformation strategy for organizations (i.e., for governmental agencies)?" Generally, in management and IS research, the concept of strategies for businesses, IT or IS are widely discussed in the previous literature (Arvidsson et al., 2014; Cummings & Wilson, 2003; Gottschalk, 1999; Atkins, 1994; Mintzberg, 1978).

Aligning with Niehaves et al. (2019) and Roeding (2019), while focusing on IS research, we noticed the development of different streams of digital transformation strategies, i.e., for individual IS use (Jahn et al., 2016), for businesses (Atkins & Lowe, 1994; Mintzberg, 1978), and for IT (Gottschalk, 1999; Niehaves et al., 2019; Roeding, 2019). Chen et al. (2010) conducted a comprehensive literature review of IS strategies in research and identified three conceptions of IS strategy: "(1) IS strategy as the use of IS to support business strategy; (2) IS strategy as the master plan of the IS function; and (3) IS strategy as the shared view of the IS role within the organization" (Chen et al., 2010, p. 233). However, recent literature has begun to focus on the digital transformation perspective of strategies in IS research (Bharadwaj et al., 2013b, 2013a; Hess et al., 2016; Matt et al., 2015; Mithas et al., 2013; Ross et al., 2017).

Current research in the public sector shows the importance of the discussion of digital transformation strategies for governmental agencies (Mergel et al., 2019). P3 identified four structural features of digital transformation strategies for governmental agencies. Analyzing 21 strategic documents, seven expert interviews, and survey data from 145 respondents in North-Rhine-Westphalian governments in Germany, strategic alignment, strategy formulation, the definition of core themes, and fields of action were determined to be core structural features of digital transformation strategies (Niehaves et al., 2019). Figure 4.8 provides an overview of structural features for digital transformation strategies.

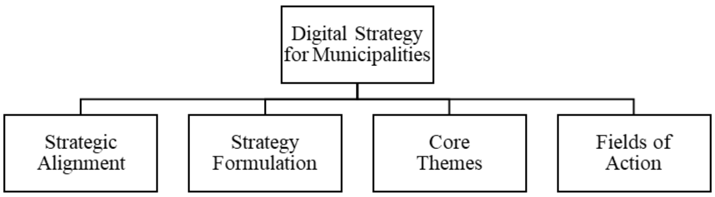

Figure 4.8 Conceptual framework for the structural features of digital strategies for municipalities (Niehaves et al., 2019)

Strategic alignment refers to the orientation of digital transformation strategies on super-ordinated digital strategies (i.e., country, or federal government strategies, economic, scientific, or political party strategies, and municipalities own strategies [i.e., e-government or urban development strategy]) (Niehaves et al., 2019; Preston & Karahanna, 2009). Furthermore, strategy formulation describes the degree to which a vision, mission statement, goals, fields of action, measures, monitoring concepts and digital risks are defined within a digital transformation strategy (Altiok, 2011; David, 2014). Core themes show which topics the digital transformation strategy aligns with, i.e., society, space, and digital services (Niehaves et al., 2019). Fields of action illustrate, in more detail, which fields a digital strategy is focused on i.e., governance, the economy, the environment, tourism, education, health, or mobility (Niehaves et al., 2019).

Development and use of the term "digital transformation strategy" (P6). Analyzing how digital transformation strategies are structured, especially for governmental agencies, raised the questions: how can digital transformation strategies be defined and how does recent literature use digital strategies as a guideline for digital transformation processes (Roeding, 2019)? Conducting a literature review across IS and the public sector, P6 identifies that both literature streams, IS and public sector research shows the development of a fusion between business and IS strategies (Figure 4.9).

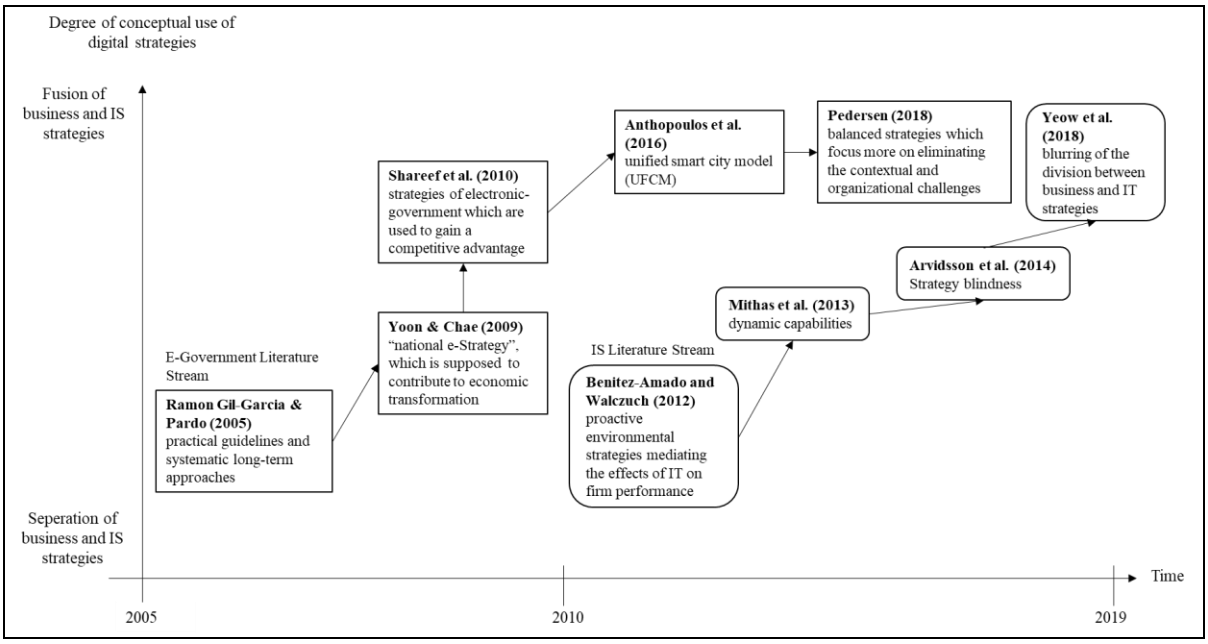

Figure 4.9 Conceptualization of the term and use of digital strategies as a guideline for digital transformation (Source: Roeding, 2019)

Aligning with previous research regarding digital transformation strategies (Bharadwaj et al., 2013a; Chen et al., 2010; Matt et al., 2015; Niehaves et al., 2019), we define digital transformation strategy "as an organizational strategy formulated and executed by leveraging digital resources to create differential value to support or shape an organization's competitive strategy, its plan for gaining and maintaining competitive advantage. Summarized, we define it as a fusion of a traditional IS/IT strategy with the business strategy of an organization in the digital age" (Roeding, 2019, p. 34). Figure 4.9 presents the development of digital transformation strategies across IS and public sector research. Analyzing both streams, we have identified a trend from the separation of business and IS strategy towards their fusion in the

2005–2019 period. Starting with strategies as practical guidelines for organizational performance (Benitez-Amado & Walczuch, 2012; Gil-García & Pardo, 2005), the term developed into strategies for competitive advantage (Mithas et al., 2013; Shareef et al., 2012) and finally towards strategies that blur boundaries between traditional IT/IS and business/smart city strategies facilitating their fusion (Matt et al., 2015; Pedersen, 2018; Yeow et al., 2018) (Figure 4.9).

Stakeholder involvement in the development process of digital transformation strategies (P7). Recognizing the development of digital transformation strategies as a fusion of traditional IT/ IS strategies with the business strategy of an organization in the digital age, we asked, "who is developing such a strategy?" Analyzing governmental agencies and developing strategies for a smart city, we asked, "who should get involved into the development process of digital transformation strategies for municipalities and how can these stakeholders be involved?" Aligning to paper P3, we analyzed 21 strategic documents, seven expert interviews, and survey data from 145 respondents in North-Rhine-Westphalian governments in Germany, asking "how can different stakeholders be involved in the development process of a digital strategy for municipalities?" (Roeding et al., 2019c, p. 21).

Based on Wanberg and Banas (2000), we define participation in our paper as "allowing citizens to have input regarding a proposed change" (Roeding et al., 2019c, p. 21). Aligning with the construct of participation used by Wanberg and Banas (2000), we found that in 82% of the participating municipalities the head of department and in 82% the mayor is responsible for the development of a digital transformation strategy (Roeding et al., 2019c). Regarding the implementation of digital transformation strategies, the head of department was responsible in 84% of the responding municipalities. In an average of 65%, of the participating municipalities the mayor, city counselor or an employee was in charge (Roeding et al., 2019c). Investigating the possibilities of citizens engaging in the development process, we observed that 88% ask questions, but only 51% get involved in the process. We also discovered that 87% of the municipalities involve external experts when developing their digital transformation strategy (Roeding et al, 2019c).

Following our results from the surveys, which were based on the results from the qualitative and quantitative content analysis and expert interviews, we identified four guidelines for the involvement of stakeholders in the development process of digital transformation strategies for municipalities (Roeding et al., 2019c). First, we found that digital transformation is a matter for executives, meaning that the development and implementation of digital strategies should be handled by the mayor or head of department. Second, we identified that digital transformation requires participatory processes, showing the importance of citizen involvement throughout the development process of digital transformation strategies while allowing citizens to take part in decision-making processes and implementation. This is important because governmental agencies are asked to align their work with the needs of their citizens, especially when drivers such as new public management and smart city movement are involved (Lane, 2000). Third, competent representatives are needed for successful digital transformation strategies in municipalities. Our findings show that different perspectives from experts, scientists, and city-owned companies can support municipalities in such strategic processes. Fourth, digital transformation is a joint task. Throughout the various processes of digital transformation strategies within governmental agencies, different personas are in charge, allowing various stakeholders to participate in digital transformation processes. Their perspectives and ideas are important, and collaboratively working on them can help municipalities overcome challenges and analyze the opportunities within digital transformation processes.

Lohmar | Digital | For everyone (P11). Against the background of the findings from papers P3, P6, and P7, we asked, "what does the complete development process of a digital transformation strategy look like?" Taking the city of Lohmar as an example, we were allowed to follow and observe the digital transformation strategy process "*Lohmar | Digital | For everyone*" over a period of 18 months. Lohmar started introducing digital transformation processes early in its governmental agencies (Schaefer et al., 2021b). First, these were across different departments, so Lohmar noticed that they would need a joint strategy to digitally transform the agency to create an impact. In March 2019, Lohmar began the process of developing its own digital transformation strategy. During an initial workshop with the board of directors and managers, the city built digital transformation competencies across its employees (Figure 4.10). Combining different stakeholders (i.e., board of directors, managers, urban society, and politicians, Lohmar was able to develop its digital transformation until December 2019, and it finalized its digital transformation strategy by including project proposals across various fields of action.

The overall process for developing Lohmar's digital transformation strategy is managed by the mayor's office and the Chief Digital Officer (CDO) along with close coordination with the Executive Board (Schaefer et al., 2021b). To moderate workshops regarding the development of a digital transformation strategy, researchers from the University of Siegen were invited. Lohmar also established a project management office (PMO) to monitor the planned strategic path. Lohmar´s CDO manages the PMO. However, to engage with its citizens, Lohmar has introduced a social media team to support the communication of news and services. It also developed an online platform on which citizens can share, ask questions, and help shape project ideas around Lohmar's digital transformation strategy (Schaefer et al., 2021b). The social media team and the online platform support citizen participation and the progress of digital processes around the city of Lohmar (Schaefer et al., 2021b).

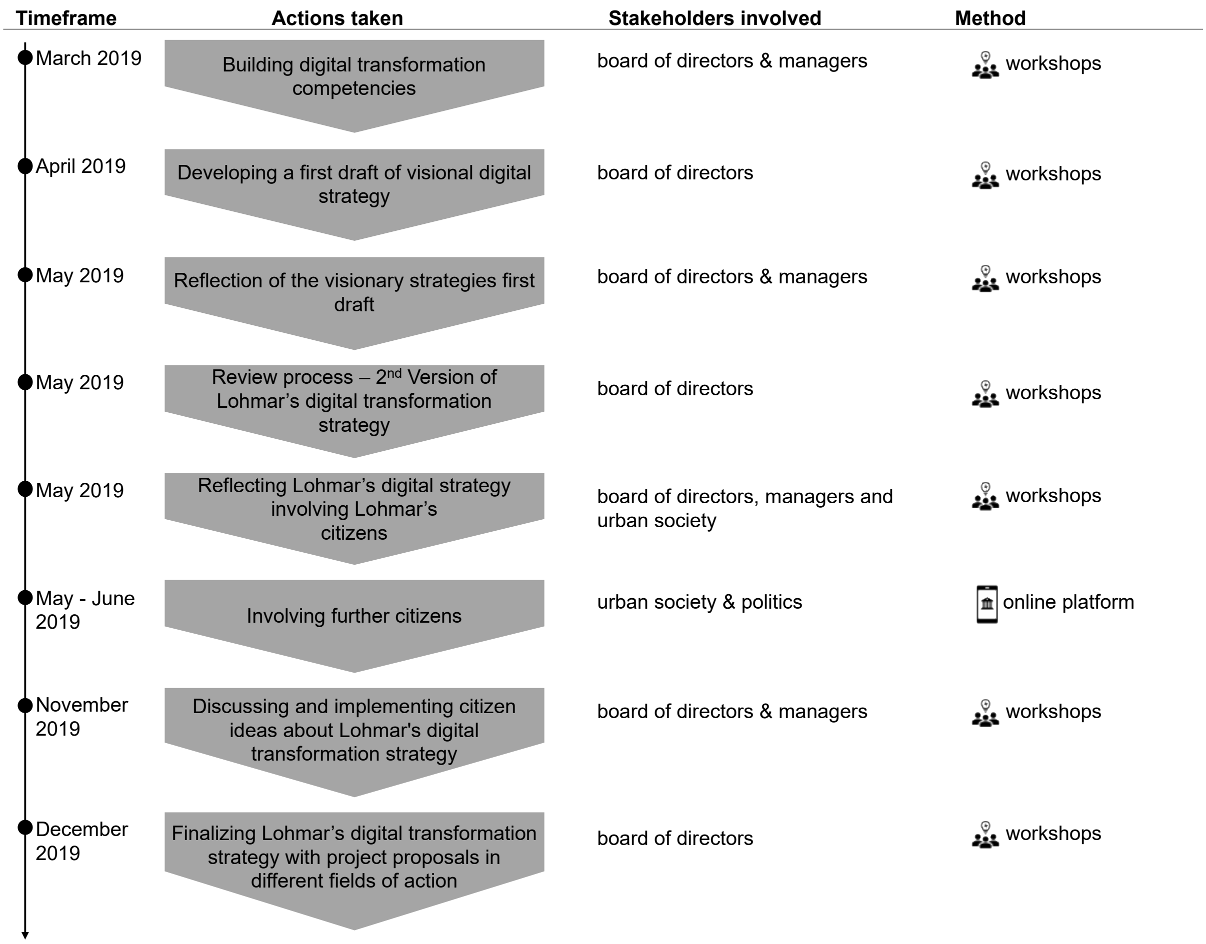

Figure 4.10 Development of the digital transformation strategy (Source: Schaefer et al., 2021b)

The findings of the strategies identified three important aspects about the development of digital transformation strategies in organizations. First, our results show that digital transformation strategies, especially for governmental agencies, are comprised of four major structural features (strategic alignment, strategy formulation, core themes, and fields of action)

(P3) (Niehaves et al., 2019). Second, we were able to show the development process of the terms and use of digital transformation strategies across two literature streams—IS and public sector research (P6). We determined that both streams describe a fusion of IT/IS strategies with business/smart city strategies in the digital age, enabling new concepts to develop, i.e., dynamic capabilities (Mithas et al., 2013) and strategy blindness (organizational incapability to realize the opportunities in digital trends and technologies) (Arvidsson et al., 2014; Roeding, 2019). Third, we were able to demonstrate who is involved in the development process of digital transformation strategies for governmental agencies (P7). We identified four guidelines: digital transformation is a matter of executives; digital transformation needs participatory processes; digital transformation strategies need competencies; and digital transformation is a joint task (Roeding et al., 2019c). These aspects could be implemented in the development process of Lohmar's digital transformation strategy (P11) (Schaefer et al., 2021b). Lohmar's development process is exhibited in Figure 4.10 and in more detail in Chapter 15. Lohmar | Digital | For Everyone.

4.4. Implementing Strategies

Aligning with RQ 3—*How can the implementation of digital transformation strategies for individuals and organizations be supported?*—we explored special cases providing concepts and technologies for the implementation of digital transformation strategies. Moving forward, we first identify IT governance strategies related to CEOs' competencies (P9). Second, we analyze the influencing factors for the adoption of AI in municipalities (P10). Third, we show the kinds of determinants that can enable AI capabilities in governmental agencies (P12). Finally, this thesis proposes establishing smart city hub architecture that enables the transformation of smart cities into hubs for data, services, people, and material flow (P13).

IT-Governance strategies and CEOs´ digital transformation competences (P9). Since IS research is a socio-technical discipline, many phenomena of interest can be seen from different points of view. P9 analyzes the influence of CEOs' digital transformation competences on digital transformation processes in SMEs. We investigated the digital competences required by CEOs of SMEs for the successful digital transformation of their organizations (Weigel et al., 2020) and considered "which governance structures support existing digital competencies or compensate for missing digital competencies of CEOs of SMEs" (Weigel et al., 2019, p. 2).

In the existing IS literature, digital transformation competences (Bassellier et al., 2001; Freiman et al., 2017; Osmundsen, 2020) and IT governance strategies (Fisher et al., 2006; Peterson, 2004) are widely discussed topics in their own right. Digital transformation competencies are structured through explicit and implicit (tacit) knowledge. Aligned to Bassellier et al. (2001), explicit knowledge defines formal knowledge and is comprised of five components: technology, applications, system development, management of IT, and access to IT knowledge (Bassellier et al., 2001; Weigel et al., 2020). Implicit or tacit knowledge describes the experience and cognition of a manager defining the "ability to perform well" (Bassellier et al., 2001, p. 164). However, IT governance defines how "the enterprise management system through an organization's portfolio of IT systems is directed and controlled" (Peterson, 2004, p. 8). Aligned to Wilkin et al. (2016), the strategic alignment of business and IT, clarity about responsibilities, and stakeholder involvement are the key benefits of IT governance (Wilkin et al., 2016). These benefits align with our findings from P3, P6, P7 and P11, as they describe structural features of digital transformation strategies. In sum, these benefits lead to a highly competitive advantage (Tiwana & Kim, 2015; Wu et al., 2015) aligning with our definition of digital transformation strategies. Thus, the findings from P9 show what kind of IT governance strategies are needed depending on the competencies of CEOs in SMEs.

Supporting the development of digital transformation capabilities and competences in relation to managers and employees, P9 shows six IT governance strategies across three subordinate structuring levels. First, there is a weakly structured level with strategies such as "learning structures" and "weaker structured cooperative relationships." Second, a less weak level follows strategies such as "structures of nearness, adaption and mediators" and "structures of trust between business managers and IT." Third, there is a strong level, at which "everyone must adapt" and "strong structures of distance and resistance" occur (Weigel et al., 2020) (Table 4.2).

CEO		**Organization**		**Explanation / Definition**	**No.**
IT-C	**IT-E**	**IT-K**	**IT-GS**		
Low	No	Inter nal	Weaker structured corporate relationships	These CEOs do not see their role as a digital actor, but as a driving force in digital transformation. With these impulses, the respective experts have a high degree of personal responsibility. It is therefore essential to avoid	*6, 7, 12, 13, 15*

				hierarchic structures, but rather to create network structures.	
Low	No	External	Learning structures	Especially the smallest companies can be confronted with the problem that neither the CEO nor an employee has a high level of IT knowledge. Here it is necessary to fall back on external knowledge. However, one should use this knowledge to build up one's own knowledge in these areas.	*1, 10, 17*
Medium	No	Internal	Structures of trust between business manager and IT	If the CEO recognizes a value of digital transformation for his organization, but is not an expert himself, it is advisable to build up a strong trust structure to internal experts. The potential changes of digital transformation can be very profound.	*9, 13*
Medium	Yes	Internal / External	Structures of nearness, adaptations and mediators	The CEOs know from their experience how to develop their employees in a targeted way and how to guide them through the digital transformation. Digitization is understood holistically, and digital transformation can lead to changes in the organization. The CEO is more likely to act as a mediator.	*4, 8, 20, 18*
Medium	Yes	No	Strong structures of distance and resistances	The CEOs act as "lone fighters" in the field of digital transformation of SMEs. The companies are characterized by strongly hierarchic structures. The employees are at most involved in operational activities.	*2, 16*
High	Yes	Internal	Everyone must adapt	A field of tension can arise if the CEO and the CIO each have very high IT competencies. Here it is recommended that CEOs can adapt and that the focus is on networked, cooperative structures.	*5, 19*

Table 4.2 Overview of discovered IT competencies and the associated IT-Governance types with characterization (Source: Weigel et al., 2020)

Our findings show that CEOs' competencies can be categorized in the continuum of their explicit IT competence (IT-C) and practical IT experience (IT-E). On an organizational level, further IT knowledge (IT-K) can be implemented through the involvement of external stakeholders, i.e., scientific researchers. Based on this data, six IT governance structures (IT-GS) were examined and defined in more detail (Table 4.2). Although these results belong to the private sector, we can find particularly important aspects for implementing digital transformation strategies in organizations in general. Our results support the importance of competences in digital transformation processes followed by the significance of clarifying responsibilities. In short, we determined that, based on the competencies that CEOs have regarding digital transformation processes, the present IT governance structure can either support or hinder digital transformation progress. Depending on CEOs' competencies, external stakeholders can get involved and employees can participate in the transformation process. This is where a continuum of decision-making processes may decide upon the digital transformation culture of an organization (i.e., the "everyone must adapt" strategy) (Weigel et al., 2020)

Influencing factors for the adoption of AI (P10). Considering competencies and emerging technologies such as blockchain and AI, we sought to identify influencing factors for the adoption of new technologies, especially AI, in digital transformation processes (Schaefer et al., 2021a). P10 explores the factors that affect the adoption of new technologies (i.e., AI) in governmental agencies. In addressing the question, "which perceived challenges face employees regarding the adoption of AI in German municipalities?" (Schaefer et al., 2021a, p. 2349), we were able to prove the influence of six factors (perceived direct benefit, perceived indirect benefit, perceived technical competences, perceived financial cost, perceived industry pressure, and perceived government pressure) and identify four factors (compatibility, strategic alignment, organizational innovativeness, and perceived pressure from society) as additional perceived challenges of AI adoption (Figure 4.11) (Schaefer et al., 2021a). Figure 4.11 shows our extended framework of perceived challenges that employees face when adopting AI in German municipalities (Schaefer et al, 2021a).

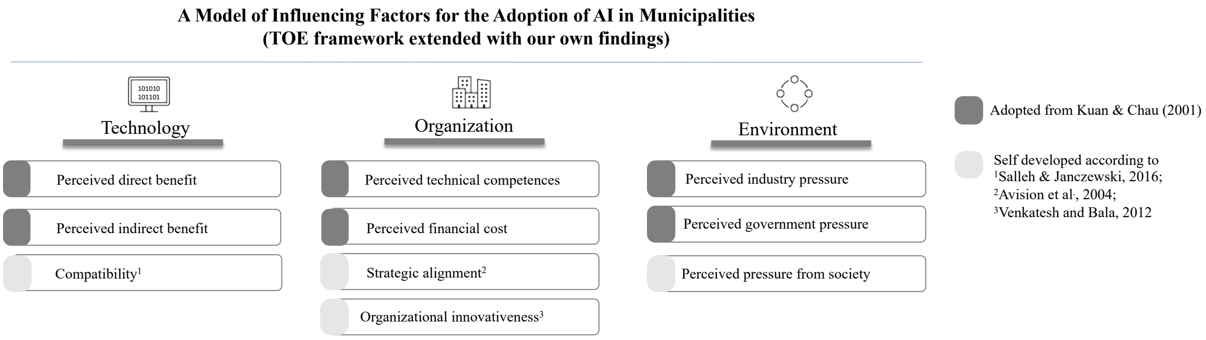

Figure 4.11 Extended TOE-framework (Source: Schaefer et al., 2021a)

In our study, we define AI as "systems that are able to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation" (Kaplan & Haenlein, 2019, p. 15). Aligning with previous research on the adoption of technology, we referred our results back to the TOE framework (Alsheibani et al., 2018; Hameed et al., 2012). The technological context describes all the technologies that are relevant for an organization, whereas the organizational context refers to the characteristics and resources of an organization (Hameed et al., 2012; Reinhart & Greiner, 2019; Schaefer et al., 2021a). However, the environmental part inhibits influences from external stakeholders and factors, such as competition from other organizations or regulatory frameworks (Pumplun et al., 2019; Schaefer et al., 2021a).

Enabling AI Capabilities in governmental agencies (P12). As we determined the factors that influence the adoption of AI, the following question arose: “What factors affect European government agencies to develop AI capabilities?” (Mikalef et al., 2021, p. 4). Building on our results in P10 (Schaefer et al., 2021a), we designed a questionnaire to analyze the factors that determine AI capabilities in three European countries (Finland, Germany, and Norway) (Mikalef et al., 2021).

Based on the TOE framework, we hypothesized factors belonging to the technological, organizational, and environmental context to influence AI capabilities in governmental agencies (Figure 4.12).

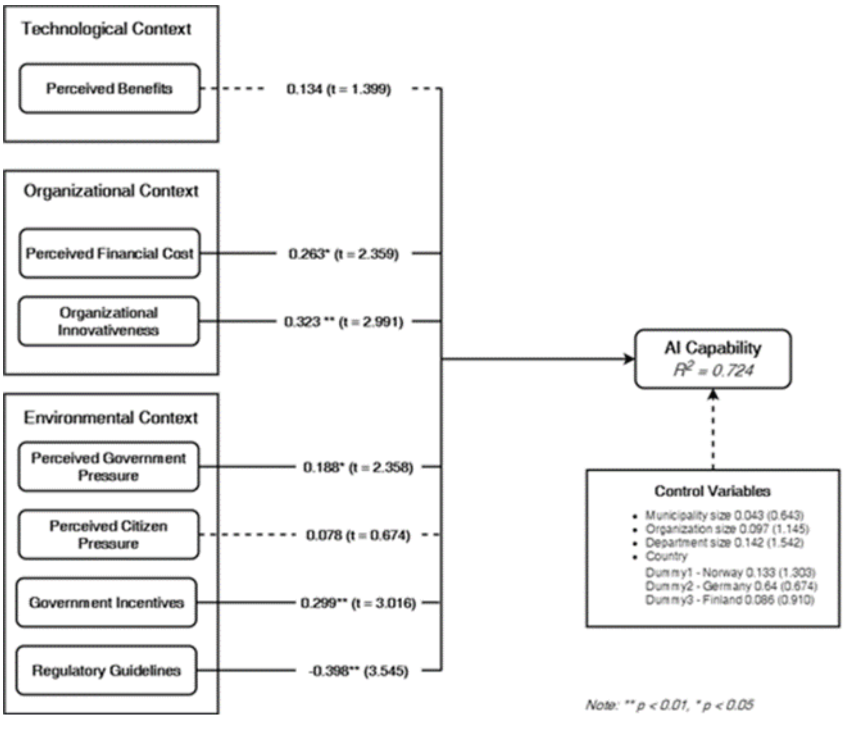

Figure 4.12 Results of the PLS-PM estimation (β* significant p<.01, β** significant p<.05, β* significant p<.1, n.s. = non-significant) (Source: Mikalef et al., 2021)**

“The structural model explains 72.4% of variance for AI capabilities (R2 = 0.724)” (Mikalef et al., 2021, p. 27). We found five out of seven determinants to be statistically significant (perceived financial cost, organizational innovativeness, perceived governmental pressure, government incentives, regulatory guidelines) (Figure 4.12). However, we determined that regulatory guidelines have a strong negative effect on AI capabilities (ß = -0.398, t = 3.545, $p < 0.01$). This might be because guidelines can hinder further maturation of AI in public agencies, due to the restrictive manner in imposing constraints (Mikalef et al., 2021). We also found that perceived direct benefits (ß = 0.134, t = 1.399, $p > 0.05$) and perceived citizen pressure (ß = 0.078, t = 0.674, $p > 0.05$) was not statistically relevant for enabling AI capabilities. This might be due to opportunities for digital transformation processes in general, which are already manifested in the minds of managers and CDOs. Pressure from citizens might not be significant due to them not being aware of the opportunities for AI to support processes in governmental agencies. Surprisingly, we found perceived financial costs (ß = 0.263, t = 2.359, $p < 0.05$) to have a significant effect on AI capabilities. This indicates that managers are not afraid of the costs of implementing AI but rather see the costs as an investment that they can plan for.

Smart Cities as Hubs (P13). Building upon previous research and against the background of emerging technologies (i.e., blockchain and AI), we wondered how cities are developing in general due to digital transformation processes, and how cities and governmental agencies are aligning with the transforming pressures from different stakeholders.

Previous research on the digital transformation of governmental agencies suggests that agencies and the cities they work for should focus on the needs of their citizens. In relation to the new public managements stream (Lane, 2000), the involvement of stakeholders and how they benefit from this participation can support digital transformation processes in governmental agencies and across cities. Thus, we ask, how can cities be transformed to address needs of their citizens? Are governmental agencies and cities not, more than ever, working as hubs to connect data, services, people, and material flow? How is a city transformed into a hub, and how are hubs constructed? (Anthopoulos, et al., accepted).

Aligned with IS and public sector research, we define a smart city as a city model that uses state-of-the-art IS to improve the lives of its citizens, its competitiveness against other cities, and its planning, construction, and management of smart services (Almirall, et al., 2016; Anthopoulos, Janssen, et al., 2016). The smartness of a city is shown by its ability to connect all of its resources, using IS to gain synergies that benefit its citizens, companies, and environment. This idea of smartness in connecting gives rise to the idea of a smart city functioning as a hub (Figure 4.13).

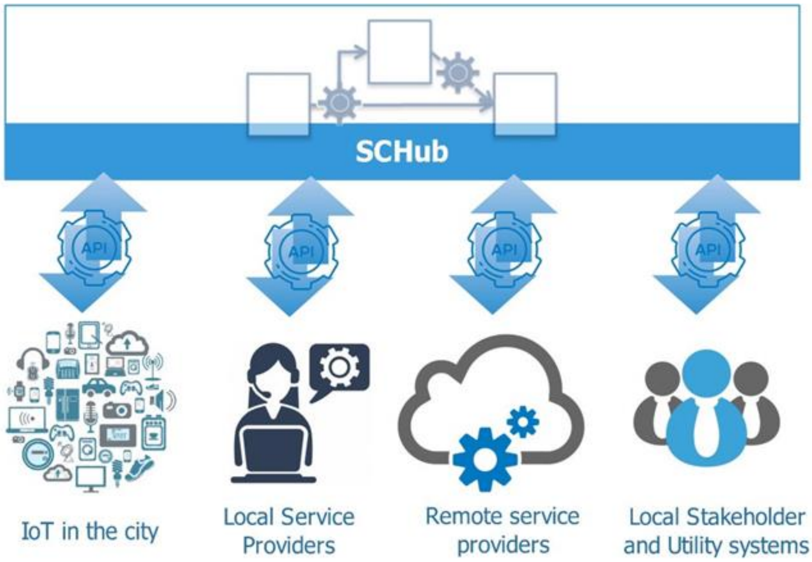

Figure 4.13 The concept of the SC Hub (Source: Anthopoulos et al., accepted)

As citizens can connect to the hub via APIs, we ask how the architecture of a hub city can be constructed to fit its tasks. We propose that the Smart City Hub consists of four layers (Figure 4.14). The context layer will include all the standards from the SC domain for its data transmission and security (Anthopoulos et al., accepted). Second, the API layer will describe, through its management, how people, companies, material flow, data, and services can connect to the hub. API management comprises the process of designing, publishing, documenting, and monitoring diverse APIs (Fremnatle et al., 2015; Raivio et al., 2011). Third, the technology layer will indicate all the infrastructures that are required to specify the hub's operations with reference to proposed data flows (Anthopoulos et al., accepted). Finally, the data transmission function will receive and send requests as well as receive responses from existing resources (Pourzolfaghar & Helfert, 2017). Figure 4.15 provides an overview of multi-partner connections enabling several use cases of the hub.

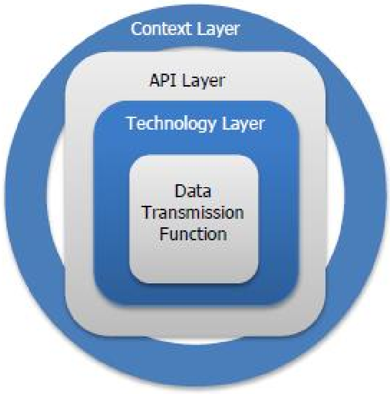

Figure 4.14 SC Hub Architecture (Source: Anthopoulos et al., accepted)

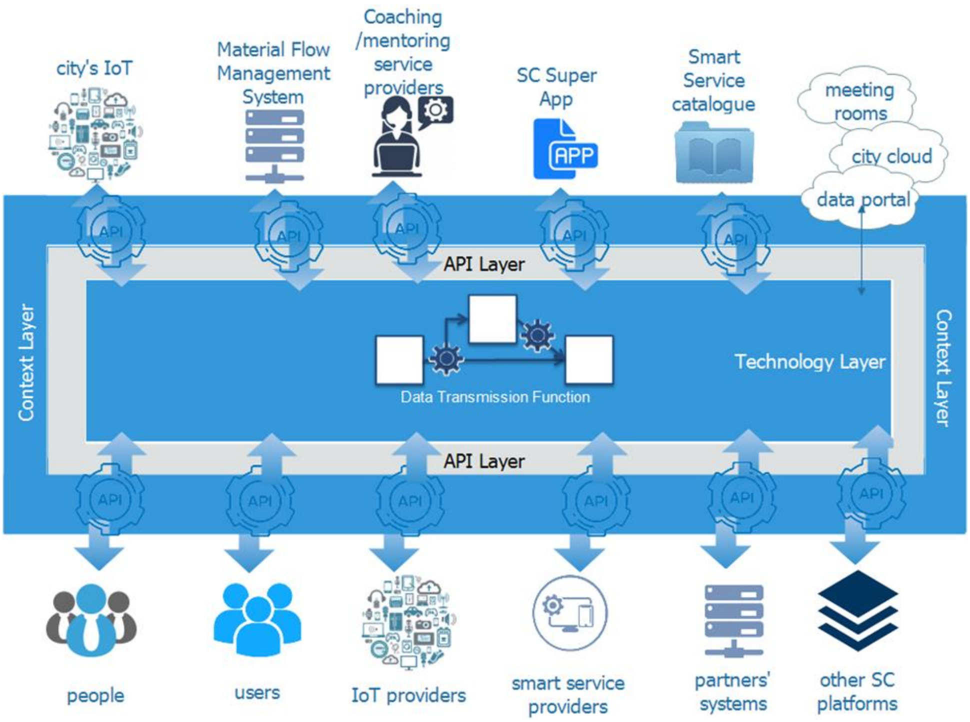

Figure 4.15 SC Hub multi-partner connections enabling several use cases (Source: Anthopoulos et al., accepted)

When implementing digital transformation strategies, there are always special cases that need to be taken care of by governmental agencies, organizations, employees, and managers. Four special cases were shown in this paper-based thesis. First, we proposed six IT governance strategies ("learning structures," "weaker structured cooperative relationships," "structures of nearness, adaption and mediators," "structures of trust between business managers and IT," "everyone must adapt," and "strong structures of distance and resistance"), which depend on CEOs' competencies for digital transformation processes in SMEs (Weigel et al., 2020) (P9).

Second (P10), by conducting qualitative interviews we identified 10 factors that influence the adoption of AI in governmental agencies (perceived direct benefit, perceived indirect benefit, perceived technical competences, perceived financial cost, perceived industry pressure, perceived government pressure, compatibility, strategic alignment, organizational innovativeness, and perceived pressure from society) and tested these in relation to their effect on AI capabilities in P10 (Schaefer et al., 2021a). We found five statistically significant determinants (perceived financial cost, organizational innovativeness, perceived governmental pressure, government incentives, regulatory guidelines) that affected the AI capability of governmental agencies across Europe (Mikalef et al., 2021). Finally, in P13, we were able to bring together various research on strategic, technological, and environmental factors, demonstrating how smart cities can be transformed into hubs, connecting data, services, people, and material flows, by implementing their digital transformation strategy (Anthopoulos et al., accepted).

4.5. Propositions on Digital Transformation Strategies

Based on the findings in this chapter, this paper-based thesis found four propositions aligned to its research questions. First, with emerging technologies such as blockchain and AI, new technologies will continually find their way into the lives of individuals (Alsheibani et al., 2018). With the emergence of AI and its technology implemented in digital assistants (Boyd & Wilson, 2018; Milhorat et al., 2014) the transformation strategies of individuals in relation to their work and private lives will become more important. For this, first, individuals need to be aware of their preferences and second, they need to have enough digital transformation competences to engage with their assistant to communicate their preferences towards the underlying AI.

Proposition 1: In research and practice, strategies of the individual will become more relevant as digital assistants support individuals to cope with transformation processes.

Second, aligning to the results of strategies for organizations, we found that governmental agencies are still opening processes of digital transformation starting with the development process of their strategies (Niehaves et al., 2019; Roeding, 2019; Roeding et al., 2019c). This status shows that topics such as monitoring are not yet present (c.f. chapters 12 [P3] and chapter

14 [P7]) but they will evolve due to being important for municipalities in the next couple of years. Against this background, this paper-based thesis suggests the following.

Proposition 2: *Monitoring the digital transformation strategies of organizations (i.e., governmental agencies) will become more important as a structural feature of digital transformation strategies during the next few years.*

Third, referring to results of P9, digital transformation competences across organizations and their employees, managers, and stakeholders will become more important. We determined that the competences of CDOs have an influence on organizational performance when aligned to IT governance structures (Weigel et al., 2020). Thus, this paper-based thesis proposes the following:

Proposition 3: *Digital competences for transformation processes will be essential for successful digital transformation processes*.

Based on our findings, this thesis also proposes that the skills and responsibilities of CDOs have a significant impact on the successful digital transformation of organizations, i.e., governmental agencies (Weigel et al., 2020). Thus, this paper-based thesis proposes that the definition of CDOs' roles, based on their competences and responsibilities, will decide upon a successful digital transformation within organizations (i.e., governmental agencies).

Proposition 4: *The definition of the role and responsibility of CDOs in organizations (i.e., governmental agencies) will decide upon the organization's success across their digital transformation processes*.

5. Discussion and Conclusion

5.1. Contribution to Theory and Practice

The overall objective of this paper-based thesis is to provide a better understanding of digital transformation strategies for individuals and organizations. Aligned with Klesel (2019) and based on the results of the empirical studies presented in this thesis, the main contributions are discussed in the light of theoretical and practical implications.

Ad *RQ 1*: *What kinds of IT-related strategies and tactics do individuals use to cope with the rising demands of digital transformation processes on their private and work lives?*

Regarding RQ 1, this thesis contributes to IS research in three ways: first, it provides six IT-related individual tactics (physical detachment, automatic response, pull information, boundary app, push information, dynamic filtering) for managing boundaries between individuals' work and private lives (Jahn et al., 2016). With these results, we were able to contribute to boundary theory (Ashforth et al., 2000; Cecchinato et al., 2015; Duxbury et al., 2014; Köffer, Anlauf, et al., 2015; Kreiner et al., 2009; Nippert-Eng, 1996) by differentiating technology related tactics (Kreiner et al., 2009) by showing that strategies and tactics help to reduce work–life conflict (Duxbury et al., 2014) and by extending our research beyond e-mail communication, thereby identifying tactics for a broad variety of IS-use scenarios (Cecchinato et al., 2015).

Second, in relation to our findings regarding the transgressive use of technology, we contribute to existing literature along the four dimensions of transgressive use (Klesel et al., 2017). We were able to extend the scope of technology use (Burton-Jones & Straub, 2006) by including new dimensions such as boundary crossing. We were also able to show that transgressive use and its explorative use behavior is in line with the enhanced use of technology (Bagayogo et al., 2014, Klesel et al., 2017). Additionally, we could contribute to the individualization of IS (Baskerville, 2011; Niehaves et al., 2012) by including individualization as a major aspect of transgressive use (Klesel et al., 2017). As we propose the degree of intensity to be a central aspect of transgressive use, literature on the duration and frequency of technology use (Soror et al., 2015) can be adapted to transgressive use more comprehensively.

Third, aligning to contributions to the body of knowledge regarding boundary theory and the individualization of IS, we were able to show how transgressive behavior can evolve over time due to the use of mobile devices within governmental agencies over a period of 12 months. Against this background, we were able to show that governance structures and digital competences can support the transgressive use of technology, reducing employees' work–life conflict while increasing their innovation behavior (Lemmer et al., conditionally accepted). Thus, governmental agencies can support their employees by encouraging them to build their digital transformation competencies and through IT governance structures that enable the transgressive use of technology.

Ad RQ 2: *How can the development process of digital transformation strategies for organizations (i.e., governmental agencies) be described?*

RQ 2 contributes to previous IS and public sector research in three ways: first, we were able to extend current research regarding digital transformation strategies in IS and public sector research by exploring the structural features of digital transformation strategies (Niehaves et al., 2019). As we determined four structural features (strategic alignment, strategy formulation, core themes, and fields of action), we extended the previous research on the structure, definition, and scope of digital transformation strategies for organizations (Bharadwaj et al., 2013b, 2013a; Hess et al., 2016; Matt et al., 2015), especially for governmental agencies (Shareef et al., 2012). Second, we extended current IS and public sector research by presenting the development process of a digital transformation strategy supporting the city of Lohmar (Schaefer et al., 2021b). Third, we showed the development of the terms and use of digital transformation strategies across the two domains (Roeding, 2019). These results demonstrate the fusion of IT/IS strategies and business strategies across IS and public sector research, defining digital transformation "as an organizational strategy formulated and executed by leveraging digital resources to create differential value to support or shape an organization's competitive strategy, its plan for gaining and maintaining competitive advantage." (Roeding, 2019, p. 34).

Since previous studies have analyzed the forms, functions and scope of digital transformation strategies, we were also able to extend the current research by exploring participatory elements of stakeholder involvement in the development of digital transformation strategies of organizations, which gave rise to four practical guidelines for managers and executives: digital transformation is a matter of executives; digital transformation needs participatory processes;

digital transformation strategies need competencies; and digital transformation is a joint task (Roeding et al., 2019).

Ad RQ 3: How can the implementation of digital transformation strategies for individuals and organizations be supported?

In terms of RQ 3, this thesis contributes to existing literature by investigating various aspects of the implementation process of digital transformation strategies. First, we extended the previous IS research regarding IT/IS and digital transformation competences (Bassellier et al., 2001; Freiman et al., 2017; Osmundsen, 2020) and IT governance structures in organizations (Fisher et al., 2006; Tiwana & Kim, 2015; Wu et al., 2015), by proposing six IT governance strategies ("learning structures," "weaker structured cooperative relationships," "structures of nearness, adaption and mediators," "structures of trust between business managers and IT," "everyone must adapt," and "strong structures of distance and resistance"), depending on CEOs' digital transformation competencies (Weigel et al., 2020). These results also show that the core structural features, defined responsibilities, stakeholder involvement, structural features, and governance strategies are important across sectoral levels (i.e., governmental, and private sector) to support successful digital transformation.

Second, another specific example of a special implementation case is given by the adoption of new technologies. Extending current research on the adoption of AI, we were able to prove the influence of six factors while identifying four new factors that influence the adoption of AI in organizations (i.e., governmental agencies). We found perceived direct benefit, perceived indirect benefit, perceived technical competences, perceived financial cost, perceived industry pressure, perceived government pressure, compatibility, strategic alignment, organizational innovativeness, and perceived pressure from society, extending the TOE framework by Kuan and Chau (2001) (Schaefer at al., 2021a). As a next step, we tested these factors in relation to their effect on AI capabilities, contribution to IS, and public sector research for building technology related digital capabilities in governmental agencies (Nguyen & Sidorova, 2017).

The results relate further, on a conceptional basis, on the transformation of smart cities to hubs, extending current literature, especially in public sector research focusing on IS (Almirall et al., 2016; Anthopoulos, Fitsilis, et al., 2016; Anthopoulos, Janssen, et al., 2016; Anthopoulos & Reddick, 2016). Besides its theoretical contribution, this research explores a hub architecture that can be tested in practice giving CDOs, mayors, managers, citizens, and vendors guidelines to transform their cities into hubs connecting data, services, people, and material flow (Anthopoulos, et al., accepted).

5.2. Limitations and Future Research

Limitations. As with every research paper, this thesis has several limitations. Aligning with Klesel (2019), this section focuses on the limitations of the overall thesis while major limitations of individual studies are mentioned in each paper (Klesel, 2019).

First, because the papers have been published over a period of more than four years, research on digital transformation strategies and related methodologies has developed significantly (Mergel et al., 2019; Roeding, 2019). For instance, research on digital transformation strategies (Datta & Nwankpa, 2021; Jedynak et al., 2021; Van Veldhoven & Vanthienen, 2021) and, in particular, the use of individuals' IS to manage work and private life boundaries have grown with the occurrence of COVID-19 (Bhattacherjee & Premkumar, 2004; Kerman et al., 2021; Perreault & Power, 2021). Similarly, terminology relating to digital transformation strategies has changed during this time (Mergel et al., 2019). For example, several studies focus on digital strategies, digitization, or digital transformation. Aligning with Klesel et al. (2019), research results can vary in terms of their interpretation and scope (Klesel, 2019).

Second, the purpose of this thesis is the acknowledgement of multiple facets of digital transformation strategies. However, this thesis limits an in-depth investigation of underlying theoretical constructs and effects. Future research can focus on these limitations and draw from these paper-based insights to investigate the effects of digital transformation strategies in the long term, with a particular focus on the development of strategic monitoring with underlying theories.

Third, at its core, this paper-based thesis investigates both individual and organizational aspects. Thus, several aspects and opinions of individuals were transferred to an organizational level. However, future research could specifically analyze developed digital transformation strategies and IT governance structures or AI strategies to obtain more objective results at the organizational level. These strategies and structures will need to be developed and implemented in the majority of private or public sector organizations.

Future research. In this paper-based thesis, P4, P5 and P8 propose future research ideas. First, P4 proposes a way to improve employees' cognitive performance while using physical feedback and avatar design with self-presence to influence their cognitive performance (chapter 16). Second, P5 and P8 suggest two types of experiment to support employees cope with IS to manage their work and private life domains. In particular, P5 proposes an investigation into the influence of avoidance training for work and private life domains on perceived strain, psychological detachment from work, and the work approach bias of employees. In P8, we hypothesize that "work avoidance training leads to lower perceived strain (H1), higher psychological detachment (H2), and lower work approach bias (H3) than private life avoidance training" (Roeding et al., 2019a, p. 2). Third, following our objectives to reduce employees' work–life conflict, Roeding et al. (2019b) propose extending recent research by Jahn et al. (2016), hypothesizing the influence of boundary preference design and automaticity on perceived usefulness and the work–life conflict of employees. These effects are moderated by individuals' boundary preferences. For example, "individuals with a separation preference experience higher perceived usefulness for separated boundary preference design (compared to integrated design) whereas individuals with an integration preference experience higher perceived usefulness for integrated boundary design (compared to separated design)" (Roeding, et al., 2019b, p. 6).

In addition, as a summary of its major findings, this paper-based thesis outlines four propositions, which suggest future research (c.f. chapter 4.5). These propositions address work–life management in relation to the emergence of digital assistants, the monitoring of digital transformation strategies, the success of digital transformation processes based on digital transformation competences, and the definition and role of CDOs in organizations. Hence, this paper-based thesis looks forward to future research that addresses these concluding propositions as an outlook for research and practice.

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Part B

RESEARCH ARTICLES

"Strategy is a pattern in a stream of decisions."

— Henry Mintzberg

I STRATEGIES OF THE INDIVIDUAL

7. Individual Boundary Management

Paper Number	**P1**
Title	**Individual Boundary Management: An Empirical Investigation on Technology-Related Tactics**
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Table 7.1 Fact Sheet Publication

Individual Boundary Management: An Empirical Investigation on Technology-Related Tactics

Abstract. Elevated through the increasing digitalization, employees are expected to be available always and everywhere. According to boundary theory, individuals can manage their boundaries between work and private life on a continuum of integration and separation. As individuals have different preferences for integration or separation, they are implementing IT tactics to meet their preferences. However, there is a lack of research addressing this topic. Therefore, we used an exploratory approach using tools from Grounded Theory in order to detect IT-related tactics which employees use to manage their boundaries between work and private life in a way that is in line with their preferences. We identified six tactics that varied in their ability to foster integration or separation and could be administered either manually or automatically. These tactics ranged from physical detachment in which employees separate work and private life manually through creating distance between the device and themselves up to dynamic filters with which the device automatically filters messages from different people and lets only relevant messages come through.

Keywords: Boundary Theory, Boundary Management, Individual IT Tactics

7.1. Introduction

Due to the technological evolution of mobile technologies including smartphones, tablets and wearables, job-related tasks can be performed nearly anywhere and anytime (Karanasios & Allen 2014; Reyt & Wiesenfeld 2015). According to a forecast from the International Data Corporation (IDC) in 2015, mobile worker population will grow steadily in the next years, increasing from ca. 96 million in 2015 to over 100 million mobile workers in 2020 – only in the U.S. By the end of the forecast period, mobile workers will account for almost three quarters of the total U.S. workforce (IDC 2015). Key drivers behind the growth of mobile workers includes reduced prices of smartphones and tablets combined with the growing acceptance of corporate bring your own device (BYOD) programs in organizations (IDC 2015). Additionally, technological innovations such as wearables, near-field communications (NFC), voice control and augmented reality are enabling workers to increase their productivity by optimizing communication along organizational workflows (IDC 2015).

Based on the technological advancement, there is a fundamental change with regard to workplace design, i.e. working times are getting more flexible and workplaces are getting location-independent. Therefore, organizations are facing new demands, norms and a cultural change. Concepts like BYOD ("Bring Your Own Device") and IT-Consumerization (Köffer, Ortbach, Junglas, Niehaves, & Harris 2015) are well-known examples and force organizations to rethink their policies and cultures with regard to the organizational use of technology.

Previous research on the use of mobile technologies has found both positive and negative effects on an individual's work and private life domain (Allen, Cho, & Meier 2014). Besides positive effects (e.g. increased productivity in business tasks (Cecchinato, Cox, & Bird 2015; Cousins & Robey 2015; Duxbury, Higgins, Smart, & Stevenson 2014; Fleck, Cox, & Robison)), tensions between work and family domains (Kreiner et al. 2009) can have a negative impact on an individual, resulting in stress or work and private domain overload (Kreiner, Hollensbe, & Sheep 2009). Individuals may lose control over their boundaries between work and private life domains (Jackson et al. 2006) resulting in a change from "work anytime and anywhere" to "work all the time and everywhere" (Cousins & Robey 2015; Davis 2002).

In the last decades, researchers have used boundary and border theory to analyse how individuals manage boundaries between work and family domains. Different boundary management tactics, styles and strategies have been developed (Allen et al. 2014). For example, Kreiner et al. (2009) describe different tactics priests use to leverage their technology in order to organize their boundaries within behavioural tactics. Findings of Duxbury et al. (2014) of the adoption and use of Blackberry smartphones indicate that successful boundary management depends on the development of a strategy in order to manage the device prior to adoption. However, research on technology related boundary tactics is sparse. Against this background, the objective of this study is to facilitate greater understanding of individual tactics to manage the boundaries between work and private life domains using information technology.

To answer this objective, the paper is structured as follows. First, we will define and describe the core themes of our study, namely boundary and border theory, and will explain how they have been used in general and in IS literature specifically (Section 2). After explaining our methodological approach (Section 3), we will present our findings in Section 4. In section 5, we will conceptualize and integrate our findings and discuss them in terms of potential generalization beyond our area of interest (Section 6). The paper concludes with an outlook, formulating the limitations as well as implications for future research and practice (Section 7).

7.2. Related Work

7.2.1. Boundary Theory

Boundary theory (Ashforth, Kreiner, & Fugate 2000; Clark 2000; Nippert-Eng 1996; Reyt & Wiesenfeld 2015; Rothbard, Phillips, & Dumas 2005) refers to the way in which people try to create, maintain, change, simplify or order their environment. Specifically, boundary theory focuses on boundaries between roles. Katz and Kahn (1978) outline roles as expectation, placed on an individual in a social system. Therefore, in the context of our study we use the term boundary to describe a limitation of space and edge of a role, varying on a continuum from thin to thick (Allen et al. 2014; Kreiner et al. 2009). Thin boundaries are associated with being weak and open to influence, whereas thick boundaries are supposed to be strong and not influenceable (Ashforth et al. 2000; Hartmann 1991).

Boundary theory has been used in different contexts e.g. psychology, organization theory and political science (Kreiner et al. 2009). Based on a cognitive theory of social classification with the focus on how people prioritize work and home (Allen et al. 2014) boundary theory evolved from sociological work of Nippert-Eng (1996). When applied to the work and family literature, boundary theory describes key challenges individuals face, managing work roles (e.g. as an employee) and family roles (e.g. as a parent) and the transition between those two roles, as they are defined as distinct from one another (Ashforth et al. 2000; Hall & Richter 1988; Kossek & Lautsch 2008; Nippert-Eng 1996). The transition between those roles, as described above, can be of a psychological or physical way and can differ, regarding an individual's preference in terms of their flexibility and permeability (Ashforth et al. 2000). Due to the variance of transitions a continuum of border demarcation arises, showing on the one-hand integrators, (individuals, drawing a thin line between work and family roles) and on the other-hand separators (individuals, drawing a thick line between work and family roles) (Nippert-Eng 1996). Ashforth et al. (2000) further distinguish between macro (infrequent, involving permanent change) and micro transitions (frequent, involving routine activities).

7.2.2. Boundary Management – Preferences, Tactics and Styles

Research of boundary theory states that there is a difference between boundary preferences, tactics and styles. Kreiner (2006) describes boundary preferences as an individual's preferences of either implementing or segmenting aspects of work and private life domains. An important aspect is that an individual's preference describes the wish of an ideal boundary management.

Therefore, individuals use tactics to create their preferred style of segmentation or integration (Kreiner et al. 2009). Whereas the boundary preferences refer to the integration or segmentation preference, the boundary styles refer to the actual enactment of integration or segmentation (Kossek, Rudermann, Braddy, & Hannum 2012).

Kossek and Lautsch (2008) identified three different boundary management styles: integrators (blending work and family domains), separators (dividing work and family domains) and volleyers (switching between those two strategies). In order to define boundary management in more detail, different frameworks developed over time (Allen et al. 2014). Allen et al. (2014) identified two lines of research that arose based on Kossek and Lautsch (2008). One line identifies specific boundary management tactics (Kreiner et al. 2009; Sturges 2012) whereas the other line analyses boundary management styles (Ammons 2013; Kossek et al. 2012).

Kossek et al. (2012) defined six different clusters that can be used to classify individuals that describe how an individual manage its personal preferences of boundary styles. These six clusters ("work-warriors", "overwhelmed reactors", "family guardians", "fusion lovers", "dividers" and "nonwork-electrics") differ regarding their control of demarcation, focus on work or family domains and break-behaviour of boundaries (e.g. "fusion lover" and "nonwork-electrics" have a high control in contrast to "work warriors" and "overwhelmed reactors", whereas "fusion lovers" and "overwhelmed reactors" both focus on both work and family and "work warriors" and "nonworkelectrics" describe the ends of boundary continuums) – focusing on either work for "work warriors" or maintaining a small identification with their family for "nonwork-electrics". Break-behaviour of "work warriors" is defined by a high permeation from work to private, whereas "overwhelmed reactors" are described by a break-behaviour in both directions – work and family. "Fusion lovers" and "nonwork-electrics" tend to integrate both break-behaviour patterns allowing work permeation during family time and the other way around (Kossek et al. 2012).

Since individuals are able to actively change their boundary style, Kreiner et al. (2009) describe tactics individuals use in order to design their preferred living of work-home integration and segmentation in daily life. These tactics can be of behavioural (e.g. involving other people), temporal (e.g. controlling work time), physical (e.g. managing separate artifacts for work and family domains) or communicative style (e.g. confronting boundary violaters either during or after a violation (Kreiner et al. 2009).

We carefully note that some work has been done in extant literature describing boundary management tactics using information technology. For instance Kreiner et al. (2009) describe a microcategory called “leveraging technology” which is a sub-category of behavioural tactics. This microtactic is linking directly to the use of information technology to manage boundary strategies. In his comprehensive study with Priests, they identify the use of voice-mail, caller ID, e-mail and the Palm Pilot Calendar as technologies that help them to facilitate their boundary management. Similarly, Duxbury et al. (2014) discovered individuals as not being able to segment between the two domains due to a lack of self-discipline and self-control when using smartphones (e.g. Blackberry). Köffer et al. (2015) found six technology-related aspects (dual use of company IT for private task, dual use of private IT for work tasks, remote access to work data, distinct devices for private and work purposes, separate private and business accounts and quality of company provided IT), explaining the intensified professional use of IT. They concentrate on IT which was originally developed for the consumer market to manage boundaries between work and private life domains. Cecchinato et al. (2015) observe the use of e-mail accounts across devices to manage boundaries in more detail, finding micro-boundary strategies in e-mail management.

Although there has been significant research in the field of boundary management so far, only limited research addresses technological aspects on boundary management. Against the background of technological advancement including the emergence of IT Consumerization previous research show that technology influence boundary management (Köffer et al. 2015). Consequently, more research is needed to shed light on technology related boundary management.

Therefore, we want to bridge this gap by further differentiating information technology microtactics. In order to identify these tactics, we conduct an explorative study with the objective to uncover IS tactics used by individuals to manage their boundary styles. Taking a qualitative approach, we build on the foundation of Kreiner et al. (2009), Kossek et al. (2006), Köffer et al. (2015) and Cecchinato et al. (2015) and extend current research by including technology related aspects. In order to address our aim, our research is guided by the following research question:

RQ: How do individuals use IT in order to manage their boundaries between work and private life?

7.3. Research Method

Method selection. Although various studies from psychology and organizational science already explored and analysed individual tactics and strategies to maintain boundaries, information systems research did not exploit the full potential of boundary theory so far. Therefore, this research pursues an explorative approach, to gain insights on how individuals use information systems to implement boundary management tactics. Based on the explorative nature of this study, we made use of tools from Grounded Theory methodology (Glaser & Strauss 1967; Urquhart, Lehmann, & Myers 2010) which is explained next.

Data collection. We conducted a total of 15 interviews (10 males, 5 females). The participants were selected out of different organisations including industrial sector, financial sector, IT-business and public sector. An overview of the interviewees is presented in Table 7.2

Position	**No of Interviewees**	**Average work experience in years**	**Number of the interviews**
Employee	9	6	1, 2, 3, 4, 5, 7, 8, 11, 13
Manager	6	14	6, 9, 10, 12, 14, 15

Table 7.2 Overview of Interviewees

We conducted a two-step approach to conceptualize individual tactics. First, we conducted four semi-structured interviews. We included open questions like "*Do you separate private and business technology?*" or *"What are technological approaches to meet your boundary preferences?"* In this first round, we interviewed doctoral students from the business faculty (employees), because they are provided with mobile technologies and they have a great degree of freedom on how, when and where they work since they are generally managed by objectives.

Based on this first step, we further adapted our questions. We continued by interviewing another eleven individuals from industry. To get insights from different hierarchies, we included both employees and manager. Furthermore, we particularly included practitioners with working experience (9.2 years of working experience in average) to capture individual strategies that have been already implemented.

Data analysis. Following the Grounded Theory approach, we analysed the data beginning with open coding (Corbin & Strauss 1990; Glaser & Strauss 1967). Three of the researchers implemented the procedure of *open coding* independently. They read the transcribed interviews and proposed codes that represent the content. Afterwards, similar codes were collected out of the interviews and grouped as a common denominator what is known as *axial coding*. For instance, for the subsequent citation "*I own an IPhone and it is equipped with the tool to only permit phone calls from people which I chose, at the times which I selected.*" (Interview 1), three independent codes ("filtering", "manage communication", and "automatic filtering") were found. Finally, "filtering" was used as an axial code. Disagreements were discussed with the remaining researchers and settled by a mutual agreement.

We finished our process when all researchers agreed that there is only little chance that new essential concepts would emerge. Since our data highlights key aspects of the integration or separation between work and life, we finish our analysis by relating our results with existing literature (theoretical coding, Section 5).

7.4. Findings

Physical detachment. Kreiner et al. (2009) analysed physical tactics describing dismantling local boundaries between work and private life domains. However, Kreiner et al. (2009) did not link physical tactics to IT. When looking at the interviews, we noticed that employees, having two devices, for example a private device and a corporate device, tend to separate between those two devices. Most commonly, they separate based on the ownership. Therefore, the corporate owned one is exclusively used for work and the private device in exclusively used for private purposes. The following excerpt illustrates this behaviour:

> *"Ultimately, that's why I own two smartphones, one for work and one for my private matters. The same for computers. Generally, I respect the separation to use the company device only for work related issues and my private phone or laptop for everything else. [...] Well, that means, I keep the usage of my private device for company matters to the minimum. I would glance at emails via a SharePoint, but I would never download an Outlook Client to have fully access to my company emails." (Interview 12)*

For example, when looking at the private life domain, ways to foster separation using mobile devices could consist of leaving the corporate device at work, switching it off or to turn it to a silent mode. The following quote shows an individual separating using two ways. First, the silent mode is used in order to prevent interruption. Second, he puts the corporate smartphone aside in order to prevent a confrontation with checking it for notifications:

> *"After my working time, when I am at home or in the gym, I put my phone away – in silent modethen I don´t realize that a message or a call came in and I won´t answer it." (Interview 15)*

Automatic notification. As technology enables the automatization of processes, it also opens the door for the individual boundary tactic, especially, in terms of communication applications there are prevailing ready-to-use configurations to define automatic notifications for instance in terms of absence times. A common use of automatic notifications can be found in E-Mail applications. The following excerpt describe how one employee use automatic E-Mail notifications.

> *"I assigned my email account to automatically answer received emails with the message "Thank you very much for your email, however right now I am unable to answer it, I will be back on XY-day." Obviously, after this email is sent and I return, I will check back to answer it appropriately. Then, of course, it will be my problem." (Interview 13)*

Although this excerpt illustrates how automatic notifications can be used, it also emphasize the importance of individual behaviour. Conclusively, if an individual uses that tactic to separate, at this point, technology does not enforce a strict separation.

Pull information. There are different ways of getting access to phone calls, e-mails and further information and notifications. Pulling information describes an individual's behaviour to inquire their current notifications. One way is described as choosing where and when to get access to information and notifications. One employee describes his preference to pull e-mails from web account browser in order to be able to decide when and where to check e-mails:

> *"I determine the time. […] That´s why I usually use the browser to access my emails. Using the online account, I decide when to check work emails." (Interview 13)*

Another employee states his preference on pulling information as viewing notifications on his smartphone, when turned on the silent mode, anytime and anywhere he prefers to:

> *"Most of the time, my private phone is in silent mode. Now and then, I would check if someone texted me and I would answer, although I am at work. It also depends on the moment, if I am very busy or if I have a little downtime to check my messages." (Interview 9)*

Pulling information is described by another employee as a routine defining when and where to check e-mails regarding, working together across different time zones: As different time zones implicate the possibility to get e.g. e-mails anytime, anywhere from everywhere, the employee talks about a routine behavior in order to cope with this permanent flow of information. He talks about a routine describing to pull information when you want to but to answer only if you need to:

> *"As I said, the time in China is 4 am when it is 10 pm here. On the other hand, it is 10 pm here in Germany when it is afternoon in the U.S.. Since my company has offices everywhere, I could receive an email in the middle of the night. The message will be read, but by now, the routine is there." (Interview 10)*

Push Information. Another way on getting information is not to decide when and where to access these information but rather just let these information go through anywhere and to anytime. In temporal intervals, e.g. e-mails being automatically queried, an individual gets to know new notifications using vibration or sounds to signalize these. An employee illustrates below how his emails are pushed anywhere at anytime:

> *"I receive every message. I don´t block out any notification. The internet on my phone is not shut down and I don´t disable private accounts, which I administer with my MacBook.*
>
> *That means, I am available all the time. However, whether I react to the notifications depends on the problem at hand." (Interview 7)*

Another employee states how she decided to get e-mails pushed at an interval of 30 minutes in order to be up to date with her notifications:

> *"Every half an hour I receive a notification. I assume half an hour is enough time, it doesn´t have to be adjusted to a minute-by-minute routine." (Interview 3)*

Different employees confirm that setting an automatic interval in order to get notifications about received e-mails is helpful to be all the time informed about work and private life domains happenings. It is also described as easier due to not to have to log in every time in order to be able to check for example their e-mails. An interviewee states below:

> *"I think that the email account is updated every 30 minutes. […] I would have adjusted the settings similarly, to avoid logging in every time. However, this setup allows the*

> *emails to refresh automatically and I would have a look at the new emails." (Interview 4)*

Dynamic filtering. Employees who want to be available only for important issues when they are at work or at home have the opportunity to filter their incoming messages dynamically. When applying dynamic filtering, only messages or phone calls from specific individuals are received in a set time frame. For example, one employee explained that he told his smartphone to only let through phone calls from his family when he is at work.

> *"I own an IPhone and it is equipped with the tool to only permit phone calls from people which I chose, at the times which I selected. For example, from 10 am until 8 pm, only my family can reach me and they only call when it is important. All other callers are blocked. Like that, I created my own free time." (Interview 1)*

When using this tactic, employees mainly separate work and private life. They only want to integrate work and private life when an intrusion from the other domain is important enough for themselves.

Boundary App. Technology can enable employees to manage their work life balance in helping them to focus on their currently active role. When employees are engaged in their work, technology prevents interruptions from family and private life. Similarly, when employees want to have private time, technology inhibits work related interruptions. Therefore, employees can integrate and separate to a certain degree to their own preferences. One employee illustrated this with a setting in his smartphone that enabled him to switch either to work or to private life:

> *"The new Blackberrys have a feature where you are able to separate work and your private information. That means, on one device you can switch between a work mode and a private mode. The private mode is used for private emails, WhatsApp, Facebook, etc. whereas work related emails can be checked using the work mode of the phone." (Interview 14)*

However, this technology might have both positive and negative effects. The advantage of a boundary app is that one can use the same device for multiple purposes without being interrupted from another life domain. Therefore, they can integrate their work and life at whatever time they like to but still keep this time free from interruptions because they separate. As a downside, at least in the context of our interviewee, there is the risk of invading users' privacy:

"The advantage is that I only have one device. However, the downside is that I give my employer information about my private life." (Interview 14)

7.5. Conceptualization of Individual Tactics

The maturity of technology use is an important aspect with regard to our research question, because it has a major influence on how individuals implement boundary tactics. Maturity in general has been addressed in various IS studies for instance as an overall technological maturity (e.g. Karimi, Gupta, & Sommer 1996) or on an individual level based on self-efficacy (e.g. Venkatesh, Morris, Davis, & Davis 2003). Since we focus on individual tactics, self-efficacy and individual maturity in terms of technology use is most relevant. Automatization of business processes can be understood as a high level of maturity, whereby manual processes can be considered as low maturity (Dumas, La Rosa, Mendling, & Reijers 2013). Based on this distinction we propose four different domains of individual boundary tactics which are summarized in the following table.

Boundary Preference	Technological Maturity	Implementation Tactic
Integration	High (automatic process)	Integration is integrated by automatic mechanisms (e.g. dynamic filtering)
	Low (manual process)	Integration is conducted loosely through manual mechanism (e.g. manual procurement of information)
Separation	High (automatic process)	Separation is implemented by automatic mechanisms (e.g. automatic response notifications)
	Low (manual process)	Separation is conduced manually (e.g. physical detachment)

Table 7.3 Four Domains of Individual Boundary Tactics

Our findings suggest that there are various approaches to comply with the individual tactic. Since automatization of IT is often on a continuum (ranging from manual to full-automation), a strict separation is of these tactics is rarely possible. For instance, the configuration of a communication filter (e.g. disable phone-calls after 8 pm) has both manual and automatic parts. In that case, we would argue that the core mechanism, namely the filtering, is mainly automatic. Conclusively, we propose a matrix including a continuum from integration to separation (Ashforth et al. 2000) and a continuum describing the technological implementation from manual to automatic. Building on this framework, the domain-affiliation of the different tactics are summarized in Table 7.3

Individual tactic	**Primary objective**	**Examples for technological implementation**
Physical detachment	separation	Leaving technology at work when at home; turning work-related technology off when at home or turning technology silent or on vibration.
Automatic response		Using an answering machine; sending e-mail-notifications for e-mails that arrive after hours or on vacation.
Pull Information	mediation between integration and separation	Actively looking up new messages and phone calls without being informed just in time.
Boundary App		Possibility to change actively within the same technology between home and private life domains.
Push Information	integration	Being informed just in time about incoming messages and phone calls.
Dynamic Filtering		Setting up filters that let notifications of specific individuals come through.

Table 7.4 Overview of Individual Tactis

In summary, we identified six major IT tactics that allow individuals to maintain their boundary preferences. As they are located on a continuum (Ashforth et al. 2000), we recapitulate them in the following figure.

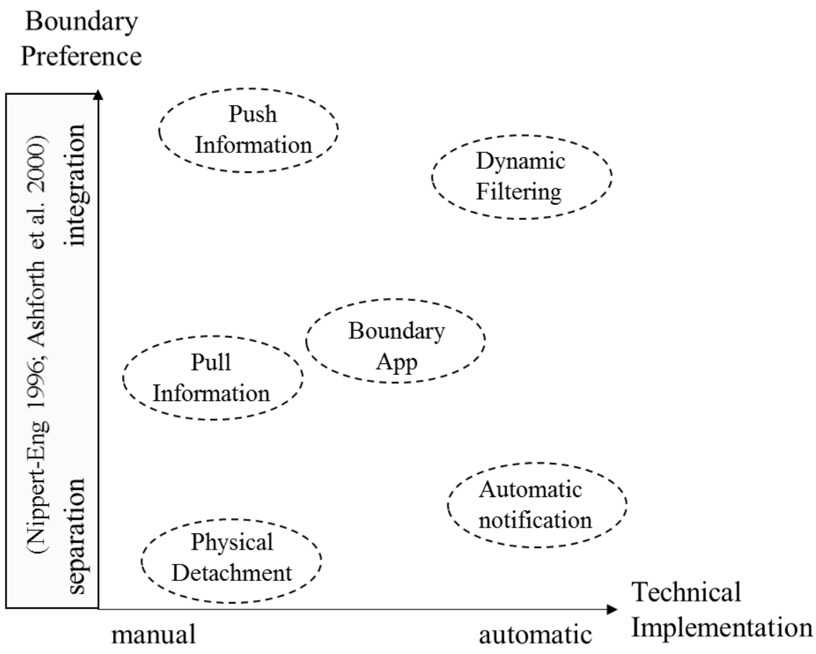

Figure 7.1 IT-related Boundary Tactics

7.6.Discussion

Summary. Information technology fundamentally influences all aspects of our life. It is therefore not surprising that IT enables a multitude of possibilities to implement and maintain individual tactics to meet one's preferences. In order to answer our research questions, we identified six different individual tactics (physical detachment, automatic notification, pull information, boundary app, push information, and dynamic filtering) and systematically categorized them with regard to boundary preferences and technical implementation (see Figure 7.1).

Implications for theory. As our findings propose a more granular distinction of technology-related tactics, they enrich the findings of previous studies. By exploring individual boundary tactics, our research primarily contributes to boundary theory (Ashforth et al. 2000; Nippert-Eng 1996). In particular, our findings enrich the boundary tactics from Kreiner et. al. (2009) by differentiating technology-related tactics. As such we added another continuum dimension besides integration and separation, namely technological implementation, to include technology-related aspects based on their automatization level.

We also contribute to the study of Duxbury et al. (2014) who describe the complex relationship between mobile technologies and individual boundaries. Their results show that developing a strategy to manage the use of mobile devices across work and private life domains is essential for reducing conflicts between work and private life domains. Our findings can be further used to analyse the relationship between mobile technologies and boundary preferences against the background of the identified technological tactics (see Figure 7.1).

Köffer et al. (2015) suggest that there are six aspects related to the consumerization of IT that influence work-life balance. They propose that the allowance or the permission of these aspects leads to work-life balance and conflict. With our findings, we further develop this idea by proposing a set of alternatives that can be used to improve individuals balance (for instance by offering a "boundary app").

Finally, we also contribute to Cecchinato et al. (2015) who put emphasize on micro-boundary strategies related to e-mail accounts. By extending our research beyond e-mail communication, we further identified technology related aspects that are relevant for individual boundary management. Specifically, the use of a mobile "app" that is used for a broad variety of scenarios (email, phone, text message etc.) allows valuable insight into individual strategies, that can be used to further develop the device management as proposed by Cecchinato et al. (2015).

Implications for practice. Based on our findings, we can derive implications for practice regarding the autonomy and the knowledge of the employee as well as the possibilities of the organization to influence an employee's boundary management. First, since individuals have different preferences in general and in terms of boundary management it is recommended that organizations try to offer enough freedom to implement them. Related to technology this can be done by offering chances to adapt and personalize technology.

Second, an individual's knowledge on technology is a main aspect on implementing boundary preferences. Without sufficient capabilities to adapt technology, individuals are not able to meet their preferences. According to person-organization fit (Chatman 1989; French, Caplan, & Van Harrison 1982; Kristof 1996) organizations are encouraged to further train their employees on how to use (mobile) technology with a focus on individual adaptation.

Finally, organizations can easily influence an individual's boundaries by setting defaults. For instance, when using a pull mechanism as default for e-mail communication, it is most likely that a great number of employees do not change to push (Thaler & Sunstein 2009). Therefore, the organization can facilitate separation between private and work life.

7.7. Limitations and Outlook

Limitations. Besides common limitations of qualitative research, this study has limitations that are worth mentioning. First, we asked the interviewees about general tactics related to IT. However, in specific scenarios, for instance employees using wearables or augmented reality technologies which can be even less separated in terms of boundaries than mobile technologies, there might be more tactics which we did not cover so far.

Furthermore, using the level of technology automation is only one possible dimension with regard to technology. Others could be mobility, complexity or ubiquity. Therefore, our findings are limited to only one specific dimension. However, our findings are well suited to transfer to other dimensions as well.

Outlook. As our study explored general tactics with regard to boundary management, our findings propose a sound foundation for future research. Especially with regard to design science, experimental research could further explain various effects by matching individual preferences and the design of IT artifacts. Furthermore, affective technologies can be included in order to be able to identify individual's preferences.

7.8. Acknowlegements

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8. Transgressive Use of Technology

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Table 8.1 Fact Sheet Publication

Transgressive Use of Technology

Abstract. Technology use is a central construct of information systems (IS) research that has been continuously reflected and re-conceptualized in order to understand use behavior. In light of the individualization of IS, use behavior has changed significantly. Therefore, existing conceptualizations, which primarily exist in a utilitarian environment, are not sufficient to explore current phenomena comprehensively. We propose transgressive use of technology as a new conceptualization of technology use that specifically acknowledges the individualization of IS. Our conceptualization is based on rich data from a multiple case study including 67 interviews from the service and manufacturing industry suggesting that transgressive use has four sub-dimensions: degree of individualization, degree of exploration, degree of boundary spanning, and degree of intensity. We show that transgressive use not only corresponds to previous conceptualizations but also extends them significantly. We conclude by providing propositions on how transgressive use can enhance future research.

Keywords: Transgressive Use of Technology, Technology Use, Case Study, Research, Individual Information Systems

8.1. Introduction

Every discipline draws from central constructs that allow researchers to proper analyze phenomena of interest. In Information Systems (IS) research, *technology use* can be considered a vital aspect. In fact, technology use has been one of the most important constructs in IS research (De- Lone and McLean 1992, 2003). As those constructs are crucial for a discipline, it is essential to ensure that they describe the phenomenon of interest in the best way possible. Therefore, continuous reflection and re-conceptualization is required.

Due to technological advancements and environmental changes, technology use has been subject to numerous extensions, adaptations, and re-conceptualizations. As a result of this ongoing process, previous literature has emphasized the multi-dimensionality of technology use (Burton-Jones and Gallivan 2007) and has proposed different notions accordingly. For instance, Barki et al. (2007) propose the notion of activity-related system use (Barki et al. 2007) that acknowledge technology-related interaction behavior. Similarly, Bagayogo et al. (2014) propose the concept of enhanced technology use that recognizes the employment of IT features.

With the rise of mobile technologies (Sørensen and Landau 2015), the ubiquity of technology (Ransbotham et al. 2016), and the individualization of technology (Baskerville 2011), technology use has changed significantly. Whereas work-related technology has traditionally been used within organizations (e.g. using terminal systems), mobile technologies, be it privately- or company owned, are now commonly used beyond geographical and time-related boundaries for both private and work-related purposes (Ashforth et al. 2000; Cousins and Robey 2015; Jahn et al. 2016; Köffer, Anlauf, et al. 2015; Kreiner et al. 2009). Therefore, it is important thinking about a reconceptualization in order to capture current trends.

In line with previous literature that has contributed to a deeper understanding of IT usage, we aim to continue this tradition in light of current developments. Specifically, we seek to shift the focus from previous conceptualizations, which have primarily directed our attention towards productivity-based technology use in the organizational realm (Burton-Jones and Straub 2006), to a new form of conceptualization that also takes into account technology use outside organizations. In doing so, we aim to capture technology use as indicated by the individualization and consumerization of IT (Baskerville 2011; Niehaves et al. 2012).

Against this background, we propose "transgressive use" of technology as a new and rich way to conceptualize technology use that has four sub-dimensions: *degree of individualization, degree of exploration, degree of boundary spanning, and degree of intensity*. It is worth emphasizing that it is not the aim of our research to question the fruitful insights of previous conceptualizations of technology use, but to explore new dimensions that have not been addressed in previous years. Therefore, our intention is not to replace current conceptualizations, but to provide a new complementary lens that can be applied to specific research questions.

There are a number of promising ways to investigate technology use that is more detached from the traditional perspective: First, previous literature has provided various concepts such as IT consumerization behavior (Ortbach et al. 2013), mobile phone use (Soror et al. 2015), or dual use of technology (Köffer et al. 2014) in order to capture contemporary technology use. The variety of constructs hinder IS research from validating related theories. Transgressive use of technology has the potential to remedy this issue. Second, a growing number of negative consequences of technology use is linked to technology use behavior (D'Arcy et al. 2014). However, current types of conceptualizations are limited as they rarely include aspects beyond organizational boundaries. Consequently, exploring the characteristics of use behavior is a promising technique to address the 'dark side of technology' (D'Arcy et al. 2014). Finally, drawing benefits from technology use remains increasingly challenging. Therefore, exploring technology use in more detail is also an important aspect of optimizing technology use in terms of performance, task-technology fit and satisfaction. In order to address our objectives, this paper is guided by the following research question (RQ):

RQ: How to conceptualize transgressive use of technology?

This paper is structured as follows. First, we describe the background of this study demonstrating the need to re-conceptualize technology use. In Section 8.3, we propose our research methodology that we choose to meet our objective in the best way possible. Next, we present the findings of our study in section 8.4. Based on our insights, we conceptualize transgressive use of technology and provide three propositions on the usefulness of transgressive use. We conclude by looking at the limitations of our study and by proposing fruitful approaches for future research.

8.2. Background

Technology use is a central aspect of IS research (Barki et al. 2007) and has been studied for several decades (Barkin and Dickson 1977; Ginzberg 1978). Therefore, the purpose of this section is not to present a comprehensive overview of related research, but to emphasize major milestones related to technology use. For a comprehensive overview of technology use as a construct, we refer to previous literature which provides an excellent in-depth analysis (e.g. Burton-Jones 2005).

There are few constructs in IS research that have received as much attention as technology use (DeLone and McLean 1992, 2003). Widely accepted theories including the technology acceptance model and its extensions (Davis 1989; Venkatesh et al. 2003, 2016), post-adoption theories (Bhattacherjee 2001; Bhattacherjee and Premkumar 2004; Karahanna et al. 1999) and research on discontinuance (Maier et al. 2015; Turel 2016) look at technology use in order to understand technology-related user behavior.

Existing research on technology use is closely linked to organizational science, assuming an organizational context. For instance, Burton-Jones and Straub (2006) base their conceptualization of technology use on the triad of user, task, and technology. Although this model does not exclude other domains (e.g. private domain), it has been widely adopted in order to explore utilitarian phenomena. In addition to that, more and more research is concerned with hedonic systems (Wu and Lu 2013). For instance, van der Heijden (2004) applied hedonic motives to his technology acceptance research. Similar objectives have been addressed in adoption literature (Lowry et al.2013) and in discontinuance research (Turel 2015).

With the emergence of modern technologies, such as smartphones, tablets or wearables, we have seen a major change in terms of end-user technologies in organizations. New forms of technology use behavior, including Bring-Your-Own-Device (Köffer, Ortbach, et al. 2015), have challenged existing models where technology has primarily been provided by the organization. Today, individuals are equipped with powerful IT, which allows them to do their work using their own devices. "*From these technologies, these individuals and family units are building complex and [..] relatively large-scale individually owned- and operated IS.*" (Baskerville 2011, p. 252). The increasing use of end-user technologies has been described as the Individualization of Information Systems (IIS) (Baskerville 2011; Gaß et al. 2015).

In line with the individualization of IS, we note that technology use is not limited to the organizational domain anymore. Previous literature provides initial evidence that the use of individual IS has a significant impact on the individual (Cousins and Robey 2015; Köffer, Anlauf, et al. 2015). Furthermore, research indicates that new opportunities provided by individual IT (such as smartphones and tablets) intensify Shadow-IT (Haag et al. 2015).

To address our research question, this study is designed to have an integrated perspective, in which IIS is considered a passage point between the organizational realm and the private realm (see Figure 8.1). Therefore, this perspective corresponds to previous concepts of technology use (Burton-Jones and Straub 2006) and the understanding of IIS (Baskerville 2011).

Existing theories have addressed contemporary developments in various ways. For example, technology acceptance models have been applied in various scenarios, including the application in households (Brown and Venkatesh 2005; Venkatesh and Brown 2001). Furthermore, technology use has also been analyzed in terms of hedonic environments (van der Heijden 2004; Lin and Bhattacherjee 2010). Similarly, the conceptualization of technology use as a construct has been adopted in various ways. For instance, Burton-Jones and Straub (2006) have called for richer conceptualizations of technology use in order to better understand individual use behavior. In this vein, the concept of IS use-related activity (Barki et al. 2007) and enhanced use of technology have also been introduced (Bagayogo et al. 2014). However, existing conceptualizations of technology use have not contributed to the individualization of IT yet.

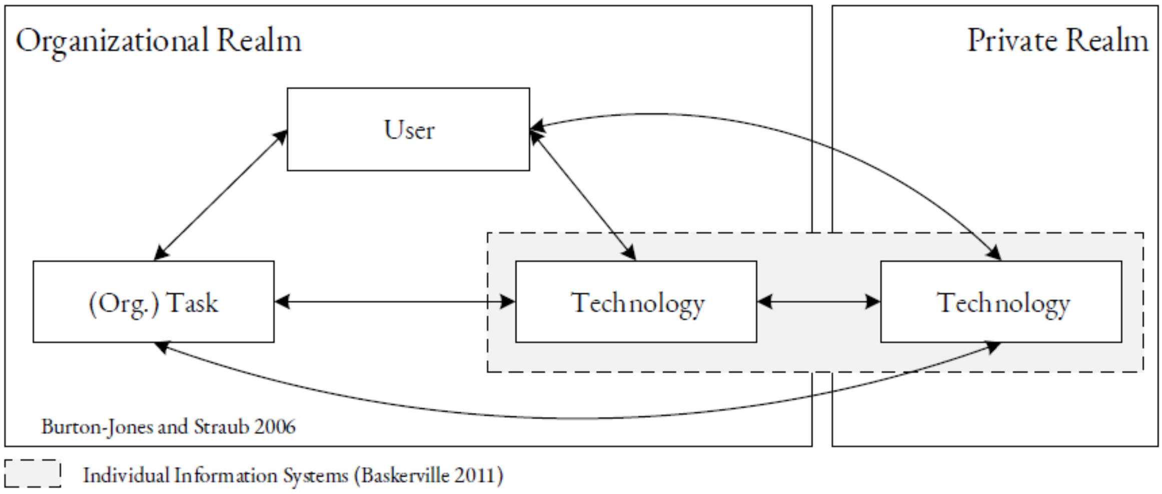

Figure 8.1 Perspective of this Study

In this paper, we propose the notion of '*transgressive use of technology'* to capture contemporary use behavior beyond organizational boundaries. Although previous literature has made considerable efforts to conceptualize use behavior in general (Bagayogo et al. 2014; Barki et al. 2007; Burton-Jones 2005), none has yet focused on technology use when boundaries are blurred and the richness of use is continuously increasing. Against this background, transgressive use seeks to conceptualize contemporary technology use by explicitly acknowledging these two dimensions. In doing so, we aim to contribute to a deeper understanding of technology use in light of the individualization of IS.

8.3. Research Model

8.3.1. Method Selection

In order to explore relevant dimensions of technology use in light of the individualization of IT, we conducted a case study (Yin 2013). Case studies are particularly useful when investing complex phenomena that have not yet been fully explored, which, in turn, does not allow for the analysis of causal relationships (Benbasat et al. 1987; Keutel et al. 2014; Yin 2013). Moreover, case studies allow an in-depth analysis of phenomena that are related to the context where those phenomena occur (Keutel et al. 2014). Since both aspects are relevant to this study, case study research is well suited for our endeavor.

It is generally assumed that the strength of case studies lies in their internal validity whilst their external validity is often considered a weakness. We took two types of measures to increase the external validity of our case study: First, the research was conducted in a team. All phases, which are described in the following, were conducted by at least two researchers. With this, we reduced idiosyncratic perceptions. Furthermore, with the use of multiple investigators, we were able to implement triangulation (investigator triangulation, Patton 2005). Second, we included multiple cases to reduce case-specific findings (Benbasat et al. 1987; Yin 2013).

8.3.2. Case Design

The context of this study is the individualization of IT (Baskerville 2011). To address our research question, we focused our attention on how individuals use both organizational and private technology beyond organizational boundaries. Therefore, the unit of analysis is the individual. As outlined above, we looked at multiple cases. Therefore, we are able to strengthen our findings in light of replication logic (Eisenhardt 1989; Yin 2013). The implementation of our case study includes four phases: pilot study, case selection, data collection, and data analysis (c.f. Figure 8.2). We briefly describe each phase in the following.

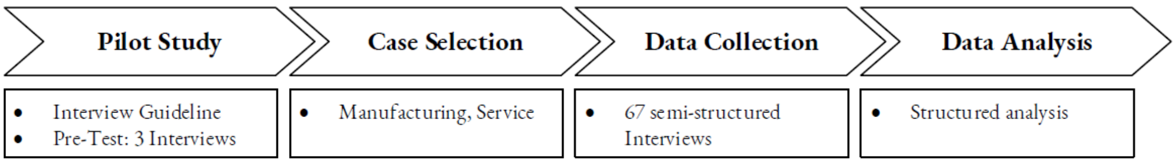

Figure 8.2 Case Study Design

8.3.3. Pilot Study

We first started with a pilot study to make sure that our questions were understandable. We recruited three employees of a mid-sized university that were affected by blurred boundaries due to their use of privately owned technology. After interviewing each of them, we carefully read the transcripts and reformulated unclear questions to make them more understandable.

8.3.4. Case Selection

After finishing our pilot study, we selected two organizations (cases). As a selection criterion, we searched for organizations that were prone to be affected by technology use outside the traditional boundaries of the organizational realm (c.f. Figure 8.1). To that end, we included a manufacturing organization (hereafter *MANUFACTURE*) as it is involved in international projects in over 30 countries, which has a high impact on working times and technology use. Since this organization is affected by blurred boundaries, it has implemented a Company Owned Privately Enabled (COPE) governance for a large amount of employees. Therefore, it can be assumed that transgressive use of technology can be found here. Additionally, we included a service organization specialized in food logistics (hereafter *SERVICE*), as this organization is highly committed to delivering foodstuff on time, which often interferes with technology use outside the organizational boundaries (e.g. due to 24-hour shifts). Again, this organization has implemented a COPE governance and is, therefore, well-suited for the investigation of transgressive use. Apart from the main selection criteria, these cases are well suited for our research question because they differ in size, number of employees, and industry. Therefore, they should provide insights beyond one specific case. An overview of the cases is provided in the following table (Table 8.2).

Case	*MANUFACTURE*	*SERVICE*
Industry	Manufacturing Industry	Food Industry
Employees	3.000	21.000
Distribution	31 foreign subsidiaries	30 domestic distribution centers
IS Governance	COPE	COPE

Table 8.2 Overview Cases

8.3.5. Data Collection

Before the actual data collection started, background information has been collected, identifying the position, age and tenure. By doing this, we ensured that the interview time was only used to collect data which could not be gathered in any other way. The data was gathered over a 3-month period between May and July 2016. As our unit of analysis is the individual, we included employees from all hierarchical levels in both cases. We conducted 70 interviews in total (3 pretest, 67 case-related). Our case-related sample includes 49 male and 18 female participants. An overview of the interviewees is presented in Table 8.3. The average age is 44.1 (SD = 8.93). The average work experience is 22.49 years (SD = 10.38).

This research follows an interview guide approach, as this is more comprehensive and systematic for data collection than a purely conversational interview. Furthermore, our interview guideline was open-ended to allow the interviewees to bring up additional concerns that we did not cover in our guidelines (Darke et al. 1998). We e-mailed the interview guide to the interviewees of both organizations in advance to give them an insight into the study. We followed the guidelines of Darke et al. (1998) who suggested conducting an interview with at least two interviewers. We recorded the interviews in order to minimize data loss and to provide a complete record of the answers and insights given by the interviewees. The duration of interviews ranged from approximately 25 minutes to 100 minutes. All interviews were transcribed completely.

Case Position	MANUFACTURE		SERVICE		Total
Employee	From ME1 to ME10	10	From SE1 toSE19	19	29
Manager	From MM1 to MM17	17	From SM1 to SM21	21	38
Total		27		40	67

Table 8.3 Overview Interviewees

8.3.6. Data Analysis

We reviewed our interview transcripts using MAXQDA 12. We specifically looked for indicators of how technology was used by individuals at work and outside their organizational domain. Although we did not intend to analyze our data based on an existing theory, we also did not assume to work with "blank slide" (Urquhart and Fernandez 2013) as indicated by the background of this study. Therefore, we draw from well-known methods from Grounded Theory (Corbin and Strauss 1990; Glaser and Strauss 1967), i.e. open coding, axial coding and selective coding. Consequently, we went through three phases of analysis.

First, we analyzed the data by means of open coding, meaning we searched for emerging aspects that were related to technology use by analyzing the interviews line by line. Within this initial phase, we took particular care that within the procedure, no themes were excluded due to previous experience or prejudice. Next, we applied what is known as axial coding to harmonize related themes. In this phase, different terminologies were discussed and integrated upon common agreement. Finally, we refined the themes in accordance with previous literature (selective coding).

As this research is explanatory in nature, it is validated by means of concatenation (Nunamaker et al. 2015; Stebbins 2001). Concatenation is similar to replication logic in experimental research, where relationships are discovered and evaluated under different conditions in various studies. Note that the point of saturation, i.e. when no new concepts emerge, makes this approach distinct from experimental research. Whereas an experiment is used to test a hypothesized relationship, new variations are undesirable. In cases where explanatory research is conducted, such as this study, concatenations provide further insights into a phenomenon.

8.4. Findings

8.4.1. The Nature of Transgressive Use

Due to the case study design of this research, which includes employees and managers with different backgrounds, our insights are very diverse. However, there are similar categories that continuously emerged in our interviews, that describe *transgressive use* from different perspectives. First, the participants commonly indicated that technological changes had a great influence on their use behavior. A manager of the service company describes it as follows:

> *"I am completely aware of the changes that have taken place in the last couple of years. The invention of the smartphone, e-mails and iPads changed our whole life significantly. Of course, we are not only working at our (office) desks anymore when doing administrative work tasks, but rather we are working while on the way to or sometimes from home." (SM04)*

This perception is also reflected by employees as the following excerpt illustrates:

> *"We are already going to use smartphones not only for WhatsApp, but rather for working tasks, to check e-mails. No matter where you are going or where you are, it can be edited. We are heading towards digital interconnectivity." (SE06)*

Most importantly, our participants commonly reported that those changes have significantly changed their use behavior as shown in the following example:

> *"Well, my mobile phone is always turned on. At night, I sometimes turn it off, when I am at home. At a hotel, it is always turned on. From time to time, I sit somewhere and check my e-mails on a Sunday at 7pm. When you can answer right away, you are going to do so. Whether it is on vacation or over the weekend, it does not matter. When it is just a task that requires about three minutes to straighten something out, then the person who needs something does not have to wait three weeks until I return." (SE03)*

We observe that technology use is continuously evolving towards rich use by exploring new features or finding new solutions with existing features (Bagayogo et al. 2014). One manager summarizes it as follows:

> *"Well, when there are deviations that need to be discussed, then this instrument [WhatsApp] is really very easy. When I have a group which is simply named 'MANUFACTURE Division XY', I am just texting via WhatsApp, because everyone involved is in this group. Well, but it is no official medium, but, well, maybe later in the future everyone will have it [...]." (MM12)*

Employees also recognize changes in terms of technology use as the following section demonstrates:

> *"WhatsApp works for communication and for calls. WeChat exists as well. This is the Chinese Version of WhatsApp and therefore I use WeChat to communicate with Chinese clients instead of using a landline phone. I think 'why should I spend money for this?' Well, then I also use Facetime and our e-mail program. To communicate with others, Facetime is so much easier than writing e-mails. It always pays off." (MM17)*

Combining the above observations, we understand transgressive use of technology as a combination of individual IS (Baskerville 2011) and rich use of technology (Bagayogo et al. 2014). In line with previous literature on technology use (Bagayogo et al. 2014; Barki et al. 2007; Burton-Jones and Straub 2006), this conceptualization indeed provides a multi-dimensional perspective on technology use. Moreover, we include the individualization of IT as a second dimension. To that end, we define transgressive use as follows:

> *Transgressive use of technology is a rich form of technology use behavior, in which technology is mainly de-contextualized, i.e. private technology is used for business-related aspects and vice-versa.*

An integrated perspective on transgressive use and previous conceptualizations is provided in the following figure (Figure 8.3).

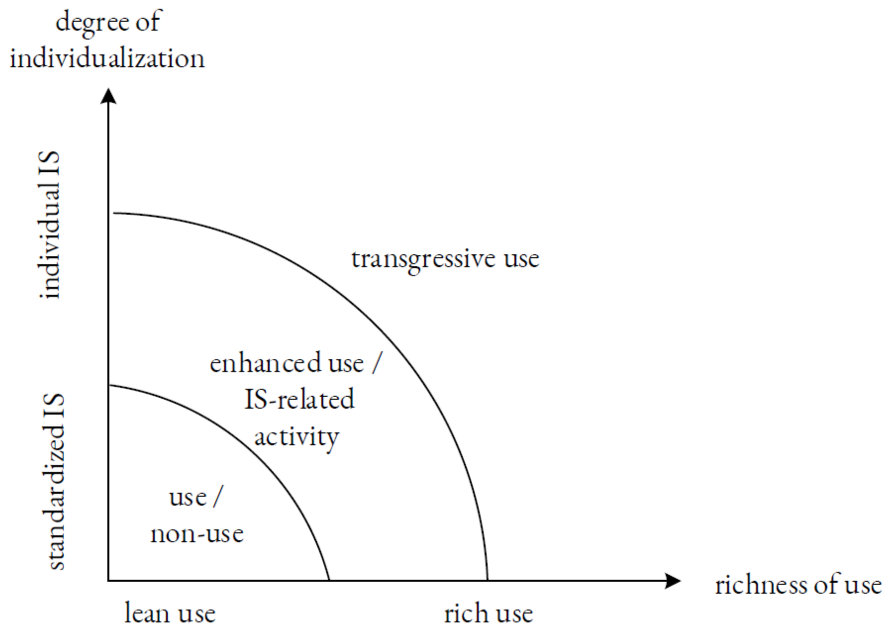

Figure 8.3 Transgressive Use of Technology

The first dimension (degree of individualization) distinguishes between standardized IS and individual IS. The second dimension (richness of use) is a continuum ranging from lean use (i.e. use or non-use) to rich use of IS. Based on these two dimensions, existing concepts as well as transgressive use can be found. Use and non-use of IS (Alavi and Henderson 1981) can be considered the starting point (left-bottom corner). Because of the increasing tendency towards IIS and a rich use of technology, enhanced use (Bagayogo et al. 2014) and the concept of IS-related activity extend this perspective. With the explicit acknowledgement of IIS and the richness of technology use, transgressive use, as proposed here, is another extension of the current scope.

8.4.2. Dimensions of Transgressive Use

Degree of individual IS. With the emergence of consumer technologies in organizations, individualization is easily achieved (Baskerville 2011). In other words, consumer technologies are well suited to be used in line with individual preferences. The following excerpt illustrates how the degree of individualization is a central aspect of technology use:

> *"My laptop and my smartphone are provided by my employer. Privately, I own a PC, which I do not use as often as my laptop. Privately, I also own an old-fashioned landline telephone. I also own a personal tablet. Sometimes, I check my work emails on there." (SE01)*

A significant number of interviewees mention, that they use their individual IS (e.g. smartphone or tablet) to check and respond to work e-mails in their private time. For instance, one employee describes the use of privately owned IS as follows.

> *"At the office, I definitely use the regular email software. There may also be occasions where I read work emails on my computer at home. That is the reason why I have a smartphone and an iPad that belong to the company, which makes keeping up with emails and other notifications very convenient. You can do it whenever you feel like it – when I have some spare time or when I am bored, I just read and answer a couple of emails. " (MM17)*

In summary, the degree to which individual IS is used shows that there are even more personally owned end-user technologies, which are used to manage different aspects of working life. Individualization of IS helps managers and employees to fulfill their tasks even more productively than standardized enterprise-systems. We conclude that the kind of technology (standard or individual) available is a relevant aspect of use behavior.

Explorative Use Behavior. Information Technology is a tool to enable and enhance organizational processes. Therefore, a lot of research has been carried out in order to align IT with business objectives (Gerow et al. 2014), increase its effectiveness (DeLone and McLean 2003), and minimize discrepancies between technology and tasks (Goodhue and Thompson 1995). With the emergence of mobile technologies, there has been a continuous growth and widespread dissemination in organizations. Therefore, individuals are presented with a large amount of technological alternatives they can choose from to complete their tasks. With the rise of consumer technologies and the consumerization of IT (Niehaves et al. 2012), the number of possibilities to accomplishing tasks in private and working life in a more productive way has increased. Due to the prevalence of mobile technologies, individuals are increasingly keen to exploit their functionalities. This observation is consistent with enhanced use of technology (Bagayogo et al. 2014). For instance, one employee of the service company describes the use of a specific end-consumer technology for one specific purpose. He shares important work information with a particular group of colleagues at short notice using an end-consumer chat application. The following quote describe his explorative use behavior:

> *"There is a possibility. We have a group in WhatsApp. Every consultant is in this WhatsApp group. This is important for me, because when I have something I want to*

> *share with the others, I can just bring it up in there. If someone feels the need to share information, they can do so." (SE08)*

This explorative use behavior is often driven to enhance processes that are not properly supported by organizational IT. An employee describes it as follows:

> *"Well, WhatsApp is a pretty good example. I actually do not make any distinction anymore. When I want to send a colleague a fast note, and I want him to see my note as fast as possible, I do not distinguish between sending him a text, WhatsApp message or an email. Normally, I send him a text or a WhatsApp message, as they immediately show up, so when he looks at his phone he knows. That's the reason why I actually don't know whether it is a private matter in everyday working life." (MM07)*

Explorative behavior is diverse with regard to the extent and the degree of innovation. An example of a rather intensive use is described by a manager as follows:

> *"For example, I privately used an alarm on my laptop for a while to start breathing sessions every two hours, but I ignored it very often because I was so concentrated that I wanted to keep working on my task. As a warning signal, it is actually very good, but it should not take you out of your 'work-flow'. I think if I had a bracelet showing me my heart beat was getting too fast or that something else was wrong, that would be very helpful." (SM8)*

In summary, explorative use behavior is an essential aspect of transgressive use. Especially in terms of consumer technologies and the consumerization of IT used in organizations, exploring new ways of doing work is common.

Degree of Boundary Spanning. Apart from technology use within an organization, technology is increasingly used in other domains as well. An established theory that seeks to conceptualize this phenomenon is boundary theory (Ashforth et al. 2000; Clark 2000). Existing literature in IS research already referred to the blurring of boundaries (Cousins and Robey 2015; Köffer, Anlauf, et al. 2015) to describe varying technology use in different domains. An employee of the manufacturing company describes his development of blurring technology boundaries using his corporate owned mobile device:

> *"No, I originally had a private mobile phone, but as I tried to stay available to my company, I noticed that I ran out of battery and so I told myself that the couple of*

contacts I have, my wife for example, etc. […], they can call me on my company mobile phone, and everything is fine." (ME03)

A manager of the same company even says that his way of fully integrating work and private life through the use of technology gives his wife the chance to work with his work calendar, entering and blocking dates:

"Interviewee: Your partner is important. This person is the one who says 'so, you're done for today'. My wife blocks all my private events in my calendar. For example, our vacation is blocked, the first day of school of our little one and so on.

Interviewer: Just a short note, your wife has access to 'Notes' [Program of the MANUFACTURE company]?

Interviewee: Yes, that is right." (MM10)

In contrast to the observations above, another employee states that he prefers to separate privately and company owned technology. He only uses his privately owned IT for personal activities and business IT only for work purposes.

"One is private and the other is professional. Well, I would not put private things on the laptop of the MANUFACTURING Company and vice versa. I try to separate it in some way." (ME02)

The degree to which boundaries are crossed has a major impact on how technology is used. An individual has the chance to either integrate company and private IT or to separate it. Using private or company technologies for one domain (e.g. private or work) shows an individual integrating use of IS.

Degree of intensity. In order to understand technology use, IS research has looked at duration and frequency of technology use. Recently, with the penetration of mobile technology, this dimension has gained importance as technology is oftentimes used 24/7. For instance, Soror et al. (2015) referred to frequency and duration in order to describe mobile phone use. The following quote states the duration to which an employee of the service company uses his IS to check on work during vacation:

"In the past, especially when I worked in our freshness center, it was really extreme. I worked a lot on weekends, before and after working hours in my free time. In [headquarter of the organization], for example, there was a trailer of the forwarding

agent, where goods were stored and where I checked the temperature using the internet every couple of hours every weekend. I checked whether everything was alright, so that the goods would not rot. I also answered emails during this time, even when I was on vacation, I checked them in the evening for one or two hours." (SE05)

Another employee of the manufacturing company describes how often he uses his IS for working purposes during vacations:

"There are two sides of the coin. You are never able to switch off from work, but I love working. I was just on vacation, I checked my e-mails every two to three days, and I still got to rest. But well, I love working." (ME4)

To summarize, the extended use, duration and frequency are obvious criteria to evaluate the intensified use of IS today.

8.5. Theorizing with Transgressive Use

8.5.1. Conceptualizing Transgressive Use

Based on our findings, we conceptualize transgressive use as a multi-dimensional construct that includes four dimensions (c.f. Figure 8.4): First, the degree of individual IS, which refers to the underlying technology that is used. Second, the degree to which boundaries are crossed, which refers to the extent to which an individual seeks to be accessible when it comes to technology us in different domains. Both aspects combined are related to the degree of individualization. Third, the degree of exploration, which refers to the extent to which an individual seeks new features or alternative technologies in order to complete a task. Finally, the degree of intensity, which includes the amount and frequency of technology use. The last two aspects relates to richness of use.

It is important to understand that each dimension on its own is not new. There is a vast amount of literature on individualization (e.g. Baskerville 2011; Niehaves et al. 2012), explorative behavior (e.g. Bagayogo et al. 2014; Durcikova et al. 2011), boundary management (e.g. Ashforth et al. 2000; Clark 2000; Köffer, Anlauf, et al. 2015) and the intensity of technology use (e.g. Soror et al. 2015; Venkatesh et al. 2008). However, we argue that those dimensions are strongly intertwined and jointly describe transgressive use. Therefore, transgressive use is a significant departure from analyzing each dimension separately.

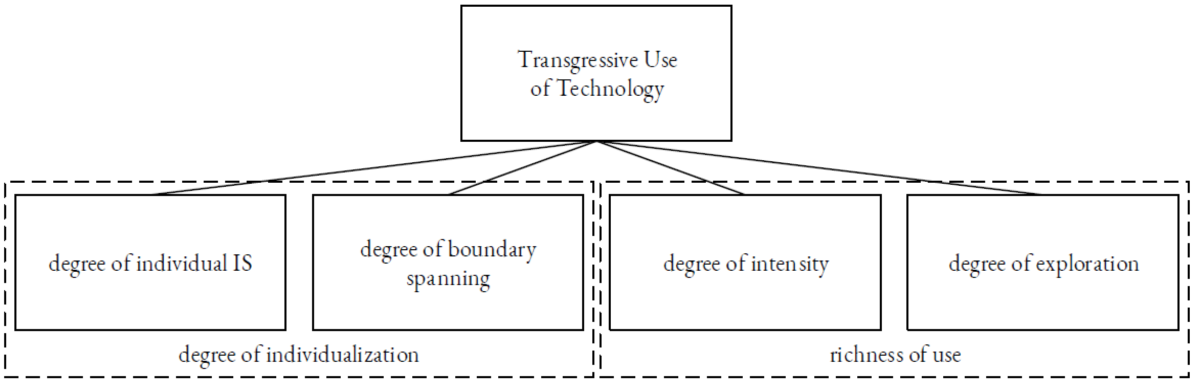

Figure 8.4 Dimension of Transgressive Use of Technology

8.5.2. Propositions on Transgressive Use

This study is motivated by the consumerization and individualization of technology (Baskerville 2011; Niehaves et al. 2012). Within this area of research, various constructs have been proposed to capture changes regarding use behavior. For instance, Köffer et al. (2015) refer to "Use of [company provided/privately owned] [traditional/consumer] IT tools" to analyze innovation behavior related to technology use. Similarly, Junglas et al. (2014) use "*Consumer IT usage within the Organization*" to explore IT empowerment. Others have focused their attention on the underlying behavior instead of the technology itself (Ortbach et al. 2013). We conclude that research has yet to establish a comprehensive construct that is able to capture the individualization and consumerization of technology. As previous literature shows, individualization is a complex phenomenon, which in turn requires rich conceptualization. Against this background, we suggest that transgressive use of technology is a suitable approach to enhance current literature on IIS and IT consumerization. In conclusion, we put our first proposition forward:

Proposition 1: *Transgressive use has the potential to bundle existing operationalizations of IIS and IT Consumerization.*

There is little doubt that IT also has its negative effects. In IS research, this overall issue is discussed under the umbrella of 'Dark Side of Technology Use' (D'Arcy et al. 2014). Specifically, D'Arcy et al. (2014) provide four domains that are most relevant: (1) *Stress caused by IT*. Technostress has been subject to numerous studies indicating that technology characteristics have a significant effect on stress (Ayyagari et al. 2011). Current literature already includes mobile phone use within this context (Soror et al. 2015). Therefore, transgressive use has the potential to give further insights into the relationship of technology use and stress. (2) *Information Overload and Multitasking*. Information Overload at the workplace has often been analyzed (Galluch et al. 2015). Due to the prevalence of mobile technologies, information overload and multitasking is also most relevant on a large scale beyond the boundaries of a workplace. As the degree to which boundaries are crossed is a fundamental aspect of transgressive use, this study can contribute to further analyze this issue. (3) *Technology-related Addictions*. Although this study does not focus on addiction, transgressive use may also contribute to research in this domain, as the extent of use is a major indicator of addiction (Xu et al. 2012). (4) *Information Technology Misuse*. Misuse has also been part of the dark side of the IS movement. Due to the richness of transgressive use, it also has the potential of being used to predict of technology misuse. Technology use is critical for research on negative aspects of IT. Combining the arguments above, we propose our second proposition:

Proposition 2: *Transgressive use has the potential to give further insights into the 'Dark Side of Technology Use'.*

Through condensed technology innovation cycles, organizations are able to produce new technologies that infiltrate organizations within short periods of time. In the last decade, the consumerization of IT has shown that consumer technologies have great potential to be used in organizations. Therefore, new innovations, such as wearables or affective technologies which have been primarily designed for a non-organizational purpose, are being used for business-related purposes. As those technologies differ from organizational technology (e.g. with regard to purpose or usability) more research will be needed within this domain than in the traditional organizational domain. Increasing research on mobile technologies (Sørensen and Landau 2015) and the role of (psychological) ownership of technology (Barki et al. 2008; Klesel et al. 2016) provides further evidence for this development. Against this background, IS research can benefit from conceptualizations that include further dimensions that also hold true for emerging technologies. Although transgressive use is suitable for all purposes, it has the potential to promote research on emerging technologies as it features various dimensions (such as the degree of individualization), which is increasingly relevant for emerging technologies. With this in mind, we present our third proposition:

Proposition 3: *Transgressive use has the potential to be used for emerging technologies.*

8.6. Discussion and Outlook

Technology use behavior has changed significantly from lean use within a defined scope of use towards rich use beyond defined boundaries. This paper seeks to conceptualize this change by proposing transgressive use of technology. With regard to our RQ ("*How to conceptualize transgressive use of technology?*"), we identified four dimensions that are relevant to describe transgressive use: degree of individual IS, degree of exploration, the degree to which boundaries are crossed and degree of intensity.

Our research contributes to existing theories in several ways: We contribute to previous literature on technology use (Burton-Jones and Straub 2006) by extending the scope of analysis. Technology use has primarily been analyzed within an organization and from a utilitarian perspective. By including new dimensions such as boundary crossing, we explicitly recognize the blurring of boundaries that comes along with technology use. We also contribute to existing literature on enhanced use of technology (Bagayogo et al. 2014). By including explorative use behavior, transgressive use is in line with enhanced use of technology, yet with a different focus.

There is more and more research that relates to the individualization of IS (Baskerville 2011; Niehaves et al. 2012). We contribute to this literature, by including individualization as a major aspect of transgressive use. Therefore, future research on individualization can refer to transgressive use in order to gain deeper insights into related phenomena.

IS research acknowledges that mobile technologies contribute to the fact that boundaries are blurred (Duxbury et al. 2014, 1992; Köffer, Anlauf, et al. 2015). Including boundary spanning as a sub-dimension of transgressive use, research on work-to-life conflict can use this conceptualization to promote their research.

Explorative use is a major aspect of enhanced use of technology (Bagayogo et al. 2014). As it is a central aspect of transgressive use, future research on technology acceptance and adoption can also refer to transgressive use, to analyze effects outside the organizational domain. This might be particularly relevant when it comes to emerging technologies that are increasingly detached from organizations (such as wearables).

Finally, we also contribute to existing literature that is concerned with the extent of technology use. We propose the degree of intensity as a central aspect of transgressive use. Therefore, related literature that is interested in use duration or frequency (e.g. Soror et al. 2015) might refer to transgressive use to explore their phenomena more comprehensively.

This study also has practical implications. Most importantly, by revealing four dimensions of technology use, managers have a promising point of departure to influence their employees' use behavior. For instance, one may limit or expand boundaries of use by defining a corresponding governance. Moreover, transgressive use can be used as a tool to influence organizational cultures. In particular, for industries that are prone for technology use beyond boundaries such as the service industry and consulting firms, transgressive use can inform leaders what aspects need to be adjusted in order to further boost transgressive use, or, in contrast, what is required to reduce technology use according to defined boundaries.

8.7. Conclusion and Outlook

We proposed the transgressive use of technology in order to capture technology use in light of IIS. Like every empirical study, this paper has limitations that leave room for future research. Apart from the typical limitations of case study research (e.g. weak internal validations), it is important to acknowledge the following: First, the nature of this study is explorative. Therefore, it intends to extend current perspectives on technology use. Future research can build upon this explorative approach in order to conduct confirmatory research. Especially in terms of further development, this research provides a solid foundation as it reveals the nature and the dimension of the construct that can be used (MacKenzie et al. 2011). Second, we provided three promising propositions that need further exploration and empirical validation. For instance, future research could address these issues by conducting comparative analyses. Finally, the unit of analysis of this study is the individual. Hence, interaction with their environment is not explored in detail. In order to overcome this limitation, future research might address these issues by using a dual perspective (i.e. organizational and individual) to further explore the phenomena related to duality (Giddens 1984; Jones and Karsten 2008; Mokosch et al. 2015).

8.8. Acknowledgements

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8.9. References

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9. Better Burning than Burning Out

Paper Number	**P5**
Title	**Better Burning than Burning Out – A Laboratory Experiment on the Impact of Training Work Avoidance on Psychological Detachment and Perceived Strain**
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Table 9.1 Fact Sheet Publication

[a] due to change of name

Better Burning than Burning Out – A Laboratory Experiment on the Impact of Training Work Avoidance on Psychological Detachment and Perceived Strain

Abstract. With the rising number of mobile devices and the chance for employees to work from anywhere at any time, the risk for employees to find it challenging to detach themselves from work is high. Recent literature on work-life balance shows how important it is to design information technology to prevent employees from work-life conflict resulting in strain, diseases or burn out. To help employees to detach themselves from work, we aim to discover how work avoidance training can affect perceived strain and psychological detachment. We hope to assist workers in learning how to detach themselves from work in their leisure time, when work demands are high. We will conduct a laboratory experiment with two groups in a between-subject experiment. We propose that employees should be able to find relaxation in times of intense work demand, in finding proven ways of 'switching off' from work mode, maintaining a better work-life balance.

Keywords: Approach avoidance task, psychological detachment from work, laboratory experiment

9.1. Introduction

In the past years, the challenge to cope with the rising volume of technology in the work place has intensified. With the increasing presence of mobile technologies (e.g. laptop, tablet and smartphone), employees are able to work from anywhere and everywhere at any time (Klesel et al. 2018, 2016; Köffer et al. 2015). This is also heightened by the constant evolution of information technologies (IT) in the work place (Sørensen and Landa, 2015; Vodanovich et al. 2010). This ubiquitous use of IT can lead to disruption in an employees work-life balance. In line with Greenhaus et al. (2003), we define work-life balance as "the extent to which an individual is equally engaged in—and equally satisfied with—his or her work role and family role" (Greenhaus et al. 2003, p. 513). This definition includes positive and negative effects of a work-life balance. Recent literature has introduced the construct of work-life conflict by demonstrating the negative aspect when work and home life are not complementary. Work-life conflict describes the negative effect an individual experiences when his or her own preferences regarding the boundaries between work and private life are not satisfied any longer (Clarke et al. 2016; Kossek et al. 2011, 2006; Kreiner 2006; Kreiner et al. 2009; Michel and Clark 2012; Nippert-Eng 1996).

Recent literature in psychology and information systems had also a look at consequences and antecedents of work-life conflict with IT (Cousins and Robey 2015; Duxbury and Smart 2011; Sarker et al. 2012). Previous studies also indicate the importance of preventing syndromes such as burn out, before they occur (Kelly et al. 2011; Kossek et al. 2014; Kossek and Lee 2017). Research on dual process models suggest that there might be impulsive approach tendencies that lead to such conditions (Strack and Deutsch 2004).

However, it is unclear whether these approach biases exist in a work context and how psychological detachment from work in leisure time can be enhanced with the help of work avoidance training. In order to address our objective, this paper is guided by the following research questions:

RQ1: Is there an impact between work approach bias and psychological strain?

RQ2: What effect does work avoidance training have on employee's psychological detachment from work and perceived strain?

This paper is structured as follows: Firstly, we give a short overview of the theoretical background and the development of our model. In the second section, we introduce the method that we use in our study. Section three will conclude with a discussion of our expected findings, proposing implications for theory and practice, demonstrating opportunity for future research.

9.2. Theoretical Background and Model Development

Psychological Detachment from work. "Psychological detachment from work refers to the off-job experience of "switching off" mentally" (Sonnentag and Bayer 2005, pp. 393). It is hypothesized that a high workload encountered during the workday has a negative impact on the way employees detach from work (Sonnentag et al. 2014, Sonnentag and Bayer 2005, Sonnentag and Kruel 2006). With this in mind, a psychological detachment from work is positively related to well-being and satisfaction.

Dual process models. According to dual process models (Deutsch and Strack 2006, Soror et al. 2015, Strack and Deutsch 2014), human behavior is formed by the interaction of two different cognitive systems. These systems are called the impulsive system and the reflective system. For automatic responses to a stimulus, which are built by associations to successful behavior in the past, the impulsive system is responsible. On the other hand, the reflective system can flexibly adapt to changes. The impulsive system is associated with heightened attention and approach toward certain stimuli, which are reflected by approach or attentional biases. Approach bias refers to the tendency to physically reaching for or approaching these stimuli (Cousijn et al. 2011). The approach avoidance task (AAT) can be used to assess this effect. A reduction of approach bias or unhealthy behavior could be detected after using the AAT as training method on the computer. This affect can be seen throughout different studies within the context of addiction (e.g. for substances such as nicotine (Machulska et al. 2016), alcohol (Wiers et al. 2010, Wiers et al. 2013) or chocolate (Schumacher et al. 2016)). However, it is still unclear if approach bias can be detected in the context of work. By following our objectives, we aim to expand on recent research related to work avoidance training and psychological detachment from work. Figure 9.1 introduces our research model for this study with our hypothesis.

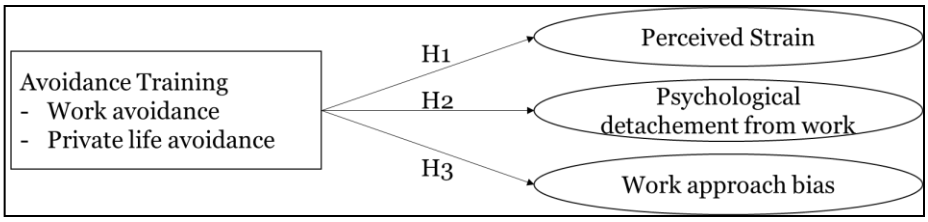

Figure 9.1 Proposed research model

We hypothesize, that work avoidance training leads to lower perceived strain (H1), higher psychological detachment (H2), and lower work approach bias (H3) than private life avoidance training.

9.3.Method

9.3.1. Data Collection

Method selection. In order to answer our research questions, we will recruit participants online and with a physical flyer for a laboratory experiment. We will also ask project partners from the public sector to take part in our experiment. We will conduct a laboratory between-subject experiment with two groups to test our hypothesis.

Participants. We will recruit 128 participants by promoting the laboratory experiment online (via Facebook), with physical flyers and with project partners in the public sector.

9.3.2. Materials

Hardware and Software. We will use a room with four computers, where 2 to 4 people can take part in our experiment, simultaneously.

Manikin Task. A modified version of the manikin task will be implemented with PsychoPy2 (Peirce et al. 2019). In recent literature, the manikin task is used as a measurement for automatic approach tendencies (De Houwer et al. 2001) to address the impulsive system. The modified tasks will consist of a set of trials. In each trial, participants will be shown a picture of a stimulus together with a manikin on the screen to address the impulsive system. The manikin can be displayed above or below the picture, so that participants have to make the manikin approach or avoid the picture. To do this, participants can press the¨up¨or¨down¨key. Whether the manikin needs to approach or to avoid the picture depends on the color that the picture is framed in. If the picture is framed in red, participants need to move their manikin away from the picture, whereas they need to approach picture when it is framed in a blue color. When participants will make a mistake, “ERROR” will be shown on the screen as a feedback for their task. Again, the task will be conducted on the computer. Participants are not able to go backwards to their writing task. Instead they have to follow the AAT. The manikin task will consist of three blocks. In the first block (pre bias measurement), both office items and pictures of private life are framed red and blue. In the second block (training), either office items are always framed red and private life pictures are always framed blue (work avoidance), or the reversed pattern is used (private life avoidance). The final block (post bias measure) is similar to the first block.

Stimuli: For the ten-trial practice, we will use neutral images of fruit. As stimuli for the bias measurement and training parts, we will use five work pictures (smartphone, laptop, office, outlook, and calendar) and five private life pictures (beach, sea, park, family event and drinks with friends) in order to address the impulsive system.

9.3.3. Measures

All questionnaire items will be measured on a scale from 1 (strongly disagree) to 7 (strongly agree) and adapted from relevant literature.

Perceived Strain. Aligned to Fuller et al. (2003) we will use adapted items for perceived strain. An example for an item is: “Indicate how much each word/phrase describes your task situation: Relaxed?”

Psychological Detachment from work. Aligning to Sonnentag et al. (2003), we will use the following item to measure psychological detachment from work ("During after-work hours, I forget about work.").

Work Approach Bias: We will measure work approach bias for pre and post bias measure by calculating the reaction time difference between pushing and pulling pictures (RT_Push – RT_Pull). Thus, if bias measure has a value greater zero, individuals have an approach bias for work, else an avoidance bias.

9.3.4. Procedure

Participants will be invited to join our laboratory experiment in the University. When participants arrive, they are grouped in four and will be invited to choose a working area with a computer. They will be informed that the study is about the ability to concentrate on a work task. After informed consent is obtained, participants will be asked to provide information on their gender, age and current job. Next, participants will read about the work task they will be given. Participants will be asked to write up to 500 words within 30 minutes about a work experience in which they had to spend much time and energy in order to complete and to explain what obstacles to completion occurred, if any were present. After 10 minutes of writing, participants will be invited to take a 10 minute break. Following the break, the procedure of the AAT will be explained to them and the three block manikin task will begin. After this section, participants will be able to work on their given writing task for another 10 minutes. Once the writing task is finished, participants will be asked to complete the survey with the statements shown under "measures". Finally, participants will be thanked and debriefed.

9.3.5. Data Analysis

We will analyze the data regarding the effects on perceived strain and psychological detachment using two one-way ANOVAs. To assess if any differences for approach bias in the manikin task occurred, we will use a 2 (time: pre vs. post) x 2 (work training repeated measure) ANOVA.

9.4. Discussion

With our study, we aim to assist employees to disconnect from work more easily, especially in times of high working demands. Our expected results (confirmation of H1 – H3) will provide a starting point for design science research to investigate how the effects of the AAT can be enhanced in health related studies combined with IT.

Regarding implications for theory, we aim to contribute to the existing body of knowledge regarding psychological detachment from work and perceived strain using the AAT in the health and burn out literature. We want to expand upon existing literature on the dual process model by showing that the AAT can enhance psychological detachment from work and can help to decrease perceived strain. Practical implications include prevention of work-life conflict and conditions like burnout. We aim to help organizations to take better care of their employees by providing a scientifically backed framework to support them to detach from work, thereby reducing perceived strain. Our study is one of the first studies using the AAT in the context of prevention for burn out.

To generalize and address the results of our experiment is a limitation we face. Our study is also limited by the question of how we can adapt the method to the work context of an individual for their individual, daily work experiences instead of in laboratory contexts. Regrettably, this limitation could not yet be met in the initial stage of this research.

Based on our results, we expect that future research can extend our study to developing and designing a tool, which can be played like a game between finishing work and entering the private life domain, in order to facilitate an employee's detachment from work.

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10. Individualized Design

Paper Number	**P8**
Title	**Individualized Design: The Role of Individual Boundary Preferences on Technology Acceptance and Work-Life Conflict**
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Table 10.1 Fact Sheet Publication

[a] due to change of name

Individualized Design: The Role of Individual Boundary Preferences on Technology Acceptance and Work-Life Conflict

Abstract. Reaching the ideal level of work life balance can be beneficial for various factors, including well-being and health. Research has already shown that technology plays an important role in facilitating or diminishing work life balance. In this research in progress paper, we want to find out which design elements a) individuals prefer and b) can minimize work life conflict based on their boundary preference. To test our proposed model, we plan to conduct a 2 (Boundary Preference Design: Integration vs. Separation) x 2 (Automaticity: Manual vs. Automatic) between-subjects experiment. With our results, we aim to extend the theory of IT-related boundary tactics by showing which design options are getting preferred depending on the individual boundary preference.

Keywords: Boundary Management, IT-related boundary tactics, between-subjects experiments, boundary preference design.

10.1. Introduction

Due to the increase in mobile devices used by individuals in their work and private life, the importance of setting boundaries becomes more and more relevant (Chen and Karahanna, 2018; Ezzedeen and Zikic, 2017; Klesel et al., 2018, 2016; Köffer et al., 2015; Lim et al., 2017). With the growing number of ubiquitious information systems (IS) (Sørensen and Landau, 2015; Vodanovich et al. 2010), we can see how individuals can adopt hardware and software to reach an optimal balance between work and private life (Baskerville 2011).

Looking at this blurred use of IS, especially with the use of mobile devices, the phenomenon of “IT consumerization” has emerged. IT Consumerization describes the trend that employees use their own Information Technology (IT) (hardware and software (Klesel et al., 2018)), to fulfill working tasks (Klesel et al., 2018; Ortbach et al. 2013). Looking at IT Consumerization from a conceptual point of view, we can see that phenomenon’s like Bring-Your-Own-Device (BYOD), which expresses Bring-Your-Own-Behavior (BYOB) are getting more popular (Ortbach et al. 2013).

The increasing availability of technology, fostered by IT consumerization, lets individuals face new challenges to maintain and improve their work life balance (Duxbury and Smart, 2011; Mellner et al. 2014; Sarker et al. 2012). Recent literature have used Boundary and Border

Theory to analyze how individuals manage their work life balance with setting boundaries between work and private life. Especially, previous research have looked at positive and negative effects on an individual's private and work life with information technology (Allen et al. 2014). For example, positive effects (e.g. increased productivity in business tasks (Cecchinato et al. 2015; Cousins and Robey 2015; Duxbury et al. 2014; Fleck et al. 2015)) can support an individual, whereas tensions between work and family domains (Kreiner et al. 2009) can result in stress or work and private domain overload. These results in a negative effect on the individual (Kreiner et al. 2009).

In the last decades different boundary management tactics, styles and strategies have been developed (Allen et al. 2014; Kreiner et al. 2009; Duxbury et al. 2014, Jahn et al. 2016), showing how we use IT to manage work and family domains. Jahn et al. (2016) introduced IT-related boundary tactics individuals use to integrate or separate between work and private life (Jahn et al. 2016). However, research on design options, which are getting preferred depending on one's individual boundary preference are sparse. Based on the IT-related boundary tactics from Jahn et al. (2016) (Psychological detachment, automatic response, pull information, boundary App, push information and dynamic filtering), we aim to develop design elements to first, confirm the assertions of Jahn et al. (2016) and second, to analyze the influence individual preferences have on the acceptance and the work life conflict of design elements. In order to address our objective, this paper is guided by the following research question:

RQ: How do individual preferences influence perceived usefulness and work life conflict of design elements?

This paper is structured as follows: First, we give a short overview of the theoretical background and the development of our model. In the second section, we introduce the method used in this study. Section three will end with discussing our expected findings, proposing implications for theory and practice and showing chances for future research.

10.2. Theoretical Background and Model Development

Boundary Management describes the way of how individuals manage, this includes trying to create, maintain, change, simplify or order their work and private life (Ashforth et al. 2000; Clark 2000; Nippert-Eng 1996; Reyt and Wiesenfeld 2015; Rothbard et al. 2005). Nippert-Eng (1996) shows that a continuum of border demarcation arises due to the variance of transitions, showing on the one hand individuals who integrate (drawing a thin line between work and family roles) and on the other hand individuals who separate (drawing a thick line between work and family roles) between work and family domains.

Existing literature has already differentiated boundary management tactics for technology use. For example, Kreiner et al. (2009) describe a sub-category of behavioral tactics with a micro-category called "leveraging technology". This micro-tactic is relating to the use of information technology to manage different boundary strategies (Jahn et al. 2016). Similarly to Kreiner et al. (2009), Duxbury et al. (2014) discovered individuals as not being able to separate between the two domains of work and family life due to a lack of self-discipline and self-control, e.g. while using mobile devices (e.g. smartphones). Köffer et al. (2015) found six technology-related aspects (dual use of company IT for private task, dual use of private IT for work tasks, remote access to work data, distinct devices for private and work purposes, separate private and business accounts and quality of company provided IT), describing the intense use of IT at work. Jahn et al. (2016) found six different IT-related boundary tactics individuals use in order to go along with their individual boundary preference of separation and integration of the private and work domain.

Qualitative research indicated that employees use different IT-related tactics in order to be able to live their individual preference to integrate or to separate between work and private life and adapt technology accordingly (Jahn et al, 2016). The technical implementations (here referred to as automaticity) were divided into two dimensions, namely manual or automatic implementation. When talking about the manual implementation the individual has to actively engage with the technology in order to be informed, whereas the automatic implementations needs to be set up for once by the individual and is afterwards automatically applied.

Following our objectives, we aim to extend recent research by Jahn et al. (2016) and we introduce our research model for this study (Figure 10.1) with our hypothesis.

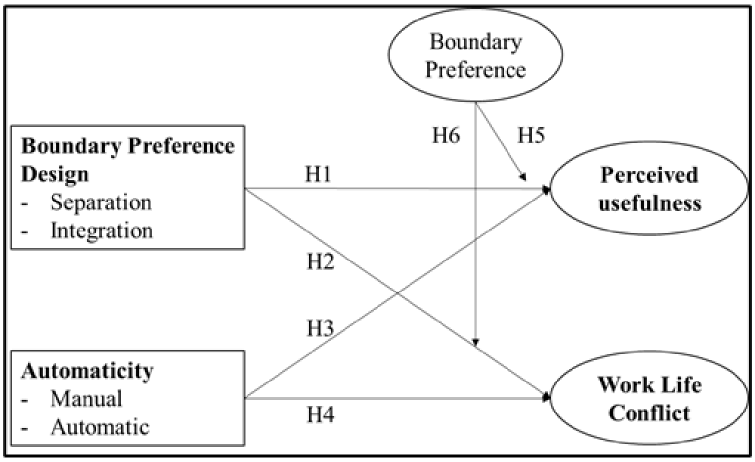

Figure 10.1 Research Model for the Influence of Boundary Preference Design

Aligning to task technology fit (Dishaw and Strong 1999; Goodhue and Thompson 1995) and boundary theory (Allen et al. 2014; Kreiner 2006; Kreiner et al. 2009) literature, preferences of an individual have an effect on usefulness. Technology, which supports an individual's preference, is seen to be more useful (Goodhue and Thompson 1995). As we have different preferences in our study using one specific task, we hypothesize that individuals will find it useful when their preferences will be supported. We decided to use perceived usefulness as it describes an antecedent of acceptance as dependent variable. Thus, we expect that individuals perceive IT, which helps them to follow their preference of integration or separation, as more useful. Additionally, research has yet to investigate whether technology design facilitates individuals' work life balance depending on their individual boundary preference. Therefore, it is important to find out to what extant design options effect work life conflict and address an individual's preference to integrate or separate work and life domains. Because first literature showed a relationship between preferences and enactment, we hypothesize an interaction effect for work-to-life conflict and boundary preference design (Allen et al. 2014).

H1: Boundary preference design for separation leads to increased perceived usefulness compared to integration.

H2: Boundary preference design for separation leads to decreased work life conflict compared to integration.

H3: Automaticity that reacts automatically leads to higher perceived usefulness than manual implementation.

H4: Automaticity that reacts automatically leads to lower work life conflict than manual implementation.

H5: The relationship between boundary preference design and perceived usefulness is moderated by individuals' boundary preference. Individuals with a separation preference experience higher perceived usefulness for separated boundary preference design (compared to integrated design) whereas individuals with an integration preference experience higher perceived usefulness for integrated boundary design (compared to separated design).

H6: The relationship between boundary preference design and work life conflict is moderated by individuals' boundary preference. Individuals with a separation preference experience lower work life conflict for separated boundary preference design (compared to integrated design) whereas individuals with an integration preference experience lower work life conflict for integrated boundary design (compared to separated design).

Table 10.2 gives an overview of how the constructs of this study are defined.

Construct	**Definition**	**Source**
Boundary Preferences	"“Segmenters” prefer to keep the two domains as separate as possible, creating and maintaining a boundary or “mental fence” (Zerubavel,1991); “integrators,” (…), prefer to combine elements of both domains, essentially removing boundaries between the two and blending facets of each. Of course, most individuals are not “pure types”—rather, their position on the continuum bounded by complete integration and complete segmentation depends on the particular circumstances and individuals involved."	Kreiner et al. 2009, p. 710
Boundary Preference Design	The degree to which technology design facilitates to enact integration or separation.	Jahn et al. 2016
Automaticity	The degree to which a technological implementation can react to events automatic (e.g. through predefined filters) or the user has to react manually (e.g. through deciding the reaction after reading a message for push notification).	Jahn et al. 2016

Perceived usefulness	As an antecedent of acceptance, perceived usefulness shows how users perceive technology to enhance their work life balance.	Agarwal and Karahanna 2000; Davis et al. 1989
Work Life Conflict	"A form of inter-role conflict in which the role pressures from the work and family domains are mutually incompatible in some respect."	Adam et al. 1996; Ahuja et al., 2007

Table 10.2 Construct definitions

10.3. Method

10.3.1. Data Collection

Method selection. In order to answer our research questions, we will gather data from an online survey including design options and demographics, including work experience, working position, working hours per week and educational degree. Using an online survey for this purpose is most convincing to address our research question because participants can answer these questions for example on their computer or with their mobile devices (e.g. smartphone, tablet and laptop) which is close to a work life boundary management environment.

Participants. We will recruit 128 participants by promoting the survey via e-mail and facebook. We will recruit participants of different working contexts (e.g. project partners from the public sector and different industrial companies).

10.3.2. Measures

Boundary Preferences. To ask for the individual preferences of the individual we adapt the segmentation preference scale from Kreiner (2006). We use four items describing whether the individual prefers to integrate or to separate work and family domains. Participants will be asked to indicate their preference using a scale ranging from 1 (strongly agree) to 5 (strongly disagree). Aligning to Kreiner (2006) the following item is used as an example: "I prefer to keep work life at work." (Kreiner 2006).

Perceived Usefulness. To measure perceived usefulness we align to Argarwal and Karahanna (2000). We adapt the scale using a 5-Point Likert scale instead of a 7-Point Likert scale, from 1 (strongly agree) to 5 (strongly disagree) and adapted the items to our context using mobile devices to manage work and family boundaries. One example item for perceived usefulness is: "Using the mobile device enhances my effectiveness at work and private life".

Work Life Conflict. Aligning to Ahuja et al. (2007) we adapt items from Adam et al. (1996), as they used already a short item scale for work life conflict in Information Systems Research. We adapted the scale using a 5-Point Likert scale instead of a 7-Point Likert scale, from 1 (strongly agree) to 5 (strongly disagree): For example, we ask: “If you are not married and/or do not have children, you can choose to respond to these questions in terms of your life outside of work in general (for example, replace "family" with "friends" and think of your other commitments, such as gymnasiums, book clubs, or any other: The amount of time my job takes up makes it difficult to fulfill family responsibilities.”

Control Variables: As possible control variables, we ask for Perceived Ease of Use, “It is easy for me to become skillful at using the mobile device.”, for Personal Innovativeness, “I like to experiment with new information technologies.”, and for Behavioral Intention to Use, “I plan to use the mobile device in the future.”

Manipulation checks. We used following self-developed items, measured using a 5-Point Likert scale, ranging from 1 (strongly agree) to 5 (strongly disagree) for a manipulation check. For example, we ask: “I made the setting to get my emails pushed, when I receive them. I had to check my received e-mails autonomous. When I get an e-mail and I am out of office, the sender will get an automatic notification about the date when I am back at the office. I sorted my contacts in different groups, so that I can differentiate between the people I want to get anywhere at any time e-mails from and people I do not want to get notifications from.“

Procedure. After opening the link to the survey, a cover page will be provided, including a short introduction that will explain the context of the survey. The short introduction will also assure privacy for our participant´s answers. Next, we will ask participants about their individual preference of separating or integrating work and private life. We will also ask for their average weekly working hours, their average time working at home or in the office, and how many years they had been working at their current employer. Then, participants will be instructed to read the following text before being presented the different design options:

> “It is Sunday and you are sitting with your family at the breakfast table. You just submitted an important project report at work on Friday. You worked on this projects and its report for the last three months. You are not sure how your supervisor will react, and in the past, his reactions ranged from only changing a few words to changing the whole concept. You know that it will be fine for your supervisor if you read his feedback on Monday.”

Thereafter, four design options (push and pull information, dynamic filtering and automatic notification) will be presented in random order and each participant has to indicate his or her reaction for each design option displayed. We selected the design options because they represent the outer points of the dimensions automaticity and boundary preference design. They are shown in Table 10.3.

Automaticity / Boundary Preference Design	Manual	Automatic
Separation	Scenario 1 – pull information „After breakfast you decide to check your e-mails. You open up your Outlook Application and look actively for responses from your supervisor. "	Scenario 2 – automatic notification "Your supervisor did response to your e-mail and got an automatic notification, saying that you are not available until Monday, when you are back at the office."
Integration	Scenario 3 – push information "Your phone is ringing as you got a new e-mail from your supervisor about the project and you already can read the email while looking on the display of your mobile phone."	Scenario 4 – dynamic filtering "Your phone is ringing as you have got an incoming e-mail from your supervisor. You actively choose your supervisor to be one of the people who are able to e-mail you on the weekend so that you see the e-mail right away."

Table 10.3 Design options for pulling and pushing information, for automatic notifications and for dynamic filtering

When participants afterwards open the e-mail, following e-mail will appear:

> "Hi,
>
> I just got around proving your work on our project. Enclosed you will find my revisions on your work for our project report. I had some mayor revisions, so please do not forget, that this report needs to be finished by Monday 12am. Please send it to me until Monday 10am, so I can review it for the last time before we have to hand it in.
>
> Best regards
>
> Alex"

Afterwards participants will be asked to answer the questions for the indication of perceived usefulness and work life conflict. Finally, participants have to fill in information about e.g. their gender, age, and had the opportunity to give additional comments in a free text field.

10.3.3. Data Analysis

We will analyze the data using ANOVA and covariance-based structural equation modeling.

10.4. Discussion

With the experiment, we plan to show which design options are preferred depending on the individual preference of setting boundaries between work and private life.

We propose that there will be a possibility to show empirically that the proposed IT-related tactics of Jahn et al. (2016) fit with the way of individual preferences and the way of automaticity. Thus, we propose, that the option of pulling information will be part of the individual preference named separation and the automaticity of manual settings. We also propose, that automatic notifications can be a way of separate automatically between private and work life by installing for example automatic response e-mails upfront, before changing into the domain of another part of life. Looking at pushing information, we propose that this is a possible way of fully integrate work and private life, as e-mails, phone calls and text messages will always come through, not depending on the location, time or domain an individual is located in. We also propose that dynamic filtering is a form of automatic moderation between integration and separation. In this status an individual does not want to get all messages and phone calls from each individual in their life. Instead, an individual can actively choose, which person are allowed to, for example call and come through any time they want.

Implications for theory. We aim to extend future research, specifically by Jahn et al. (2016), in order to show which design options are getting preferred depending on one’s individual preference to separate or integrate between private and work domains. We want to show experimentally that the proposed IT-related tactics of Jahn et al. (2016) match the automaticity and which design options are needed for this.

Implications for practice. Showing which design options are getting preferred depending on one´s individual preference of segmentation and integration, organizations can use our results to support their employees in order to find the right balance between work and private life.

Based on our results, we expect that future research can extend our study by developing a construct for IT-related boundary tactics, giving the possibility to use it for measuring effects on and of IT-related boundary tactics and work life conflicts.

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11. One Tool to Rule

Paper Number	**P14**
Title	**One Tool to Rule? – A Field Experimental Longitudinal Study on the Costs and Benefits of Mobile Device Usage in Public Agencies**
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Table 11.1 Fact Sheet Publication

One Tool to Rule? –

A Field Experimental Longitudinal Study on the Costs and Benefits of Mobile Device Usage in Public Agencies

Abstract. With the rising number of mobile technologies used in work- and private-life domains, opportunities, and challenges of mobile device usage in daily lives arise. Against this background, we strive to investigate how the effects of mobile devices develop and manifest in people's work and nonwork. As there exist significant differences between the private and the public sector (i.e., motivation of employees, different work time models and more intrinsic motivation goals in governmental agencies), we choose to analyze employees in German public agencies due to their high intrinsic motivation goals along their strict working schedules. To reach this goal, we look at employees use of government-provided mobile technologies. Our research pursues an explorative multi-method approach conducting a field experiment with qualitative and quantitative data. Employees were divided into two groups: Ten employees with a tablet and ten employees without a tablet. After analyzing the interviews and survey data using methods from grounded theory, our main results show that a) digital competences can create a bottleneck for employees' innovation behavior, b) government-provided mobile device (GOPE) decrease employees work-life conflict, although their workload increases, and c) GOPE-IT can support innovation behavior of employees in public agencies, assisting them to keep up their efficient work when work demands are high. All these effects can be mediated by the development of employee's ownership towards their GOPE-IT.

Keywords: Work-life conflict, innovation behavior, governmentally-owned-personally-enabled, longitudinal study, psychological ownership

11.1. Introduction

Working in governments is heavily impacted by the introduction of mobile devices. The use of mobile technologies (i.e., laptops, smartphones, and tablets) for work has increased steadily in recent years. Thanks to this development, employees can choose how, when and where they want to work (Klesel, Lemmer, Bretschneider, & Niehaves, 2017). This development is especially beneficial for employees who often work in the field, be it for work- or private-life purposes. In this study, concentrating on IT owned by the government, we refer to this IT as GOPE-IT (GOPE = governmentally-owned-personally-enabled). However, recognizing the distinct differences between the public and the private sector (i.e. motivation of employees, non-profit-making intent, different work time models, more intrinsic motivation goals and the diverse spectrum of values and requirements for data security purposes in governmental agencies) researchers have started to acknowledge the relevance of explaining phenomena describing impacts of mobile devices on work and nonwork such as Bring-Your-Own-Device (BYOD) and Corporately-Owned-Personally-Enabled (COPE) (Bretschneider, 1990; Bretschneider & Wittmer, 1993; Campbell et al., 2009; Eom et al., 2016; Rainey, Backoff & Levine 1976; Rocheleau & Liangfu, 2002; Ward & Mitchell, 2004). BYOD describes the phenomenon of employees who use their privately-owned Information Technology (IT) for work purposes, whereas COPE describes employees´ use of IT owned by the company for private life purposes (Köffer, Ortbach, Junglas, Niehaves, & Harris, 2015).

The introduction of mobile device at the workplace requires a better understanding of the positive and the negative effects following its use. Many studies have already been conducted to explain the phenomenon of IT consumerization, which refers to privately-owned IT resources that are used for business purposes. These studies indicate beneficial effects for a range of performance and experiential outcomes (Klesel, Kampling, Bretschneider, & Niehaves, 2018; Köffer, Anlauf, Ortbach, & Niehaves, 2015; Köffer, Ortbach, & Niehaves, 2014; Köffer, Ortbach, Junglas, Niehaves, & Harris, 2015; Kohne, Ringleb, & Yücel, 2015; Niehaves, Köffer, & Ortbach, 2012; Struthers & Lee, 2013). Previous literature looked at the effect mobile devices have on the work-life balance of employees (Cousins & Robey, 2015; Duxbury & Smart, 2011; Jahn, Klesel, Lemmer, Weigel, & Niehaves, 2016; Köffer, Anlauf, et al., 2015; Kossek & Lee, 2017). For example, when interruptions due to mobile device usage (i.e., tablets) occur, a conflict between the private life and work domain can arise, leaving the employee in a conflict between work and private life domains (Chen & Karahanna, 2018).

Mobile devices changed our way of working significantly. With their emergence employees were able to work anywhere and anytime giving rise to more flexible work hours across individuals life (Allen et al., 2011; Chen & Karahanna, 2018; Cousins & Robey, 2015). For example, one of its effects on work consists in supporting innovation behavior (IB) of employees, describing employees´ experimental use of information technology to choose between different applications or to redesign or create new processes by opening new ways of performing work tasks (Baskerville, 2011, Köffer, Ortbach, et al., 2015; Lee et al., 2019). These innovative behaviors of employees can lead to more efficient ways of performing tasks or leaning processes.

Mobile devices have also been linked to consequences across the work and nonwork domains, especially blurring boundaries between those two domains (Chesley, 2005; Köffer et al., 2015). In general, there are always two sides of the coin while using mobile devices, positive and negative. Depending on an individual's preferences of separating or integrating work and life domains, these consequences can be interpretated as costs or benefits. While innovative behavior is listened as positive outcome regarding the use of mobile devices in organizations, work-life conflict (WLC) seems to be a negative outcome as stress and dissatisfaction can be enhanced through rising demands on blurring boundaries between an employees' work and private live (Cousins & Robey, 2015; Duxbury & Smart, 2011).

Literature on the use of mobile devices offers valuable insights in the impact of mobile devices on people's work and nonwork domains. Most of the studies are based on cross-sectional observations (Chesley, 2005; Cousins and Robey, 2015; Duxbury, Higgins, Smart, et al., 2014). However, it takes time for the effects of mobile technology use to develop and manifest in our work and nonwork domains. Longitudinal research that examines the development of mobile technology use for work purposes over time is sparse (Duxbury, Higgins, Smart, & Stevenson, 2014). Therefore, we aim to develop a longitudinal view of how the use of mobile devices influence our work and nonwork domains through a mixed method approach.

Moreover, most of the studies on mobile technology use are in the context of private sector, which differs from public sector for example regarding employee's intrinsic motivation, non-profit-making intent, different work time models, and the diverse spectrum of values (Buelens & Broeck, 2007; Lachman, 1985; Lane, 2000; "Public vs Private Sector | Top 11 Differences & Comparison Infographics," 2019; Wal et al., 2008). Especially focusing on the work culture of employees, we notice that the private sector is driven by the purpose of serving citizens the best services over their lifetime, such offering their employees high job security by lower payments as compared to the private sector, which is profit driven with competitive work and higher payments (Buelens & Broeck, 2007; Lane, 2000). However, seeing the importance of digital competences to help with dealing the cost and benefits of mobile device usage, digital competences are a limited factor in public agencies (Chakravarty et al., 2013). Often public agencies do not have the capabilities to pay well-trained professionals in the field of digital transformation comparable salaries that they would receive in the private sector. To address our objective of focusing on the use of government-provided mobile devices and how their impact on employees work and nonwork domains unfold over time, this paper is guided by the following research questions (RQ):

RQ: How does the impact of governmental-provided mobile devices (i.e., tablets) on employees work and nonwork domains unfold over time?

This paper is structured as follows: First, we describe the background of this study demonstrating the need to look at the effect mobile device usage has on employees´ work and nonwork in public agencies over time. Then, we propose our methodology used to meet our objectives in the best possible way, followed by the findings of our study. Next, we provide propositions on the overtime use of government-provided mobile devices in the public sector. We conclude by discussing our findings and propositions and by showing limitations of our study, proposing ideas for future research.

11.2. Background

First of all, it is important to study the use of government-provided mobile devices (GOPE-IT) and how its impact on work and nonwork domains unfold over time in the public sector due to its differences from the private sector. The two sectors differ i.e., in their primary purposes, their ownerships and especially their work culture of employees (Buelens & Broeck, 2007; Lachman, 1985; Wal et al., 2008). For example, public sector entities provide the basic public services to their citizens at a reasonable cost, without the intent of being profitable("Public vs Private Sector | Top 11 Differences & Comparison Infographics," 2019). Against this, private sector companies, which are owned by private individuals aim for profits by operating within rules of their respective government. Looking at the work culture of employees, both sectors differ in their competitive work environment. The private sector contains a competitive work culture with performance-based career growth combined with high payments (Buelens & Broeck, 2007). However, the public sector contains a relatively relaxed work culture, focusing on high job security combined with lower payments in comparison to the private sector, suggesting the higher motivation of employees (Buelens & Broeck, 2007). Still, movements such as the new public management supports the public sector to start working similar to the private sector, focusing on citizens as customers providing modern IT-supported services in the best possible way (Lane, 2000)

Previous literature looked at the use of mobile devices at the workplace showing different effects mobile device usage have on employees (Cousins & Robey, 2015; Duxbury & Smart, 2011; Kreiner, 2006; Kreiner et al., 2009; Köffer, Anlauf, et al., 2015; Köffer et al., 2014;

Kossek & Lee, 2017, Piszczek, 2017). Two dimensions of mobile device work have emerged – the performance- and boundary-related dimension. The performance-related dimension describes the way employees use their mobile devices to increase their performance regarding work-processes whereas the boundary-related dimension describes the way employees cope with setting boundaries between work and private life domains (Duxbury et al., 2014; Köffer, Anlauf, et al., 2015) (Figure 1). Mobile device usage is a key factor in supporting employees´ innovation behavior regarding work processes (Köffer, Ortbach, et al., 2015; Lee et al., 2019). The way mobile devices and their use are communicated (i.e., through organizational policies) is supposed to influence employees´ work-life conflict (Ahuja et al., 2007a; Chesley, 2005). Especially in the public sector, where employees are working with sensitive personal data sets (for example taxes), a transparent and secure mobile device usage needs to be realized.

Looking at the performance-related dimension of work, where employees´ use mobile devices to increase their process performance, innovation behavior defines one key factor of mobile device behavior (Figure 1). Innovation behavior due to mobile device usage is characterized by an employee´ freedom of choice about which technology they want to use for different specific work tasks (Köffer, Ortbach, et al., 2015; Niehaves et al., 2012). Aligning to Scott and Bruce (1994) the process of innovation behavior starts with an individual recognizing a problem and generating ideas or solutions for it (Scott & Bruce, 1994). In their study, Scott and Bruce (1994) describe that the way of problem solving, defined as finding different or better ways of engaging with work processes, is related to innovation behavior. After the individual searched for feedback and support regarding their ideas, a prototype or model of the solution is developed and can be experienced by others and implemented into the process (Kanter, 1988; Scott & Bruce, 1994; Wonglimpiyarat, 2014). Recent literature on IT consumerization (Gregory et al., 2018; Mokosch et al., 2015; Niehaves et al., 2012) shows that using mobile devices for work purposes, which were made for consumers (i.e., smartphones and tablets), increases new design options in existing work processes. As an example, Köffer et al. (2015) illustrate, that consumer IT and the permission to use privately owned IT (i.e., mobile devices as laptops, tablets, and smartphones) for work, leads to positive effects on employees' innovation behaviors.

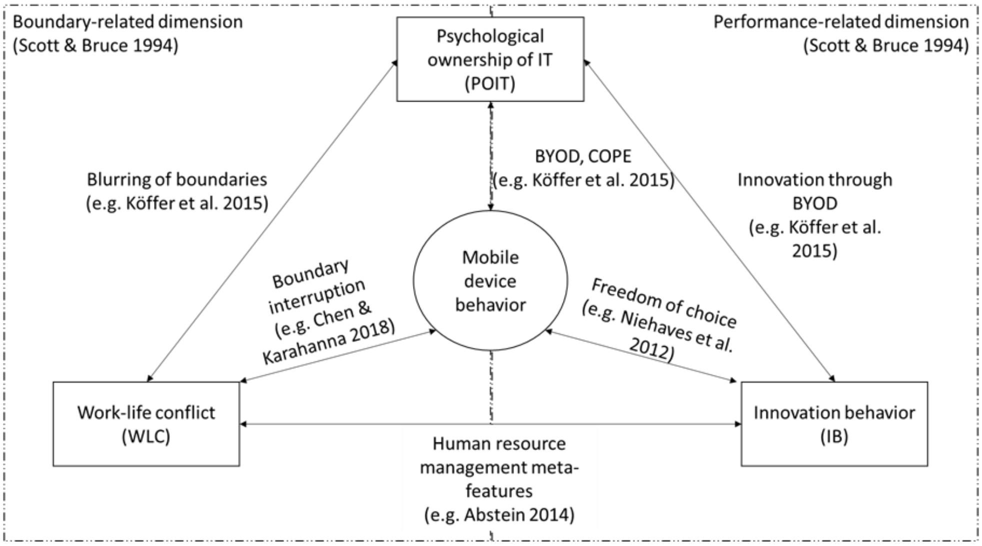

Figure 11.1 Overview of the underlying concepts of mobile device behavior, work-life conflict, psychological ownership of IT and innovation behavior

The use of consumer IT for work purposes increased the importance of the boundary-related dimension of work, describing the way employees cope with setting boundaries between work and private life domains. With the use of privately-owned devices for work and corporate-owned devices for private tasks, the boundaries between work and private life domains started to blur (Chesley, 2005). Previous literature analyzed the effects of consumer IT and mobile devices on the work-life conflict of employees (Cousins & Robey, 2015; Duxbury, Higgins, Smart, & Stevenson, 2014; Duxbury & Smart, 2011; Jahn et al., 2016; Köffer, Anlauf, et al., 2015; Kossek & Lee, 2017). Work-life conflict is described as challenges which occur when employees are not able to maintain their set boundaries between work and private life domains (Kossek, Hammer, Kelly, & Moen, 2014; Kossek, Lautsch, & Eaton, 2006; Kossek, Pichler, Bodner, & Hammer, 2011; Kossek & Lee, 2017). As an example, Duxbury et al. (2014) undertook a longitudinal case study on the adoption and use of a BlackBerry Smartphone by 25 professional knowledge workers to answer the question why some employees and their families benefit from the use of mobile technology while others do not. They used four different theoretical lenses to analyze their data: boundary theory, the social constructivist view of technology, sense making and attribution theory. Their analysis showed that the benefit from mobile technology use depends on employee’s individual strategies to manage their devices in work or private life domains prior to adoption.

Previous studies on psychological ownership of IT, which can be positioned between the performance- and boundary related dimension, have tried to explain why and when employees think of their corporately-owned IT as their own (Barki, Pare, & Sicotte, 2008; Dawkins, Tian, Newman, & Martin, 2017; Karahanna, Xu, & Zhang, 2015; Klesel, Ndicu, & Niehaves, 2016). Referring to previous literature psychological ownership mediates work-life conflict and innovation behavior of employees. Depending on how an employee feels about his or her IT has significant influence on their innovation behavior and perceived work-life conflict. However, previous literature misses to study how psychological ownership develops over time and how exactly it can influence the development of an employee's feeling of GOPE-IT as their own.

Further, previous literature regarding innovation behavior and work-life conflict in the light of mobile device use at work were often conducted as point in time analysis (cross-sectional analysis) in the private sector. These studies miss the ability to describe different phases employees are undergoing when new mobile devices are implemented.

Author	Title	Sectoral focus	Type of study	Key themes	Unaddressed issues to RQ
Chesley, N. (2005)	Blurring boundaries? Linking technology use, spillover, individual distress, and family satisfaction	Private sector	Period-of-time analysis (longitudinal study)	Mobile device use, distress, and family satisfaction	• No field experimental design, • no examination of effects during the implementation process, • looks at cell phones, • study was conducted in 2005, where the phenomenon of IT consumerization did not exist, • no linkage of innovation behavior, work-life conflict, • private sector study
Cousins, K. and Robey, D. (2015)	Managing work-life boundaries with mobile technologies: An interpretive study of mobile work practices	Private sector	Period-of-time analysis (longitudinal study), field study,	Concept of affordance (mobility, connectedness, interoperability, identifiability, and personalization)	• Observation of two points in time, • no field experimental design • no examination of effects during the implementation process, • looks at mobile devices in general, • no linkage of innovation behavior, work-life conflict, • private sector study
Duxbury, L., Higgins, C., Smart, R., & Stevenson, M. (2014)	Mobile Technology and Boundary Permeability	Private sector	Period-of-time analysis (longitudinal study), case study	Boundary theory, social constructivist view of technology, sensemaking and attribution theory	• No field experimental design, • no examination of effects during the implementation process, • no linkage of innovation behavior, work-life conflict, • private sector study

Table 11.2 Overview over recent literature regarding longitudinal studies in the context of mobile device use

The intensified monitoring of different phases of problem solving to develop new processes and innovate their work routines cannot be displayed using cross-sectional analysis. The effect mobile devices have on employee's work-life conflict is also studied mainly at a point in time, rather along a specified period (i.e., start of technological implementation process and the end of it). Additional, previous studies are mainly conducted in the private sector (Table 1).

Yet, there exist significant differences between the private and the public sector (i.e., motivation of employees, different work time models and more intrinsic motivation goals). Especially considering public agencies, research regarding the use of mobile devices for work purposes over a period is sparse (table 1). With this in mind, we aim to enrich research in the field of government-provided mobile devices, which are personally enabled, by identifying and understanding the influence of mobile device usage on employees´ work and nonwork domains over time.

11.3. Method

11.3.1.Method Selection

Given our interest in how the dual effects of mobile devices unfold over time, we used a longitudinal study. Our study was conducted in a governmental agency in Germany. As qualitative research gives more opportunities to observe phenomenon's under investigation in more detail and recent research has called for the use of more qualitative and mixed method approaches to study the effect of mobile devices on employees innovation behavior and work-life conflict over time, this research pursues an explorative multi-method approach conducting a field experiment with qualitative and quantitative data (Ahuja et al., 2007; Allen et al., 2014; Chesley, 2005; Kreiner, 2006). Based on the explorative nature of this study (longitudinal analysis regarding mobile device use in the public sector), we started to develop surveys which employees had to answer every month, while we also designed interview guidelines for three points in time where we made use of tools from grounded theory methodology for analyzing our qualitative data (Gioia & Chittipeddi, 1991; Gioia, Corley, & Hamilton, 2013; B. G. Glaser, 2002; B. G. Glaser & Holton, 2004; B. G. Glaser & Strauss, 1999a; B. G. Glaser & Strauss, 1999b; B. Glaser & Strauss, 2006; Urquhart & Fernández, 2013).

11.3.2.Data Collection

General information. The participants (6 males, 14 females) were recruited from different public sector agencies including community workers, city councilor, street worker and mayor´s secretariat. They also differed in their way of their hierarchical positions in the public sector (manager, employee). We randomly assigned the employees to two groups. One group consisted out of one employee with and one without a tablet (over the course of time, one of the employees with tablet dropped out, leading to his partner without tablet taking his place, which resulted in only 251 surveys and 58 interviews in total, with estimated 560 interview hours in total). Furthermore, we particularly included practitioners with working experience (24.2 years of working experience in average; group 1 with tablet 21 years of average work experiences, group 2 without tablets 27.8 years) to be able to capture mobile device use behavior that already existed and were proven in daily work. We conducted a multi-method longitudinal analysis, consisting of interviews and surveys to understand how mobile device use influenced employees work behavior over a period of 12 months (Fig. 2).

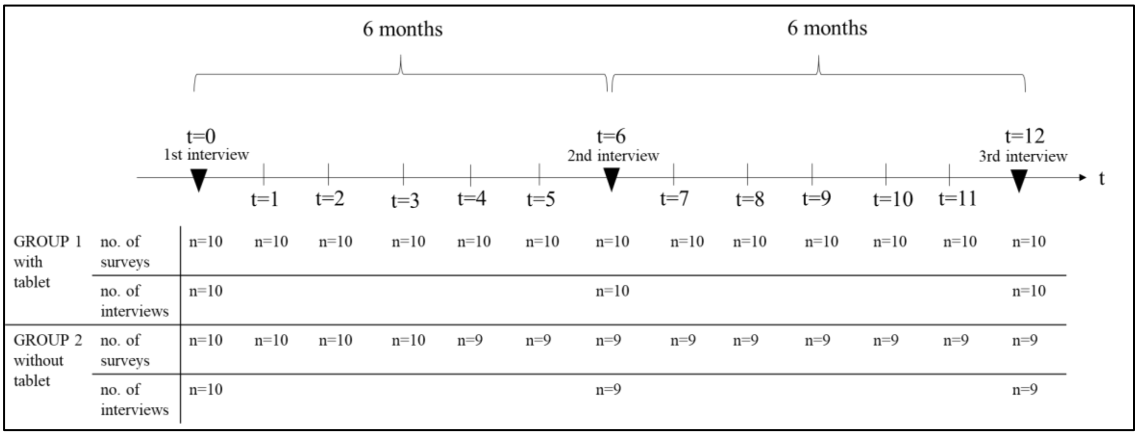

Figure 11.2 Concept of the longitudinal multi-method approach

Qualitative Study. In our field experiment, we conducted 58 semi-structured interviews at three points in time over a period of twelve months (Figure 2): before the tablets were provided (t=0), six months after the tablets were provided (t=6), and twelve months after the tablets were provided (t=12). Given the evolving nature of technology use over time, the two rounds of interviews after the distribution of tablets allow us to capture how respondents incorporated their tablets into daily life and how the tablet use influenced their work and nonwork domains. The three rounds of interviews yield a total of 68 hours of qualitative data.

To check whether the questions of the semi-structured interview protocol were comprehensible and adequate, we conducted four interviews in a pre-test. We selected open questions like “How does your use of mobile technologies at work look like?” or “How could the use of a tablet change your daily work experience?”. Based on this first round of interviews, we adapted our questions due to the changes employees’ notices while using tablets. We continued by further developing questions for the next two interview rounds being conducted in month number six and after month twelve for both groups.

We conducted the first round of interviews just before the tablets were randomly provided to 10 of the 20 respondents. Interviews during the first round focused on the respondents’ current work routines and how they expected to incorporate mobile devices (if assigned to them) into their work routines. We conducted the second round of interviews six months after the tablets were provided. These interviews with respondents who received a tablet focused on whether and how the use of tablets led to changes in their work routine and other aspects of daily life. We conducted the third round of interviews 12 months after the tablets were provided. During the second and third rounds of interviews the respondents were also asked to reflect on how much the expectations they expressed during the first round were met and how satisfied employees were overall with their tablets since the previous interview. During the interviews, different important themes emerged (Table 2).

Interview Themes	**1st Interview Round**	**2nd Interview Round**	**3rd Interview Round**
Explorative Behavior	x	x	x
Ownership of IT		x	x
Work-Life-Conflict	x	x	x
IT-Satisfaction	x	x	x
Technological Expectations	x		
Fulfilled Technological Expectations			x
Work Routines	x		
Changes in Work Routines		x	x

Table 11.3 Emerging Interview Themes

Quantitative Study. We conducted a quantitative study to empirically assess the changes due to the implementation of mobile device usage of employees. A web-based survey was used to gather this information. We implemented the survey using the software Unipark. We choose the survey method to be able to get insights into changes which occurred due to the implementation of tablet usage every month (Fang et al., 2014). In the end of every month, we sent a reminder e-mail to our participants with the link to the next survey round. Before conducting the survey, we designed a questionnaire based on existing IS literature with focus on work-life conflict and innovation behavior. We used 7-Point Likert scales from 1 (“strongly disagree”) to 7 (“strongly agree”) aligned to previous studies. For example, we adapted items from Ahuja (2007) and Adams (1996) for the construct work-life conflict. To capture innovation behavior, we adapted items used by Scott & Bruce (1994), and Köffer, Junglas et al. (2015). To validate the scales, we invited 15 doctoral students from a German university to complete the survey. As one of our participants with tablet dropped out and his partner took his place, we collected 251 surveys from 13 points in time taken (t=0 to t=12).

11.3.3.Data Analysis

Interviews. Following the grounded theory approach, we analyzed the data beginning with open coding (Corbin & Strauss, 1990; Gioia & Chittipeddi, 1991; B. G. Glaser & Strauss, 1999a; B. G. Glaser & Strauss, 1999b). Two of the researchers implemented the procedure of open coding independently. They read the transcribed interviews and proposed first order concepts that represented the content. Afterwards, similar codes were collected out of the interviews and grouped as a common denominator what is known as axial coding. Aligning to what we know as the Gioia methodology (Gioia et al., 2013), “we treated ourselves as knowledgeable agents who can (and have to) think at multiple levels simultaneously (i.e., at the level of the informant terms and codes and at the more abstract, 2nd-order theoretical level of themes, dimensions, and the larger narrative—answering the important question ‘‘What’s going on here?’’ (theoretically)” (Gioia, Corley & Hamilton, 2012, p. 20). An example of this process is given with the following quote of an employee we interviewed. "For example, if someone pipes waters. Waters are open in nature. (...) Moreover, when you see something like that in the field and think ‘Well, should this person not have a permit to pipe waters?’, if this is the case I can just take a picture of it and send it, standing in the field, via e-mail to my colleague, and ask him: ‘Please have a look, if this person has a permit for piping waters.’” (Interviewee 15). Two independent concepts (“Operation of the tablet is easy” and “Operation of the tablet is intuitive”) were identified. Additionally, “Ease of Use” was used as a 2nd order theme combining axial and theoretical coding. Disagreements were discussed between the researchers and settled by a mutual agreement.

We finished our process when the researchers agreed that there is only little chance that new essential developments in mobile device usage would emerge. Since our data highlights key aspects of the development of the use of tablets in the workplace, we finish our analysis by relating our results with existing literature developing our 2nd-order themes further into 2nd-order “aggregate dimensions” (theoretical saturation, Section 5). The resulting data structure, as recommended by Gioia et al. (2012), can be seen in the Appendix, table A1.

Survey. We used SPSS to analyze the data and test for changes which occurred during our longitudinal study. Concentrating on the consequences of GOPE-IT on work-life conflict and innovation behavior of employees, we first started to "normalize" our results to remove group differences, meaning that we set the starting value of the indices per group at the starting time to 100, by dividing each value by the group-specific value in t=0. In this way, the subsequent indices represent the relative value per group compared to the starting time. As we divided our sample in two groups by giving 10 participants tablets, leaving 10 without tablets, we developed two similar groups out of the organization, so that group 2 was able to function as our organizational control group. To find out the fundamental organizational developments we divided the value of group 1 (with tablets) by the one of group 2 (without tablets) resulting in an index for work-life conflict and innovation behavior, representing the changes due to implementing tablets.

As we want to know exactly what influences tablets have, compared to the entire organization (represented by the control group, group 2), this method allowed us to eliminate normal organizational developments leaving us with the changes due to the tablet effecting work-life conflict and innovation behavior. To summarize our methodological approach, both groups were normalized to be able to calculate the changes and to compare group 1 with tablets to the entire organization (group 2 without tablets). In doing so, the pre-experimental value represented the relation to the pre-value. Thus, a time normalization has taken place, showing us changes, which occurred due to the usage of the tablets.

11.4. Findings

11.4.1. Qualitative Study

In this section, we present the findings of the qualitative study. Our interviews revealed that people’s emotional attachment to the government-provided tablets developed over time. In the early stage of using these tablets, respondents clearly defined these devices as “not mine” given their employer-provided nature. Interviewee 9, department head of operating costs for day-care facilities, explained how he felt towards the tablet shortly after he started using it:

> "*In my opinion these devices are not mine. They are owned by my employer and according to this fact I must deal with it. As I did not buy the tablet myself, I do not have the feeling of owning it. It is only assigned to me*." (Interviewee 9, 1st Interview)

As people incorporated the tablets into their daily work routines, they enjoyed the flexibility afforded by these mobile devices. Tablets had become an integral part of their daily life across both work and nonwork domains. The same respondent (Interviewee 9), who first indicated no feeling of ownership over the tablet, described his growing attachment to it:

> *"I feel that the tablet is mine. It is more than at the beginning. However, I do not feel that it is mine for a hundred percent yet. I think it is mine for seventy-five percent."* (Interviewee 9, 3rd Interview)

The feeling of ownership seems to be nurtured by two factors. First, being the only person with exclusive access to the tablet contributed to the feeling of ownership. Second, the ability to carry the tablet to any places, including one's personal space (i.e., home), also nurtured the feeling of ownership. Interviewee 9 also shared how he started to feel ownership over the tablet:

> *"Yes, because I am the only one working with my tablet, no other colleague does, (...). I have the feeling that the tablet belongs to me more than the office computer, because everyone can log into my office computer but no one can log into my tablet using their ID. I am the only person knowing the password for my tablet. I also take the tablet with me to work in the morning and take it home with me at noon, (...) because then, of course, I also have the possibility to work from home."* (Interviewee 9, 3rd Interview)

The comments by Interviewee 8, assistant to the district administrator, also highlighted the growing feeling of attachment towards the employer-provided tablet over time. In the beginning, she drew a clear line in terms of the device ownership:

> *"No, not at all. I don't have the feeling that it is my own."* (Interviewee 8, 1st Interview)

As she further incorporated the tablet into her daily life – not just work routines but also nonwork tasks – she acknowledged a stronger feeling of ownership:

> *"It may not be my own, but yes, of course I have the feeling that it is my own. I also use it for private things, of course."* (Interviewee 8, 2nd Interview)

After using the tablet for about one year, respondents expressed an even stronger feeling of ownership:

"Exactly, I feel more strongly that it's my own now." (Interviewee 8, 3rd Interview)

Psychological ownership can lead to positive work outcomes such as organizational citizenship behaviors (Liu et al. 2012). As people became more attached to their tablets, they developed positive attitudes towards these devices, which motivated them to explore different ways to incorporate their tablets into daily activities as an extension of themselves. Employees actively searched for and experimented with ideas to optimize their work routines. Interviewee 2, a social pedagogue, explained how the use of tablet enabled him/her to work more productively and leverage the in-between times:

> *"In the field meetings can sometimes finish a little earlier. Then I have an hour sparse until I meet the next client. During this time, it does not make sense to go back to the office. Using the tablet, I can sit in my car and dictate notes from the last meeting, (...) afterwards, I send my notes to my business mail account so I can open them later in the office (...). With this optimized process work becomes easier for me and I am able to visit more clients."* (Interview 2, 2nd interview).

A fusion of the self with the target of ownership typically takes place through one's control over and intimate knowledge of the target (Pierce et al. 2001). As employees developed deeper understanding of their tablets, their innovative behaviors were no longer limited to just adapting their work routines. They went beyond the apps currently installed on the tablet and found new ones to better support their work routines. During this process of exploring and improvising their own technology solutions, the employees felt that they developed greater amount of control and better knowledge of their tablets, which positively fed into their feeling of ownership towards the tablets. Interviewee 1, a social worker at the specialized service of health and consumer protection, explained how he was able to use different applications to increase his productivity, i.e., while downloading an app to dictate information which are directly translated in written form, which he can email himself to store it better digital:

> "*I no longer record the conversation with the client when I use an app to dictate my notes on my tablet. Having the notes readily in written form allows me to more easily store it or email it directly to my account."* (Interviewee 1, 3rd interview)

Our quantitative results reveal a rise of ideas on efficient technology use during the first six months of the tablet use. However, during the last six months of tablet use, our quantitative results suggest a decrease in innovativeness. Although the level of innovativeness rose since the distribution of tablets within the government, the upward trajectory of employee innovation seemed to be dampened by the lack of IT support. As employees explored innovative IT solutions on their tablets, they were still bounded by the current government IT infrastructure. Interviewee 4, who was a clerk, explained her frustration when IT support was not able to keep up with employees' innovative behaviors. This highlights the importance of digital competence (i.e., up-to-date IT knowledge and support) in advancing public sector's technology infrastructure:

> *"It is so annoying when you slam shut doors [in the administration]. At the beginning you are telling yourself 'Oh come on, and can we, and maybe, and here and I searched.' Then in the end, I just accepted the fact and told myself: 'come on, they [public administration] have not enough competences to help us."* (Interviewee 4, 3rd interview)

Employees also leveraged their tablets to cope with high workload. When facing a surge in work demands, employees took advantage of the tablet-enabled capability to work from home and work during in-between time when they commuted between client sites, home, and work. Interviewee 5 who is technical clerk describes his coping with high workload using the tablet as follows:

> *"I can document something faster on the spot outside. Because often I'm not in meetings until Tuesday, because there's hardly anyone present on Monday. And on the first day, Tuesday, work demands are high. Consequently, I need Wednesdays to work on documenting my meetings from Tuesday. The tablet gives me the opportunity to work on something for Wednesday, Tuesdays while I'm still at work, or even the possibility to work on it during the meeting.* (Interviewee 5, 3rd interview)

The feeling of ownership also led employees to invest more time and attention in tablet use during their nonwork time. The use of government-provided tablet in their nonwork domain may be work-related or nonwork-related. Our interviews revealed the blurring boundaries between work and private life domains as employees started to use tablets to work from anywhere at any time. During the course of the study, several employees shifted their boundary enactment towards integration (Interviewee 8).

> *"(...) only the fact that I can take my work everywhere, meaning that I have all or most of it anytime with me using the tablet. I can always use the contacts on my tablet. This means that my work is no longer only attached to the office. I am able to work anywhere at any time, between meetings. This is a relief."* (Interviewee 8, 2nd interview)

Over time, the places where employees used tablets to engage in work-related activities expanded from the office (i.e., using tablets to take notes during meetings) or other places involved in work tasks (i.e., client site) to nonwork locations (i.e., home).

> *"In any case, I noticed that I am more flexible, especially as our amount of work arose during the last months, and that I am not only tied to my workplace in the office, but I can also access certain things from somewhere else. I have also noticed that after work I can't completely detach my mind from work because the tablet is present, and I check my e-mails or something in between private-life tasks".* (Interviewee 9, 3rd interview)

The interviews show that the improvement of efficiency and communication while blurring boundaries can be seen on the one hand as relief (Interviewee 8) and on the other hand as a tension (Interviewee 9). However, we have to notice that interviewee nine describes an increase in workload ("*…especially as our amount of work arose during the last months, ...*") where the tablet offered him more flexibility to get things done. The quantitative data confirms, that both groups WLC increases between the second and third interview round (between the 7th till 13th months). Combining the results from survey and interviews reveals, that tablets and therefore mobile GOPE-IT in general can decrease WLC of employees while their workload and the load across the organization increases (the increase of work demands is also proven by the employees without a tablet (i.e., Interviewee 12 and 14)). This phenomenon of coping with higher work demands due to blurring boundaries using mobile devices can be explained by employees developing their own GOPE-strategies. An example is shown by Interviewee 6:

> *"Yes, that I can receive my e-mails and reply to them when I'm not in the office. I can also look up certain things on the Internet when it comes to regulations, when I am not here in the office but in the field. I can quickly retrieve data on the Internet, and I can get information which I can use for my work."* (Interviewee 6, 2nd interview)

Interviewee 6 explains his integrating of work and private lives using the tablet with a specific example of checking e-mails everywhere at any time, enhancing efficiency due to improved communication. This strategy can also be seen in previous studies. As an example, Kreiner et al. (2009) analyzed different boundary-tactics (behavioral, temporal, physical and communicative) which can be used to manage work and private-life boundaries. We notice from our interviews in combination with the survey data, that employees need to build up individual strategies, aligned to IT policies from the public administration, to cope with government-provided mobile devices when intensified demands occur. This allows employees to cope with the higher amount of work, being more efficient and improving communication, while keeping the conflict between work and private life low.

Additional quotations of other interviewees regarding work-life conflict and innovation behavior and psychological ownership are shown in table 3.

Second Order Theme	**Representative Quotation**
Innovative Behavior with Technology	
Ease of use	For example, if someone pipes waters. Waters are open in nature. (...) Moreover, when you see something like that in the field and think 'Well, should this person not have a permit to do so?', if this is the case, I can just take a picture of it and send it, standing in the field, via e-mail to my colleague, and ask him: 'Please have a look, if this person has a permit for piping waters.' (Interviewee 15) "I'm used to working with a small device, because the device I used before, my smartphone, was much smaller. For me it is nice, others said it is excessively small. They would need a bigger screen. This is different for each person. Personally, it does not matter to me, the size of such a tablet is sufficient. " (Interviewee 3)
Adaptation in use behavior	"I still do a lot on my smartphone, but normally I could use my tablet more often. It is always charged so I could use it." (Interviewee 3, 2nd interview) "Yes of course, I use it privately and here in the office if we have any advanced trainings or events etc. Then I also take it with me and use it, however, predominantly for the fast receipt of information and for passing on etc. In general, I use it for the same tasks as my privately-owned smartphone before, but in a much more pleasant way. Because it has a bigger screen and is easier to use." (Interview 3, 3rd interview)
Process optimization	"That you can use Outlook, that the calendar can be opened and that you can arrange appointments faster, even outside the office, for example. Because that is the main reason, for which I use the tablet. Another task is checking e-mails and quickly reading an information or something." (Interviewee 3) "I can still coordinate my appointments with the tablet. I can read my e-mails between meetings, i.e., when I am away for a longer time or I make house calls, my lunch break, in between the next client meeting, then I can check if something urgent happened and I can answer it right away. I am a bit more independent." (Interviewee 2)
Tablet tasks	"Sometimes I am out of office in the field or last time I did a long-term training, and that was great because we had to bring mobile devices. I used my own tablet before at these meetings, but my work-tablet is much better than my private one. I use my work tablet for photo protocols and to do research." (Interviewee 7). "For example, I had a client meeting with another youth welfare worker. (…) The colleagues of the youth welfare department have all privately an iPhone with internet access. We visited a Bulgarian family who did not speak German but as we had the iPhone with a translator application on it, we were able to communicate with the family. And the same process is possible with the tablet now." (Interviewee 11)
Integrating work IT into family life	
Leaving the tablet in the office after work	"If I drive straight home from field duty, yes. But then I also usually switch my tablet off when I am in the car, because I get my e-mails on the tablet as well and I don't want to check them at home." (Interviewee 4) "This [the tablet] stays in the closet here, she won't take it with her home." (Interviewee 14, partner of Interviewee 4)
Using the tablet at home for working tasks	"As I said, it makes my work easier. In addition, yes, it also interferes with my private life, but I do not think that this is negative. I do think so, because I set myself limits on how often I use the tablet and when I use the tablet, whether I really use it now, as I just said, leisurely to search on the internet or whether I really detach myself from the tablet and from work. I try not to check my e-mails then. But that is up to me, and that's for me just a very pleasant way of using it." (Interviewee 8) "If someone wrote me an e-mail (...) and it is urgent I will answer it right away, even on the weekend. If I had the Friday off and would check my e-mails coincidentally on the

	tablet, and if I got an e-mail whether for example the date next week is still safe, I just answer right away. (Interviewee 10)
Using the tablet at home for private life	"I think I would be more distracted. I play football myself and I am interested in football and would read some news or, if I could stream a game that is running. So, if I could really use my tablet for anything, I would distract myself." (Interviewee 18) "And sometimes I take the tablet with me home and since we can use it privately, I have a few things on it, so I can somehow access the city library, have an eBook on it or something. That's quite good." (Interviewee 2)
Working anywhere at anytime	"Yes, that I can receive my e-mails and reply to them when I'm not in the office. I can also look up certain things on the Internet when it comes to regulations, when I am not here in the office but in the field. I can quickly retrieve data on the Internet, and I can get information which I can use for my work." (Interviewee 6)
Ownership of Technology	
Tablet is owned by the public administration	"No. I would not feel that way now, unless I am explicitly told that the tablet is going to be my property. But I would first assume that I am only allowed to use it for work." (Interviewee 12) "No, so this is my business tablet. I have my own tablet and I have a business tablet. When I do some research for private issues then I use my own and when I have business issues then I use the business one." (Interviewee 7)
„It´s mine!“	"I don't know. Because I have the tablet with me as for the other business equipment, it is in my office and belongs to the public administration, like my chair. But my tablet is with me in the handbag and belongs to me, like my pen or my key." (Interviewee 3) "And sometimes I take the tablet with me home and since we can use it privately, I have a few things on it, so I can somehow access the city library, have an eBook on it or something. That's quite good." (Interviewee 2)

Table 11.4 Data supporting interpretations of tablet usage in the long-term

11.4.2.Quantitative Study

Work-life conflict. The normalized group comparison shows the development of the tablet usage regarding WLC over the period of 12 months. To be able to note differences in the employee's awareness of their own WLC, we conducted surveys in every month resulting in data from 13 points in time (figure 3).

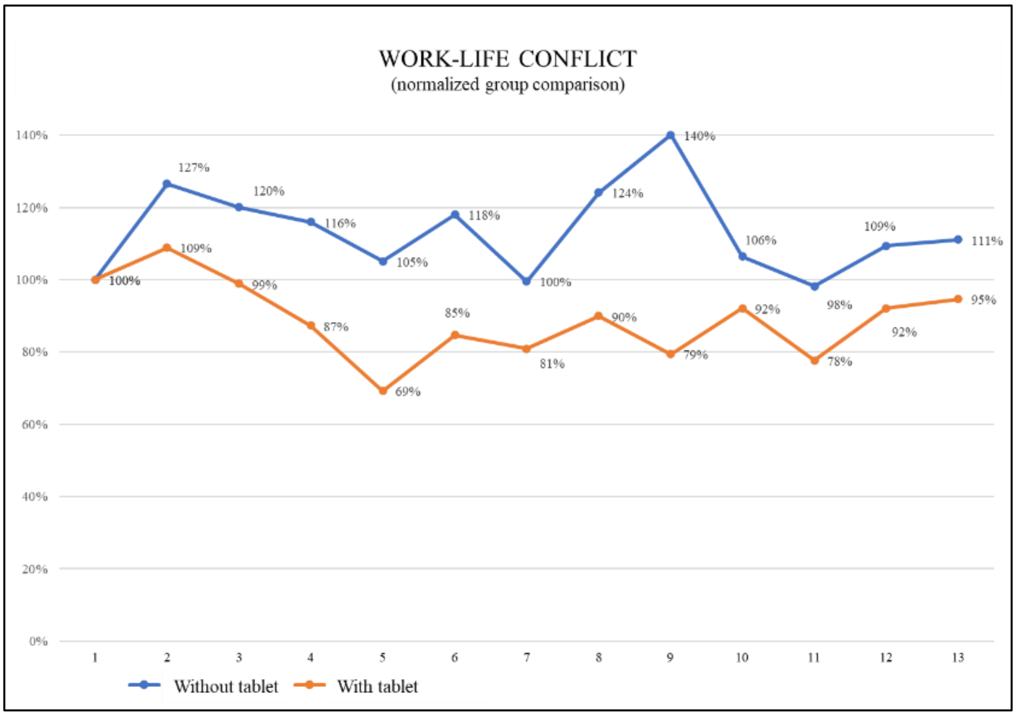

Figure 3. Work-life conflict, normalized group comparison

The normalized group comparison shows that during the first month, both groups list an increase in their perceived WLC, where the group without tablets list a 18% higher increase in WLC than the group with tablets. Between months number two and five we notice a strong decrease in WLC. In the fifth month the group with tablets represent a perceived WLC ranging at 69%, showing a decrease of 40% starting in the third month. In comparison the group without tablets shows a decrease in WLC of only 22%. Looking at months six to eight, we see a slightly comparable development in both groups, noticing that changes in the group without tablets are more than double as high, as the ones in the tablet group. In the ninth months, we see different developments in the groups. The perceived WLC of the group without tablets still increases from month eight to nine, whereas it decreases in the group with tablets. In the 10th month, WLC decreases along 34% in the group without tablets, whereas it increases 13% in the tablet group. From month 11 to 13 we see an almost parallel development of WLC in both groups, resulting in the 13th month in a lower WLC (95%), compared to the starting point, for employees using a tablet than for the ones without a tablet (WLC 11% higher than in month number one).

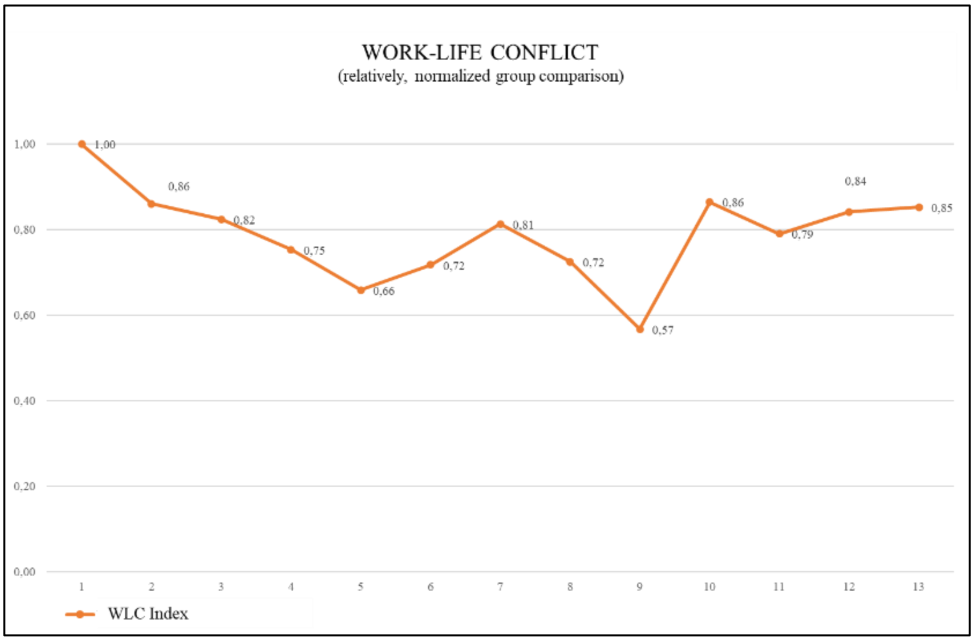

Figure 4. Work-life conflict-Tablet-Factor; relatively, normalized group comparison

To see the changes, separate from normal organizational developments, but compared to the entire organization (represented by the control group, group 2) we conducted time normalization (figure 4). Both groups were normalized to be able to calculate the changes which occurred. In doing so, the pre-experimental value represented the relation to the pre-value resulting in an index for WLC and IB (WLC Index and IB Index).

Considering the index for WLC we notice a decrease in WLC from the first till the fifth month. From month number five to seven the index rises where it starts dropping towards month number six till 0.57 indices in month number nine. In the 10^{th} month we notice an increase of the WLC index to 0.86 indices. With a slight variance the index ends with 0.85 indices in month 13, showing an overall decrease of WLC due to the use of tablets.

Innovation Behavior. Looking at the development of employees´ IB over the time of 13 months, we notice a general decrease of IB (figure 5). Beginning in month number one we see a slight increase in IB for the group with tablets in the second month, whereas the group without tablets notice a slight decrease. From month number two to three, both groups record a decrease in IB, where the decrease of the group without tablets is 26% stronger. Starting in month three IB increases until month number five for the group using tablets. For the employees without a tablet IB increases till month number four and decreases again in month five. As IB increases again for the group without tablets, the perceived IB decreases for the group with tablets until the eight months (68%). During this time IB in the group without tablets states at 75%, being the first time higher in the group without tablets than the one with tablets. In the group without tablets IB is decreasing again, whereas it increases for employees with tablets. In the ninth month both groups state a normalized IB of 85%. Till month number 13 IB decreases overall for employees without a tablet, showing an increase of IB for the group with tablets. IB group values end lower as they started in the first month showing a higher IB for the employees using a tablet than the ones without tablets.

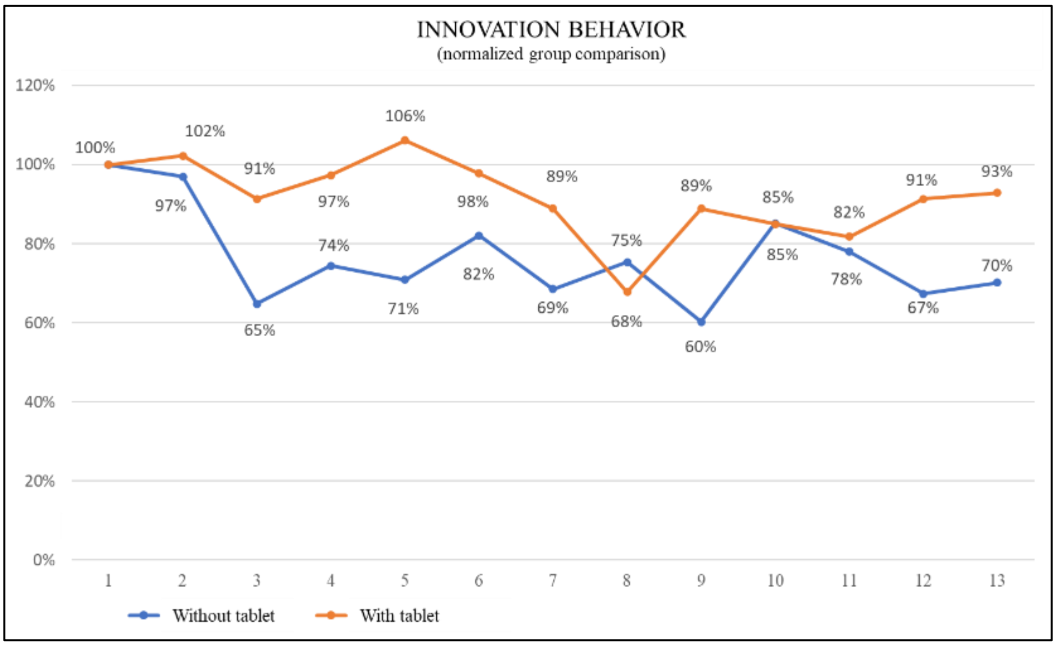

Figure 5. Innovation behavior, normalized group comparison

As we are interested in the changes which occurred in the organization due to the use of tablets, we eliminated normal organizational developments by developing the IB index in comparison to the WLC index. Figure 6 shows the development of the IB index over the period of 12 months.

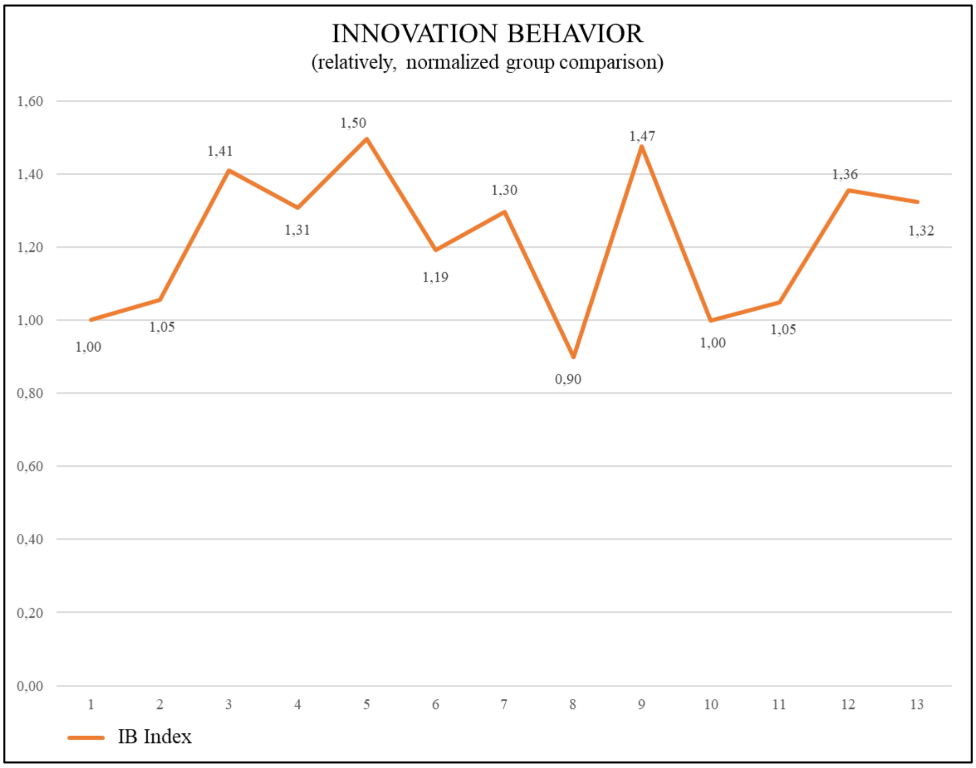

Figure 6. Innovation behavior; relatively, normalized group comparison

Considering the development of IB during the period of twelve months, we notice an overall increase of IB due to the use of tablets. The index rises during the first two months, when it starts decreasing to 1.31 indices in the third month. The indices rise and fall during the next months, showing its lowest point with 0.9 indices in month number eight. Beginning in month number eight the indices rise again and fall back to 1.0 in month number 10. After rising the IB index ends with 1.32 (with an overall of 0.31 indices of rising) after 13 months.

11.5. Propositions on mobile device use in the public sector

This study is motivated by the effect mobile device usage has on employees work and nonwork domains the public sector. Within this area of research, various constructs have been proposed to capture the use of mobile devices for work. For instance, Köffer et al. (2015) referred to "Use of [company provided/privately owned] [traditional/consumer] IT tools" to analyze innovation behavior related to mobile device use. In contrast, Ortbach et al. (2013) focused their study on the underlying behavior (BYOB) instead of mobile devices itself (Ortbach et al., 2013). We conclude that research has yet to look at innovation behavior over time for the use in public agencies. As our study shows, tablet-enabled innovation demonstrates different trajectory over the course of one year. Despite the upward trend shortly after employees started to use the tablet, their innovativeness decreased due to the lack of support for mobile devices in public agencies. Whenever they could, employees developed workarounds on their own to solve the problems. However, there were situations where they relied on the government agency's IT support to unblock issues due to policy compliance (i.e., permission of using applications and ports) or time pressure (i.e., a surge in workload). Oftentimes public agencies tend to lag behind in terms of their IT support and regulations for new technologies such as mobile devices. The lack of digital competences to support the tablet use leads to employee frustration and dissatisfaction. In conclusion, we put our first proposition forward:

> ***Proposition 1****: Digital competences can create a bottleneck for innovation behavior, which can have deteriorating effects on employees' experiential and performance outcomes.*

Recent literature from Köffer et al. (2015) noticed in their study that strategies in the context of BYOD and the diffusion of consumer IT are beneficial for innovation in the context of organizations. Bridging our results back to previous literature shows that policies for mobile device use can increase ideas of employees on how to implement mobile technologies in their work routines. This also can lead, aligning on previous literature to an increase in IT satisfaction (Chesley, 2005; Klesel et al., 2018). Being transparent about expectations of availability of employees using GOPE-IT can support employees in developing boundary strategies (Cousin & Robey, 2015; Duxbury et al., 2014b; Jahn et al., 2016; Klesel, Jahn, Müller, & Niehaves, 2016). This can support the decrease of employees perceived work-life conflict. With this in mind, we introduce our second and third proposition:

> ***Proposition 2****: Policies for mobile device behavior are able to increase employee's innovation behavior and psychological ownership of IT.*

> ***Proposition 3****: They can also decrease employees' work-life conflict, especially if their workload increases.*

Previous literature from Klesel et al. (2017) introduced the construct of transgressive use. Transgressive use is described as a multi-dimensional construct that includes four dimensions: the degree of individual IS, the degree to which boundaries are crossed (technology usage in different domains), the degree of exploration and the degree of intensity (amount and frequency of technology use) (Klesel et al., 2017). The construct of transgressive use describes dimensions, which are shown in the excerpts of the interviewees describing characteristics of psychological ownership of IT (Barki et al., 2008; Dawkins et al., 2017; Karahanna et al., 2015;

Klesel, Ndicu, et al., 2016). Combining recent literature with our findings, we propose our fourth and final proposition:

Proposition 4: *Transgressive use of governmentally-provided mobile devices increases innovation behavior by decreasing work-life conflict mediated through psychological ownership.*

11.6. Discussion

We aim to explore how the effects of mobile technology use develop over time and manifest in people's work and nonwork domains. Using our explorative multi-method approach conducting a field experiment with qualitative and quantitative data (Ahuja et al., 2007; Allen et al., 2014; Chesley, 2005; Kreiner, 2006), we developed four propositions regarding mobile device use in the public sector.

Implications for theory. We aim to enrich recent literature on work-life conflict, innovation behavior and psychological ownership of IT. First, we identified psychological ownership as an important factor that explains the dual effects of mobile technology use. Our study also reveals the dual effects of the feeling of ownership. On the one hand, the feeling of ownership over mobile devices motivates users to explore new ways of work as enabled by the devices. On the other hand, the attachment to the mobile devices also leads to the blurred boundaries between work and nonwork. First, we want to extend previous literature on work-life conflict and GOPE-IT policies by showing that policies for mobile device use have the possibility to increase employees' innovation behavior for implementing governmentally-provided mobile devices in their daily work. If employees know about regulations on how to use government-provided mobile devices, getting support from their governmental agencies, it is easier for them to use their devices along their work routines, even if their workload increases. This phenomenon can also be seen when expectations of the management on employees using mobile devices are made transparent. Job satisfaction can increase, while work-life conflict decreases, although workload increases.

Second, innovation behavior has been looked at from the individual and technological perspective (Köffer, Ortbach, et al., 2015; Scott & Bruce, 1994). We want to enrich current literature by considering another point of view, helping employees to innovate even more, enabling a stable, accountable and responsive government (Janssen & van de Voort, 2012; Ojo, Janowski &Awotwi, 2013). Analyzing the need of digital competences for public agency employees can help to increase their innovation behavior.

Third, we aim to enrich research on psychological ownership (Barki et al., 2008; Dawkins et al., 2017; Karahanna et al., 2015; Klesel, Ndicu, et al., 2016). In our study, we found that the private use of governmentally-provided mobile devices increases ownership. The different types of use can be described aligned to Klesel et al. (2017) as transgressive use blurring the boundaries between work and private life.

Implications for practice. Our findings highlight the importance of digital competence in public sectors. First, digital competence will enable government agencies to unleash the potential of mobile devices. For new technology to be more fully utilized, it is important that IT support personnel are equipped with knowledge of the latest technology and are capable of integrating new technology into the IT infrastructure. Second, digital competence will also empower employees in their innovative behaviors. Public-sector employees, who are highly passionate about their job despite not being competitively paid as their private-sector counterparts, tend to be more motivated and devoted to finding better and smarter ways to work more productively. When employees are ahead of their IT support personnel in searching for technology-based solutions, the lack of support capability will dampen their passion about incorporating new technology in their work. Our findings and propositions can serve public administration management as guidelines for mobile device use, assisting them to support their employees in their daily work. As an example, the communication of expectations of public agencies on the availability of their employees using government-provided mobile devices can increase employees' job and IT satisfaction while decreasing work-life conflict. This can cause less staff turnover by increasing the productivity of work tasks.

11.7. Conclusion and Outlook

Like every empirical study, this paper has limitations that leave room for future research. Even though we tried to bring qualitative rigor in our study using the Gioia Methodology to conduct grounded theory, we still have to mention typical limitations of qualitative research (i.e., weak internal validation). Apart from those, it is important to acknowledge the following: First, the nature of this study is explorative. Therefore, it aims to extend current research on mobile device use in the public sector. In our study, we concentrated on changes in employees' behavior of using GOPE-mobile devices over time. As we only had a relatively small sample size (10 employees with tablet and 10 employees without a tablet) conducting our field experiment, future research might be able to find even more changes in the behavior of employees analyzing a larger group of employees with and without a tablet over a larger period of time. Second, we only conducted 58 interviews at three points in time. Future research could also extend the number of interviews being conducted to have even more points in time to document changes, finding out exactly when and why changes occur in more detail. Future research could also engage in analyzing documents (Gioia et al., 2013) (i.e., policies of the public administration) to engage even more in the topic of policy development for mobile device usage in public agencies. Third, we provided four promising propositions that need further exploration and empirical validation. For instance, future research could address these propositions by conducting surveys parallel to the interviews in a monthly rhythm to document changes occurring during the longitudinal analysis in more detail. Finally, the unit of analysis of this study is the individual. Hence, we did not explore their environment in detail. Future research could address this limitation by taking a dual perspective (i.e., an organizational and individual view) (Giddens, 1984; Jones & Karsten, 2008; Mokosch, Klesel, & Niehaves, 2015) to explore the phenomena more detailed.

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11.9. Appendix

Aggregate Dimension	Second Order Themes	First Order Concepts
	Ease of use	- Operation of the tablet is easy - Operation of the tablet is intuitive
	Adaptation in use behavior	- Doing working tasks with the personally-owned smartphone instead of using the corporately-owned tablet - Doing paperwork tasks as usual without using the tablet
	Process optimization	- Dictation of protocols into the tablet - Doing research directly in the meeting with a client - Taking digital notes with the tablet in meetings reducing paperwork
	Tablet tasks	- Taking notes between meetings - Research tasks outside the office in client meetings - Having paperwork as online documents in the tablet - Writing e-mails outside of the office
Integrating work IT into family life	Leaving the tablet in the office after work	- „I do not take the tablet with me home." - What do the IT policies say? What are the expectations from management?
	Using the tablet at home for working tasks	- Checking e-mails after hours - Working on vacation - Working from home to be more flexible
	Using the tablet at home for private life	- Checking private e-mails on the tablet - Installing games and apps which can be also used privately - Research on the internet about private life concerns
	Working anywhere at anytime	- Working in between meetings when driving to another client - Working with the tablet in meetings outside the office - Mobile working in communal centre without being in one's own office
Ownership of Technology	Tablet is owned by the public administration	- "I do not own the tablet." - Tablet is owned by the public administration and can be taken away
	„It´s mine!"	- „It is mine!"

		- Tablet is personalized due to employees account and settings

Table 11.5. A1 Data structure

1st Interview Round
First, we would like to ask you a few general questions about yourself. **1.** How old are you? _____ **2.** What is your marital status? o single o married/partnered o living separately o engagedto divorced o widowed **3.** How many children do you have? _____ **4.** What is your position in the administration? **5.** At what ratio are you employed? o Employed o civil servant o other: ________________ **6.** How many years of professional experience do you have? _____ **7.** How many years of that did they work in public administration? _____ **8.** What IT is provided to you for business purposes? o Computer o Laptop o Smartphone o Tablet o other: _______________ a. Which of these do you also use privately? o Computer o Laptop o Smartphone o Tablet o other: _______________ **9.** What IT do you own privately? o Computer o Laptop o Smartphone o Tablet o other: _______________ a. Which of these do you use for professional purposes? o Computer o Laptop o Smartphone o Tablet o other: _______________ Thank you very much We will now move on to some questions related to the project and their expectations in terms of using the different technologies. **10.** What were your motivations for participating in the project? **11.** What are your expectations for using a tablet for your work (with your colleagues)? **12.** What opportunities do you see in the use of a tablet? o for yourself/for colleagues/for public administration **13.** What risks do you see in using a tablet? o for yourself/for colleagues/for public administration **14.** To what extent does your workplace have specific policies on the use of IT for work? - Organization/Supervisors - Private IT for work and employer-provided IT private **15.** To what extent do you think it would make sense to make a tablet available to all employees? o What do you think distinguishes the employees from each other? Innovation potential **16.** Do you use applications not provided by your employer to do your job better? **17.** Are you looking for software or apps during your working hours to help you do your job better? o If so, which ones? And what has changed? **18.** At what point could you use a tablet to work better? a. Z. E. g. in relation to work processes **19.** How could your employer best support you in working better with technology? o In relation to the tablet o With regard to other IT Ownership

Next, we are interested in what role attitudes play in relation to technologies. To illustrate this, imagine you had to borrow a car. Presumably, your perception of the extent to which you own this borrowed car, i.e., it is "your own," would differ from your attitudes toward your private car. Presumably, you would also behave differently towards the borrowed car than towards your private car.

20. To what extent do you feel that the technical devices you use for work are "your own"?
    a. Are there differences between the technologies?
21. What is it about one device that makes you feel more like you own it than another?
    a. What would change if private use is allowed?
22. To what extent do you use technical devices differently depending on your attitude towards the device?
    a. Proactively fix problems
    b. work more performant

Wellbeing

In the following part, we are interested in your well-being at work as well as the balance between work and private life.

23. To what extent are you currently satisfied with the technical equipment provided to you by your employer?
24. To what extent is work self-realization for you?
25. What does it mean to you when you receive a tablet from your employer?
    a. Z. E. g. in terms of appreciation
26. Do you sometimes feel burdened by your work?
    a. In terms of volume of work?
    b. What role do mobile technologies such as smartphones or tablets play here?
27. To what extent does their work have a health or social impact on their personal lives?
    a. What role do mobile technologies such as smartphones or tablets play here?

Balance between work and private life

28. What do you think your employer's expectations are regarding your accessibility after you leave your administrative job?
    a. What role do mobile technologies such as smartphones or tablets play here?
    b. What would you like to see in terms of your availability?
29. Do your family members/friends have expectations about your work/life separation?
    a. What role do mobile technologies such as smartphones or tablets play here?
30. What are the reasons you separate/integrate personal and professional?
31. To what extent can you switch off from work in your free time? What influence does technology or accessibility have on this? How do you think the use of a tablet would affect this?
32. Are you able to balance work and private life/leisure time well, or does something come up short? What influence does technology or accessibility have on this? How do you think the use of a tablet would affect this?
    To what extent would you want to use a tablet privately, if allowed?
33. What role does technology generally play for you in the separation of private and professional life?
    - Do you apply specific techniques to use technology to separate work and personal?
    - Would a tablet change anything in your strategies?
34. To what extent do positive or negative experiences at work affect your private life? What influence does technology or accessibility have on this? How do you think the use of a tablet would affect this?
35. To what extent do positive or negative experiences in your private life affect your work? What influence does technology or accessibility have on this? How do you think the use of a tablet would affect this?

Close

36. We have now almost reached the end of the interview. If you recap the interview, to what extent do you think the things discussed so far could lead to conflicts?
    - In your work life?
    - In your personal life?
37. What other topics do you think would be important that we haven't addressed yet?

38. Imagine if your employer told you that you could use your tablet however you wanted during your working hours and that the tablet would have the functions you needed at any time. What would be different then?

2nd Interview Round

Receives tablet

What changes have you noticed since you received the tablet?

Innovation potential

39. Are there any work processes that have been simplified/changed by the introduction of the tablet?
40. To what extent can your employer support you in using the tablet to work better with it?

Ownership

41. To what extent do you feel that the tablet you use for work is "your own"?
    a. Are there differences to the other technologies?
42. Do you/would you like to use the tablet for private purposes?

Wellbeing

In the following part, we are interested in your well-being at work as well as the balance between work and private life.

43. To what extent are you currently satisfied with the tablet that your employer provides you with?

Balance between work and private life

44. Has the introduction of the tablet changed their separation between work and private life?
45. How have you been able to switch off from work since the introduction of the tablet?

Close

46. We have now almost reached the end of the interview. If you recapitulate the interview, to what extent do you think the introduction of the tablet has changed the work in administration?
47. What other topics do you think would be important that we haven't addressed yet?

Does not receive a tablet

What changes have you noticed since your tablet partner received the tablet?

Innovation potential

1. Are there any workflows that have been simplified/changed by the introduction of the tablet at your tablet partner?
2. To what extent can your employer support your colleague in using the tablet to work better with the tablet?

Wellbeing

In the following part, we are interested in your well-being at work as well as the balance between work and private life.

3. To what extent has your well-being at work changed after your colleague received the tablet?
4. After introducing the tablet to your colleague, to what extent would you now also like to use a tablet?

Balance between work and private life

5. Has the introduction of the tablet changed their separation between work and private life?
    a. With her/his colleague(s)

Close

6. We have now almost reached the end of the interview. If you recapitulate the interview, to what extent do you think the introduction of the tablet has changed the work in administration?
7. What other topics do you think would be important that we haven't addressed yet?

3rd Interview Round

Receives tablet

If you now recap everything again: What changes have you noticed since you received the tablet?

Innovation potential

48. Are there any work processes that have been simplified/changed by the introduction of the tablet?

49. To what extent can your employer support you in using the tablet to work better with it?

Ownership

50. To what extent do you feel that the tablet you use for work is "your own"?
    a. Are there differences to the other technologies?
51. Do you/would you like to use the tablet for private purposes?

Wellbeing

In the following part, we are interested in your well-being at work as well as the balance between work and private life.

52. To what extent are you currently satisfied with the tablet that your employer provides you with?
53. Do you feel more burdened by the introduction of the tablet?

Balance between work and private life

54. Has the introduction of the tablet changed their separation between work and private life?
55. Have your employer's expectations about your accessibility after you leave your administrative job changed with the introduction of the tablet?
56. How have you been able to switch off from work since the introduction of the tablet?

Close

57. We have now almost reached the end of the interview. If you recapitulate the interview, to what extent do you think the introduction of the tablet has changed the work in administration?
58. We talked about opportunities and risks in the first interview session. What opportunities/risks do you now see after using the tablet?
59. Could you imagine the tablet replacing your current computer? Why (not)?
60. What other topics do you think would be important that we haven't addressed yet?

<u>Does not receive a tablet</u>

What changes have you noticed since your tablet partner received the tablet?

Innovation potential

8. Are there any workflows that have been simplified/changed by the introduction of the tablet at your tablet partner?
9. To what extent can your employer support your colleague in using the tablet to work better with the tablet?

Wellbeing

In the following part, we are interested in your well-being at work as well as the balance between work and private life.

10. To what extent has your well-being at work changed after your colleague received the tablet?
11. After introducing the tablet to your colleague, to what extent would you now also like to use a tablet?

Balance between work and private life

12. Has the introduction of the tablet changed their separation between work and private life?
    a. With her/his colleague(s)

Close

13. We have now almost reached the end of the interview. If you recapitulate the interview, to what extent do you think the introduction of the tablet has changed the work in administration?
14. What other topics do you think would be important that we haven't addressed yet?

Table 11.6. A2 Interview Guidelines

References	Constructs	Measurement	Adapted Item
Barki et al., 2008	Psychological Ownership of IT	Likert-7 (strongly not agree, strongly agree)	I personally invested a lot in the implementation of the tablet usage process in my organization.
			When I think about the tablet, I see a part of myself in it.
			I feel the tablet will belong to all the employees in my organization.
			I would feel a high level of ownership toward the tablet.
			I will hardly think of the tablet as being my own system (reverse coded).
			I will see myself as a champion of the tablet my clinic.
			I will configure the functionalities of the tablet to better align it with my working process.
Scott & Bruce, 1994; Köffer, Junglas et al., 2015	Innovation Behavior	Likert-7 (strongly not agree, strongly agree)	I am looking for new technologies to improve my IT-related work processes.
			I develop creative ideas for my IT-related work processes.
			I discuss my ideas for IT-related work processes with others.
			I am looking for resources to implement new ideas for IT-related work processes.
			I develop adequate plans to implement new ideas for IT-related work processes.
			I implement my ideas for IT-related work processes on my own.
Ahuja, 2007; Adams, 1996	Work-life conflict	Likert-7 (strongly not agree, strongly agree)	The demands of my work interfere with my home and family life.
			Things I want to do at home do not get done because of the demands my job puts on me.
			My job produces strain that makes it difficult to fulfill family duties.
			Due to work-related duties, I have to make changes to my plans for family activities.
			The amount of time my job takes up makes it difficult to fulfill family responsibilities.

Table 11.7. A3 Survey Constructs

II STRATEGIES FOR ORGANIZATIONS

12. Structural Features of Digital Strategies for Municipalities

Paper Number	**P3**
Title	**Structural Features of Digital Strategies for Municipalities**
Authors	Bjoern Niehaves[1] bjoern.niehaves@uni-siegen.de Kristina Röding[a] (Lemmer)[1] kristina.roeding@uni.siegen.de Frederike Marie Oschinsky[1] frederike.oschinsky@uni-siegen.de [1] University of Siegen Kohlbettstraße 15 57074 Siegen
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Table 12.1 Fact Sheet Publication

[a] due to change of name

Structural Features of Digital Strategies for Municipalities

12.1. Introduction

The age of digitization demands municipalities to quickly adapt to technological developments. In doing so, demographic change and rural depopulation requests from them to orient these progresses to the needs of their citizens. The risk of not getting skilled workers or of an endangered social life in villages and communities due to a too small or too old population is high. To address this challenge, there are many federal state projects helping municipalities to integrate digitization. For example, some federal states try to help their municipalities with state subsidies. The result is that many municipalities use those state subsidies to run projects regarding digitization in different sectors. However, those projects only last for the duration of the funding as afterwards, the lack of monetary support cause the projects to be abandoned. This is a phenomenon often seen nowadays, but what else can help municipalities ensure these projects continue to their fruition?

This is where digital strategies become important. Digital strategies are discussed brightly in the existing literature. Aligning to the Information Systems (IS) literature, digital strategies related to a business can be described as an "organizational strategy formulated and executed by leveraging digital resources to create differential value" (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013, p. 472). Such a digital strategy could help municipalities to initiate a local digital development.

In line with previous literature that has contributed to a deeper understanding of strategies in the IS (Arvidsson, Holmström, & Lyytinen, 2014; Bharadwaj et al., 2013; Chen, Mocker, Preston, & Teubner, 2010; Cummings & Wilson, 2003) and regarding smart cities (Almirall et al., 2016; Anthopoulos & Reddick, 2016; Meijer & Bolívar, 2016), we want to aim to continue this tradition in light of current technological developments. Specifically, we seek to shift the focus from previous conceptualizations to a new form of conceptualization that considers structural elements of digital strategies, especially for municipalities.

Recognizing the need to get a better understanding of the formation of digital strategies, the goal of our study is to contribute to the exiting literature and to give information about how a digital strategy can be structured in the public sector, especially for municipalities, by proposing a framework for the formation of digital strategies for municipalities. In order to address our objective, this paper is guided by the following research question (RQ):

RQ: How can a digital strategy be structured in the public sector, especially for municipalities?

The paper is structured as follows. In section two, we derive our research question giving an overview of the current literature regarding digital strategies. Section three describes the research design of this study. In section four, the conceptual framework for the structural features of digital strategies for municipalities is introduced, then tested in all 427 municipalities in North Rhine-Westphalia, Germany, the results of which are detailed in Section Five. In Section Six implications for theory and practice are discussed as well as the limitations of the study giving recommendations for future research.

12.2. Background

The importance of developing and implementing policy papers has been discussed actively in existing literature (Bardach & Patashnik, 2016; Sabatier & Mazmanian, 1980). Policy papers have the aim of structuring the world around us by giving behavioural advice and regulation. (Bardach & Patashnik, 2016).

In our study, we are looking at policy papers for municipalities and specifically, strategies for coping with digitisation. As prior research on strategies in the IS field has been influenced by the field of strategic management (Chan & Huff, 1992), we first give an overview of strategies in the strategic management literature.

The construct of strategy as a policy paper has been discussed from various angles in the strategic management literature (Cummings & Wilson, 2003). The existing literature shows, that there is not one common definition of strategy (Bourgeois, 1980; Gluck, Kaufman, & Walleck, 1982; Hatten, 1979; Lenz, 1980; Chaffee, 1985; Mintzberg, 1978, 1987). A single strategy model, which has met general approval, does not exist either (Markides, 1999). Instead, different models explaining strategies (e.g., Porter's five-forces (Porter, 1980), core competency theory (Prahalad & Hamel, 1990) and the resource based view of the firm (Barney, 1991; Rivard, Raymond, & Verreault, 2006)) can be found in the present literature. Mintzberg (1987) attempted to bring more clarification into the construct of strategy. With his five P's for strategy (strategy defined as plan, ploy, pattern, position and perspective), Mintzberg brought different definitions of strategy together giving researchers an overview of strategy definitions (Mintzberg, 1987).

Chen et al. (2010) conducted a comprehensive literature review on strategy from the IS perspective. They define IS strategy as “the organizational perspective on the investment in, deployment, use, and management of information systems” (Chen et al., 2010). In their literature review, Chen et al. (2010) found that a variation of expressions have been engaged to represent similar constructs such as IT strategy, IS strategy, IT/ IS strategy or information strategy (Chen et al., 2010). When we are looking at digital strategies, we see that they are understood to be even more far reaching, when looking at a range of action fields, for instance, not on the investment and management of information systems but rather on thew hole business (Bharadwaj et al., 2013).

Against the background of the existing literature, we want to define digital strategies for municipalities. We define a digital strategy for municipalities as an organizational strategy for municipalities formulated and executed by leveraging digital resources to create differential value (Bharadwaj et al., 2013) to support or shape a municipality’s development goals, (and) its plan for gaining and maintaining locational advantage in the digital age (Chan & Huff, 1992). Recognising the need to get a better understanding of digital strategies for municipalities, we define our objective as analysing structural features of digital strategies for municipalities.

12.3. Method

In order to explore relevant elements of digital strategies, we applied a multi-method approach of qualitative and quantitative research (Bryman, 2006). We conducted multiple case studies (Yin, 2013) consisting of qualitative and quantitative content analysis of implemented digital strategy documents. Based on the results, we did a qualitative process analysis combined with expert interviews and reflected on our results with experts in a subsequent workshop. Based on our conclusion from existing literature, the case studies and the expert workshop, we developed a survey afterwards (Figure 12.1).

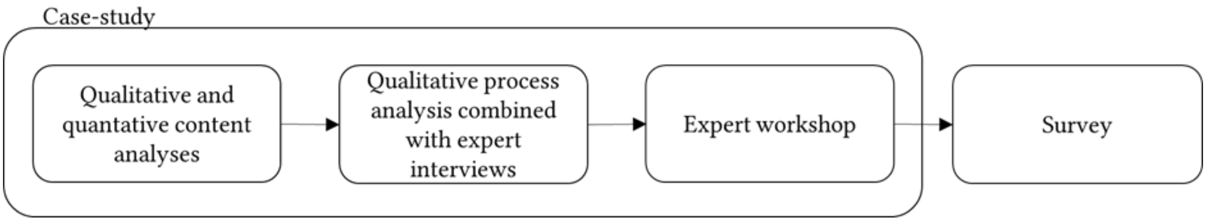

Figure 12.1 Research Design

Case studies are a useful method for investing complex phenomena that have not been fully explored yet (Benbasat & Taylor, 1978; Yin, 2013). Furthermore, case studies allow an in-depth analysis of phenomena that are related to the context where those phenomena occur (Bonoma, 1985). Since both mentioned aspects are relevant to our study, case study research is a well-suited method for the first part of our endeavour. In general, it is supposed that the strength of case studies lies in their internal validity whilst their weakness is often to be the external validity. Therefore, we took two forms of measures to increase the external validity of our case study: First, our research was conducted in a team. At least three researchers conducted all phases, which are described in the following. With this, we aimed for reducing idiosyncratic perceptions (Eisenhardt, 1989). Furthermore, with the use of multiple investigators, we were able to implement triangulation (investigator triangulation, (Benbasat & Taylor, 1978)). Second, we included multiple cases to reduce case-specific findings (Benbasat, Goldstein, & Mead, 1987; Yin, 2013).

In the first part of our case study analysis, we conducted qualitative and quantitative content analysis following the eightfold path by Bardach and Patashnik (2016). In a first step, we defined the problem we are looking at. In our case, we looked at how digital strategies are structured in the public sector. In a second step, we selected some evidence from municipalities, constructed alternatives (step 3) and selected criteria for the analysis of digital strategies (step 4). As the assembling of evidence recurs through the entire process of the analysis (Bardach & Patashnik, 2016), we analysed in sum 21 digital strategies of national and international best practice municipalities (Birmingham, Brussels, Cape Town, Copenhagen, Den Haag, Dubai, Duesseldorf, Edmonton, Eindhoven, Gothenburg, Hamburg, Leipzig London, Manchester, New York City, Oldenburg, Sonderborg, Stavanger, Sydney, Tallinn and Vienna).We projected our outcomes (step 5), confronted the trade-offs (step 6), stopped, focused and narrowed our outcomes (step 7) to successfully show structural features for digital strategies of municipalities in the end (step 8) (Bardach & Patashnik, 2016).

In the second part of our case study, we conducted a qualitative process analysis combined with seven in-depth interviews with experts of the municipalities we analysed in the first part (Den Haag, Eindhoven, Leipzig, Oldenburg, Sonderborg, Tallinn and Vienna). We analysed the process of developing a digital strategy and conducted our interviews using an interview guide approach, as this is more comprehensive and systematic for data collection than purely conversational interviews. Furthermore, we developed our interview guideline to be mostly open ended in order to allow the experts to bring up additional concerns that we did not cover in our guidelines (Darke, Shanks, & Broadbent, 1998). The duration of interviews ranged from approximately 60 min to 100 min. We transcribed the interviews and assembled even more evidence for the structural features of digital strategies for municipalities.

In the third part of our analysis, we reflected our outcomes in an expert workshop. Our outcomes, projected from the content analysis (first part) and the process analysis combined with expert interviews (second part), were reflected together with experts from different municipalities in Germany. We revised our structural features of digital strategies based on the expert's feedback in a last step.

12.4. Conceptual Framework

In order to empirically assess structural features of digital strategies for municipalities by means of a survey, we develop a conceptual framework. Our survey is based on the findings from different stages of the case studies that were mentioned above. Thus, the survey consists out of questions concerning the structural features of digital strategies. These features are findings taken out of the case studies, which we linked back into the existing literature. As an example, we found strategic alignment to be an important dimension emerging from the qualitative analysis of the strategic documents, which was confirmed through the expert interview and later on in the expert workshop. In the existing literature, we also found the construct of strategic alignment and adapted it in relation to our findings from the case studies so that the wording fitted well to the NRW-municipalities. This procedure was repeated for every structural feature. Our final conceptual framework for our survey can be seen in Figure 12.2.

Strategic Alignment. The construct strategic alignment was adapted from the construct of strategic alignment used by Preston and Karahanna (2009) and (Tallon, Kraemer, & Gurbaxani, 2000). With the results from our case studies, we adapted the items for municipalities in NRW, asking: “Your digital strategy is (1) …aligned with super ordinated digital strategies (e.g., country, federal government). (2) …aligned with different organizations’ digital strategies (e.g., economic, scientific and political parties). (3) …coordinated with further own strategies, concepts or similar (e.g., IT-/E-Government-/urban development strategies).”

Strategy Formulation. The construct of strategy formulation is based on Altiok (2011), Wheelen and Hunger (2012) and David (2014), who described strategy formulation for companies in the strategic management literature. With the results from our case studies, we adapted the items for municipalities in NRW, asking: “If you do have a digital strategy or your digital strategy is under development: Which aspects matter? (If you do not have any digital strategy, please indicate to what extent the following aspects are significant in your opinion.) (1) The digital strategy contains a vision/mission statement. (2) The digital strategy contains goals. (3) The digital strategy contains fields of actions. (4) The digital strategy contains a catalogue of measures. (5) The digital strategy contains a monitoring concept. (6) The digital strategy contains digital risks (e.g., data protection).”

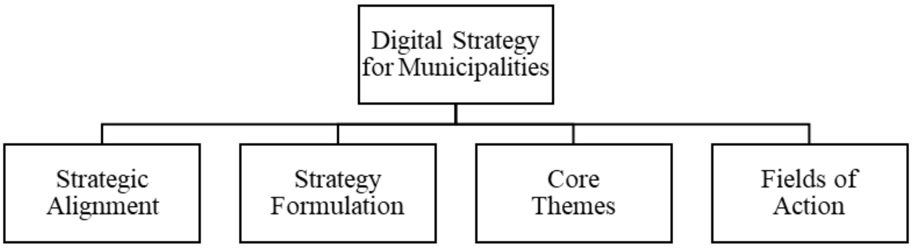

Figure 12.2 Conceptual framework for the structural features of digital strategies for municipalities

Core Themes. The question for core themes of digital strategies for municipalities was self-developed from our case studies focusing on the three main topics a digital strategy for municipalities can look at. In our case studies, we found that the core themes are space, service and society. Against this background, the following items were developed and used for the survey: “Your digital strategy considers the core areas: (1) Digital services (e.g., digital civil office). (2) Space (e.g., sensor technology for urban development). (3) Society (e.g., co-working spaces).”

Fields of Action. Based on Giffinger and Gudrun (2010) and in line with the results from our case studies, we developed the following items to ask for the different fields of action focused on in the digital strategies: “Your municipal digital strategy considers additional fields of action: (1) Governance, (2) Economy, (3) Environment, (4) Tourism, (5) Education, (6) Health, (7) Mobility, (8) Others."

Every item was asked using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Afterwards, we cumulated the answers 1 and 2 from the Likert scale to one new scale called "fully disagree" and 4 and 5 to "fully agree". Number 3 of the Likert scale stayed as "neither". Using relative frequencies, we were able to show how often and strong individuals of the municipalities agreed or disagreed with the proposed structural features of digital strategies for municipalities.

When rolling out our survey, we first run a pre-test in 300 municipalities in Germany. We chose the municipalities regarding their number of inhabitants in relation to the overall population of the state the municipality is located in. The number of municipalities taken for a state was calculated in relation to the number of municipalities in general. As the survey was going to be run in the federal state of NRW in Germany, the pre-test was conducted in every state in Germany leaving NRW out of the scope.

After we adapted our survey regarding the results from the pre-test, we conducted the survey in the state of NRW. We asked all 396 NRW-municipalities and 31 districts to participate in our study. With a response rate of 34%, we were pleased that 133 municipalities and 12 districts took part in our study. As we wanted control of the employees answering our survey, we put a question asking for the name and position of the employee. We found that in each answered survey, employees or mayors, who are concentrating on the topic of digitalization in their municipalities, answered our survey.

12.5. Findings

Strategic Alignment. We found that 80% of the municipalities in NRW that took part in the survey are orienting their strategies on super ordinated digital strategies from, e.g., the country or federal government. 45% are aligning their strategies on different parties' digital strategies (e.g., economic, scientific and political parties) and 88% with further own strategies, concepts or similar strategies (e.g., IT-/E-Government-/urban development strategies). In general, we noticed that there is a need of aligning digital strategies to other strategies on different levels in order to structure and to position municipalities' own digital strategy. Looking at the NRW municipalities, we see that the importance of alignment is noticed by them and practiced already in most of their strategic developments.

Strategy Formulation. Our results show, that 92% of the NRW-municipalities that participated see the vision as an important element of the formulation of a digital strategy. 95% define goals in their digital strategy that they want to achieve in a considered timeframe. 93% answered, that mentioning fields of action, a roadmap und digital risks is important in their digital strategy, but only 84% of the municipalities are talking about the importance of monitoring elements for their digital strategy. As many municipalities in NRW are still at the beginning of digitization, it is understandable that only 84% are considering monitoring as an important element. You only monitor when you already developed or implemented a strategy and projects.

With more than 90% of the municipalities formulating a vision, defining goals and mentioning fields of action and a roadmap, we recognise a difference in the timeframe municipalities have to define with those elements. Formulating a vision is a long-time definition for future developments, whereas formulating a roadmap means defining a middle term time horizon. Formulating an action plan as well, as the municipality of Vienna did in our best practices, shows a short-term orientation defining specific next steps. We recognized that it can be helpful for municipalities to differentiate between formulating a vision, a roadmap and an action plan in order to be able to structure their digital strategies more transparent regarding their defined goals.

Core Themes. NRW-municipalities are mostly concentrating on digital services in their digital strategies (100%). Only 63% of the municipalities are focusing on the core theme space. The core theme society is integrated in the digital strategy by even less municipalities (only 55%). For the municipalities in NRW it would be recommended to not only concentrate on one of the core themes but also to see digitization as chance to connect all three core themes with each other. Doing so can help municipalities to generate synergetic effects. Showing that municipalities consider every core theme to be part of their digital strategy still gives them the possibility to concentrate on one of the core themes in more detail in order to specialize and position themselves as municipality in the digital age.

Fields of Action. 100% of the municipalities are concentrating on the field of Governance. Education is considered to be integrated into the digital strategy by 89% of the municipalities. 82% are concentrating on Mobility. Economy (78%) and Tourism (73%) are even less integrated and only 63% of the NRW-municipalities consider Environment to be part of their strategy. Even less (53%) concentrate on Health. Noticing that 100% of the municipalities consider Governance to be an important field of action, we recommend municipalities to see digitization as more than digitization of the government and administration, but rather to see it as a chance to integrate different fields of action and connect them in the long run.

12.6. Discussion and Conclusion

Implications for Theory. As the existing literature has no common perspective or view regarding digital strategies or even digital strategies for municipalities, our study can help to give guidance on how to structure digital strategies for municipalities. Referring to our conceptual framework (**Figure *12.2***) structural features based on existing literature and the case studies could be developed.

We enrich the construct of strategic alignment developed by Preston and Karahanna (2009) and Tallon et al. (2000) showing another perspective of alignment specifically adapted for municipalities. Whereas organizations have the possibility to align their strategies congruent with their corporate business strategy or their corporate strategic plan, municipalities have the possibility to align their strategy with super ordinated digital strategies, different parties' digital strategies and with further own strategies and concepts.

We also contribute to the construct of strategy formulation by Altiok (2011), Wheelen and Hunger (2012) and David (2014), showing that formulating a digital strategy for organizations and municipalities follows specific elements. Looking at our results from NRW municipalities, we found that formulating a vision, goals and defining fields of action and developing a roadmap are the most important elements for digital strategies.

Giffinger and Gudrun (2010) suggested the existence of six different fields of action municipalities are working on while becoming a smart city. We found in our case studies that the different fields were addressed in varied ways, regarding the name and content of the field of action. Based on our case studies we extended Giffinger and Gudrun's (2010) list of fields of action and tested it within our NRW-municipalities. We could enhance the research by Giffinger and Gudrun (2010) adding a new field of action to their list.

Implications for Practice. Based on our findings we can derive practical implications for municipalities while developing a digital strategy. First, based on the results of 145 municipalities in NRW, municipalities should align their digital strategy with super ordinated digital strategies, different organizations' digital strategies and with further own strategies and concepts if possible. Second, municipalities should be clear in their formulation of their digital strategy. It might be a more transparent way to have three different parts of digital strategy addressing different time horizons. For example, a municipality should formulate a vision and goals for future guidance, develop a roadmap for middle term projects and achievements and define an action plan for specific next steps, which have to be taken on the way. Third, there are chances for municipalities to see digitalization as more than the digitalization of the government but as an instrument, they can design to connect their core themes and fields of action they want to specify on with each other in order to gain synergies.

Limitations and Outlook. Despite the theoretical and practical relevance of our study, it is fraught with difficulties and shortcomings that leave room for future research. Besides the regular limitations of case studies (e.g., weak internal validations), our study is of an explorative nature. Its intention is therefore to extend current perspectives on structural features of digital strategies, especially for municipalities. Our research can therefore be used to further develop structural features for digital strategies (MacKenzie, Podsakoff, & Podsakoff, 2011), but is somewhat weak in its theoretical contribution. Second, the unit of analysis is the municipality. As we asked for digital strategies for municipalities, only one of the employees of the municipal administration answered our survey representing the whole municipality. We asked for the name and position to control the employees answering our survey to make sure that they are familiar with digitization and strategic developments. We had to trust those employees who answered our survey. In order to overcome these limitations, future research might ask more than one employee in a municipality and make sure the employees are familiar with digitization and strategy development as well as ensuring that they answer the survey by themselves. Since the municipalities' way to a Smart City or Smart Region is still in its infancy in many places, future studies will have the potential to pursue this transformation empirically and to reconstruct the liveliness of the strategies directly on site. In addition, there are links to neighboring disciplines (e.g., architecture, social science, geography, etc.) and topics (e.g., open data, digital competence management, participation, etc.). Moreover, our study provides initial insights how to structure digital strategies at other levels of government (e.g., federal level). Finally, as the relevance of digitization in society and politics are still developing, we expect many future research questions to come.

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13. Digital Strategies as a Guideline

Paper Number	**P6**
Title	**Digital Strategies as a Guideline for Digital Transformation Processes in Municipalities – A Literature Review**
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Table 13.1 Fact Sheet Publication

[a] due to change of name

Digital Strategies as a Guideline for Digital Transformation Processes in Municipalities – A Literature Review

Abstract. Digitalization is one of the words everyone gets to hear almost every day. The need to digitalize information and services is greater than ever. Municipalities try to digitalize themselves to service their citizens. First steps show municipalities starting different projects for digitalization. Nevertheless, a phenomenon, which is often seen, is that those projects do not have a common aim they are aligning to. As an instrument, digital strategies can help municipalities to align their projects, leading the way into digital transformation. However, what is a digital strategy and how is it structured? What can recent literature teach us about digital strategies? How can digital strategies help to support digital transformation processes in municipalities? To answer these questions, we conducted a systematical but selective literature research on digital strategies in the Information Systems (IS) and the public sector. We found that both literature streams show the development of a fusion between business and IS strategies leading to new concepts of capabilities, needed in municipalities to develop and monitor digital strategies.

Keywords: Digital Strategy, Literature Research, Public Sector.

13.1. Introduction

Digitalization is becoming one the most important words nowadays when we talk about transformation processes. With the digital age at hand, we seek for ways to digitalize the world around us, as everything needs to be digitalized. This is a phenomenon, which we can see in the private as well as in the public sector. Especially the public sector, which is interested in the needs of their citizen are on their way to digitalize e.g., their public services [1].

Looking at transformation processes in the past, we can see that strategies are instruments, which were often used to guide ways into the future. Mintzberg [2] defines strategies as patterns in a stream of decisions guiding the way for future actions.

In the last century, the concept of strategy developed in different ways regarding the stream of research we are looking at. For example, Jahn et al. [3] looked at strategies and tactics from the unit of analysis of employees, whereas Mintzberg [2] and Atkins and Lowe [4] looked at strategies from the perspective of businesses. Gottschalk [5] and Arvidsson et al. [6] looked at strategies from the perspective of Information Technology (IT) in organizations. As an example from IT strategies, Chen et al. [7] conducted a comprehensive literature review on Information

Systems (IS) strategies in the IS literature. As an example, Chen et al. [7] showed that different studies named IS strategies in diverse ways. However, after they conducted the reconceptualization, measurement and implications of IS Strategies, recent literature is missing a research based on new developments of strategies which occur due to digitalization. While there has been an extensive debate on digital strategies, especially for municipalities, in practice, recent research has not developed a clear theoretical understanding of the phenomenon describing what digital strategies are and how they can help municipalities as guidelines in digital transformation processes. In order to address our objectives, this paper is guided by the following research question (RQ):

RQ1: How does recent literature define and use digital strategies as a guideline for digital transformation processes?

The remainder of the paper is structured as follows. In the second section, we give a short background of the emergence of digital strategies in practice and science. Section 3, describes the research design of this study. In Section 4, the findings of the literature review are presented showing recent literature regarding the conceptual use of digital strategies. Section 5 discusses implications for theory and practice, especially municipalities, shows the limitations of the study, and gives recommendations for future research.

13.2. Background

An emerging topic for municipalities is the chances and challenges of digital transformation. With IT becoming ubiquitous, phenomenons like IT consumerization emerge. IT consumerization describes the use of consumer market mobile devices (e.g., wearables, smartphones, tablets) and shows the phenomenon of how citizens are able to engage in diverse governmental topics from everywhere at any time [8]–[11]. Thus, digital services around citizens are becoming more and more important [12]. However, not only services are important but also the whole governmental digital transformation becomes necessary (e.g., transformation of internal administrative processes, engaging diverse actors in decision-making processes and planning and implementing projects). At this point, digital strategies can help municipalities to set guidelines for digital transformation processes.

Recent literature has already studied the phenomenon of strategies, for example in the management studies [2][4], [13], in IS research [5][7] and of individuals regarding their use of mobile technologies [3][14][15]. In their literature review, Chen et al. [7] give a clear overview of different definitions of IS and IT strategy in literature. They also identified three conceptions of IS strategy: "(1) IS strategy as the use of IS to support business strategy; (2) IS strategy as the master plan of the IS function; and (3) IS strategy as the shared view of the IS role within the organization" [7] (p.233). Niehaves et al. [16] found in their case study structural features of digital strategies for municipalities. They found that the denomination of strategic alignment, strategy formation, core themes and fields of action are features, which structure digital strategies for municipalities. However, since Chen et al. [7] the emerging concept of digital strategies and their development from IS strategies has not yet analyzed from a theoretical point of view. The construct of digital strategies, especially for municipalities is yet understudied. We aim to enrich recent research on digital strategies by showing the development of the term digital strategy and by listing and describing recent research on the construct of digital strategy for municipalities.

13.3. Method

For our literature review, we applied the framework for literature reviewing proposed by vom Brocke et al. [17] consisting of 5 steps: (I) definition of review and scope, (II) conceptualization of topic, (III) literature search, (IV) literature analysis and synthesis and (V) research agenda [17].

We first defined our review scope using Coopers taxonomy of literature reviews [18]. Aligned to Cooper [18], we conducted a literature review of digital strategies for municipalities. Aligned to the taxonomy, we focused during our literature review on research outcomes having the goal to summarize our findings to get a more comprehensive inside of the term of digital strategies for municipalities. We decided to organize our literature review theoretical, as the question we are trying to answer is given. We aim to a neutral representation perspective and choose our audience to be general scholars and practitioners/politicians. We also cover our reviewed literature to central/pivotal to our topic. Table 13.2 summarizes our categories taken for the literature review.

Characteristics		Categories			
1	focus	research outcomes	research methods	theories	applications
2	goal	integration	citicism	central issues	
3	organisation	historical	conceptual	methodological	
4	perspective	neutral representation		espousal of position	
5	audience	specialised scholars	general scholars	practitionars/politicians	general public
6	coverage	exhaustive	exhaustive and selective	representative	central/pivotal

Table 13.2 Taxonomy of Literature Review (Following [17][18]) aligned to our research

Second, we conceptualised our topic. We conduct a literature review of digital strategies for municipalities concentrating on the term digital strategy and their support for digital transformation processes. Regarding vom Brocke et al. [17], it is important to pay attention to the fact that a review must begin with “a broad conception of what is known about the topic and potential areas where knowledge may be needed” (p.10). We, therefore, provided a working definition of the key term “digital strategy”.

In their study, Chen et al. [7] defined IS strategy as “the organizational perspective on the investment in, deployment, use, and management of information systems” (p. 237). Chen et al. [7] also found that a variation of expressions have been engaged to represent similar constructs such as IT strategy, IS strategy, IS/IT strategy or information strategy. However, aligning to Niehaves et al. [16] digital strategies are understood to be even more, looking not only for examples on the investment and management of information systems but rather on the whole business [19]. Such a digital business strategy could be defined as an “organizational strategy formulated and executed by leveraging digital resources to create differential value” [19] (p.472) and “to support or shape an organization’s competitive strategy, its plan for gaining and maintaining competitive advantage” [20] (p.191). Against this background and aligning to Niehaves et al. [16], we define digital strategy as an organizational strategy formulated and executed by leveraging digital resources to create differential value to support or shape an organization’s competitive strategy, its plan for gaining and maintaining competitive advantage. Summarized we define it as a fusion of a traditional IS/IT strategy with the business strategy of an organization in the digital age. For municipalities this definition offers a variety of possibilities how to align their digital strategy in practice. For example, it could be their own strategy itself aligned to an urban development strategy or it could be directly integrated in the urban development strategy.

In the third phase (III), literature search, we conducted the actual search-involving database, keyword, backward, and forward search, as well as an ongoing evaluation of the sources [17]. Table 13.3 shows the structure and results of our conducted literature review.

	Journal	Database	Search	Search Item	Hits per Item	Reviewed Hits
1	Government Information Quarterly	Science Direct	title, abstract, keywords	digital strategy	11	3
				IS / IT strategy	12	
2	Journal of E-Government Research	IGI Global	all fields	digital strategy	12	3
				IS strategy	13	
3	Transforming Government: People, Process & Policy	Emerald Insight	all fields	digital strategy	9	2
				IS strategy	15	
4	Information Polity	IOS Press	all fields	digital strategy	8	1
				IS strategy	8	
5	European Journal of Information Systems	Palgrave Macmillan	all fields	digital strategy	5	1
				IS strategy	14	
6	Information Systems Journal	Wiley Online Library	all fields	digital strategy	5	0
				IS strategy	23	
7	Information Systems Research	Informs	title, abstract, keywords	digital strategy	0	0
				IS strategy	5	
8	Journal of the Association of Information Systems	AIS	all fields	digital strategy	2	0
				IS strategy	5	
9	Journal of Management Information Systems	JSTOR	all fields	digital strategy	2	0
				IS strategy	6	
10	MIS Quarterly	MISQ	all fields	digital strategy	5	5
				IS strategy	12	
11	Journal of Strategic Information Systems	Science Direct	all fields	digital strategy	10	3
				IS strategy	23	
12	Journal of Information Technology	Palgrave Macmillan	all fields	digital strategy	1	2
				IS strategy	11	
					∑ 218	∑ 20

Table 13.3 Structure of the Literature Review Process

As recommended by previous literature [17][21][22], we focused on the review articles of high quality. We also looked at rankings. For example, vom Brocke et al. [17] synthesized ranking for the AIS in order to select journals we would search in. Only to take the 10 best-ranked paper did not seem like a comprehensive overview for our topic, as we looked at the development of the term digital strategy since the literature review of Chen et al. [7] supplemented by governmental literature. This is the reason why we decided to look at the description and aim of each high quality journal ranked and take into account the journals, which fit into our topic the best. For our topic, we decided it is best to look at the eight highest ranked IS Journals (European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of the Association of Information Systems, Journal of Management Information Systems, MIS Quarterly, Journal of Strategic Information Systems, Journal of Information Technology), in order to identify “digital strategies in IS”. Building upon the research from Chen et al. [7] we filtered, in a second step for research articles since the year

2010. As we look specifically at the formation of digital strategies for municipalities, we choose to look at high quality E-Government Journals with IS reference as well, namely Government Information Quarterly, Journal of E-Government Research, Transforming Government: People, Process & Policy, and Information Polity. As those were not included in the research of Chen et al. [7], we looked at those from their point of existence until now. In general, we looked for journal and publisher homepages in order to do a comprehensive literature search.

Applying our working definition, we used following search items, "digital strategy", "IS strategy" and "IT strategy", during the literature review process. Our working definition would lead us to look also for "digital business strategy" as well as "smart city strategy" or "e-government strategy".

After we conducted the literature search (phase III, resulting list of literature can be seen in Table 13.4), we analyzed and synthesised our literature (phase IV) as recommended and developed by and adapted by Webster and Watson [22]. As our aim was to focus on research outcomes with the goal of current issues, we analysed the current literature on digital strategies and derived key aspects out of the different research papers.

We report that we found 218 Articles in 13 Journals looking for our three search items. However, we have to note that as our working definition let us expect, and as already presented by Chen et al. [7], IS- and IT Strategy led to almost the same results. We found 20 articles to help us get a glimpse of digital strategies as guideline for digital transformation processes, in the public sector and across organizations. Aligning to our taxonomy of literature research and our definition of digital strategy, we were only able to identify 20 research articles, which were able to help us answering our research question. This also shows how understudied this phenomenon is in literature. We conducted our analysis focusing on the unit of analysis explored in each research paper, the context of digital strategy and the key aspects of the research outcomes summarized. We classified the Unit of Analysis in Organizations (O), Government (G) and the Individual (I). As our working definition shows, digital strategies are important for the Institutional level. This is the reason why we excluded paper where the Unit of analysis is the individual and concentrated on paper examining governmental institutions and private sector companies.

The analysis of our listed research paper led us to phase V of the framework for literature reviewing proposed by vom Brocke et al. [17]. Phase V describes how the synthesis of literature (phase IV) results in a research agenda (V). In our study, the result of our synthesis is our resulting research questions (RQ1: How does recent literature define and use digital strategies as a guideline for digital transformation processes?).

13.4. Findings

The following section will show our findings which are divided into two parts: First, development of the term and use of digital strategies as a guideline for digital transformation processes in E-Government- Literature; Second, development of the term and use of digital strategies as a guideline for digital transformation processes in IS-Literature since 2010.

A. Development of the term and use of digital strategies as a guideline for digital transformation processes in E-Government- Literature.

We noticed a change in definition of the term digital strategy in the E-Government Literature showing that in 2005 Gil-Garcia and Pardo [23] described the term strategy as practical guidelines and systematic long-term approaches to problems in order to further e.g., e-government goals.

In 2009, Yoon and Chae [24] conducted a study of national strategies for ICT (also called "national e-Strategy"), which is supposed to contribute to economic transformation. In this study, the trend to contribute to economic transformation with higher aligned strategies developed.

In 2010, Shareef et al. [25] examined implementation strategies of electronic-government which are used to gain a competitive advantage. In this study, we notice that the development of digital strategies in the public sector seems to direct towards our definition of digital strategies, including competitive advantage of organizations.

Anthopoulos et al. [26] introduced conceptualization, benchmarks and evaluations of the smart city concept. In their study, they discovered eight classes of conceptual models. The classes address smart city architecture, governance, planning and management, data and knowledge, energy, health, people and environment and resulted in an unified smart city model (UFCM) [26].

In 2018, Pedersen [27] recommended in his study to develop more balanced strategies which focus more on eliminating the contextual and organizational challenges instead of just aiming to increase project level capabilities.

B. Development of the term and use of digital strategies as a guideline for digital transformation processes in IS-Literature since 2010.

In 2012, Benitez-Amado and Walczuch [28] found in their study IT capability to be an enabler of proactive environmental strategies. These strategies, as they found, mediate the effects of IT on firm performance. The finding of Benitez-Amado and Walczuch [28] can be seen also in our applied definition of digital strategies. In our literature review, we found in 2013 a special issue in the MIS Quarterly regarding digital strategies and their competitive advantage [19][29]–[31]. For example, Mithas et al. [29] found in their study that “IT both enhances the firm 's current (ordinary) capabilities and enables new (dynamic) capabilities, including the flexibility to focus on rapidly changing opportunities or to abandon losing initiatives while salvaging substantial asset value” (p. 511).

Arvidsson et al. [6] conceptualized in their study the concept of strategy blindness. Strategy blindness describes “the organizational incapability to realize the strategic intent of implemented, available system capabilities” [6] (p. 45).

In 2018, Yeow et al. [32] describe the blurring of the division between business and IT strategies which lead to a fusion between them. The fusion is described as digital strategy. Yeow et al. [32] study, found “an aligning process model that is comprised of three phases (exploratory, building, and extending) and generalizable organizational aligning actions that form the organization's sensing, seizing, and transforming capacities” (p. 43).

With our study, we aim to enrich recent literature regarding digital strategies as a guideline for digital transformation of municipalities analyzing the development of the term and use of digital strategies in the E-Government Literature and the IS Literature (since 2010). A conceptualization of our findings can be seen in Figure 13.1. As our finding, Figure 13.1 only shows examples of the emerging literature streams. Every analyzed 20 papers can be seen in the Appendix in Table 13.4.

As we proposed, aligning to Bharadwaj et al. [19] in both literature streams, the term and use of digital strategy develops into the description of a fusion of business and IS strategies. We also can notice that this development leads to new emerging concepts, such as dynamic capabilities and strategy blindness in the digital strategy literature [6][29]. We also found that the use of digital strategy and its definition does not vary if we are looking at smart cities or municipalities in the E-government literature or if we look at companies showing a consensus for digital strategies as guidelines for digital transformation.

13.5. Discussion and Outlook

The following section will show the discussion and will give an outlook for future research.

A. Implications for theory and practice.

We aim to enrich recent literature regarding digital strategies as a guideline for digital transformation in E-Government literature and the IS literature analyzing the development of the term and the use of "digital strategies". We enrich research by Chen et al. [7] by extending their literature review of IS strategy giving an overview of the development of digital strategies in the IS literature since 2010. We also aim to extend research by Pedersen [27] giving empirical evidence that the fusion of business and IS strategies is taking place in theory and practice giving rise to new concepts like dynamic capabilities. Practice can also benefit from our study, as it gives guidance in which directions future digital strategies should be developed and gives research recommendations where to look for even more guidance. But practitioners need to take care, as digital strategies have still special features e.g., in their structuration [16] even if our study shows a consensus on a meta-level. It also shows different ways of developing a digital strategy. For example, a digital strategy for municipalities can stand on its own as digital strategy or it could be integrated into the urban development strategy showing a real fusion of the main strategies.

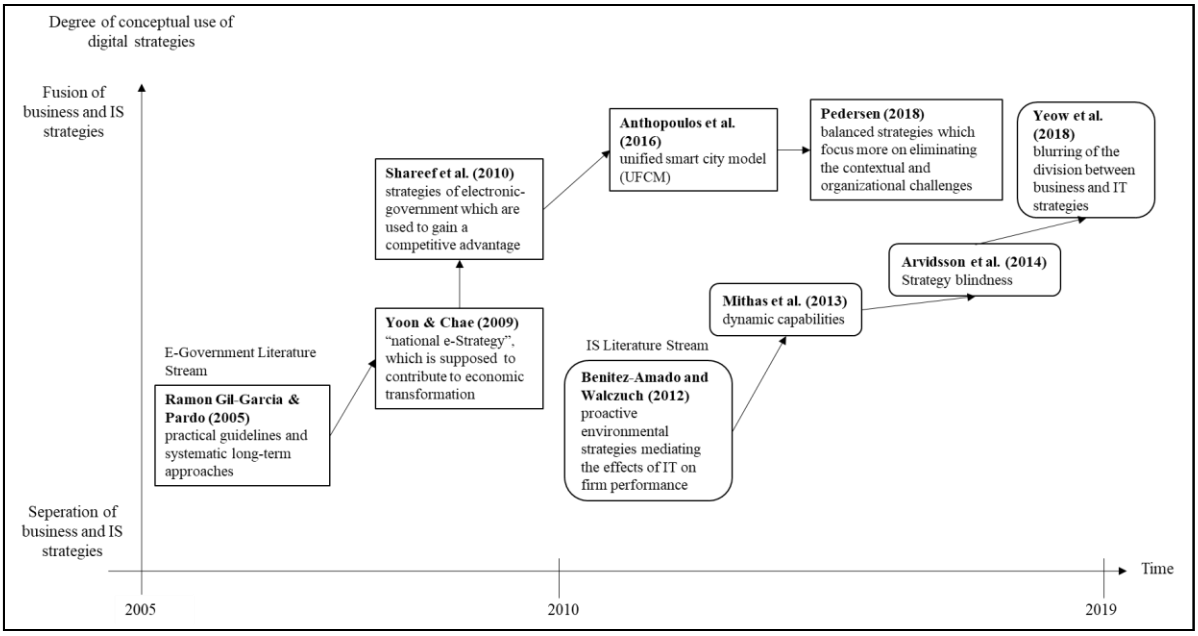

Figure 13.1 Conceptualization of the term and use of digital strategies as a guideline for digital transformation

B. Limitations and Outlook.

Like every other empirical study, our research as well has limitations that leave room for future research. Apart from the typical limitations of literature reviews [17], it is important to acknowledge that we only searched the highest 8 and 5 ranked journals in the e-government and IS literature. Future research could extend our literature by including conference papers and book publication to extend our conceptualization.

13.6. References

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13.7. Appendix

Journal	Article	Autor	Year
Government Information Quarterly	Conceptualizing smartness in government: An integrative and multi-dimensional view	Gil-Garcia et al.	2016
	E-government success factors: Mapping practical tools to theoretical foundations	Gil-García and Pardo	2005
	Varying criticality of key success factors of national e-Strategy along the status of economic development of nations	Yoon and Chae	2009
Journal of E-Government Research	E-Government Implementation Perspective: Setting Objective and Strategy	Shareef et al.	2010
	The Örebro City Citizen-Oriented E-Government Strategy	Ask et al.	2008
	A Unified Smart City Model (USCM) for Smart City Conceptualization and Benchmarking	Anthopoulos et al.	2016
Transforming Government: People, Process & Policy	E-government transformations: challenges and strategies	Pederson	2018
	Managing continuity and change: a new approach for strategizing in e-government	Saboohi	2010
Information Polity	Whole-of-government approach to information technology strategy management: Building a sustainable collaborative technology environment in government	Ojo et al.	2011
European Journal of Information Systems	Information technology, the organizational capability of proactive corporate environmental strategy and firm performance: a resource-based analysis	Benitez-Amado and Walczuch	2012
MIS Quarterly	Information Technology and Business-Level Strategy: Toward an Integrated Theoretical Perspective	Drnevich and Croson	2013
	How a Firm's Competitive Environment and Digital Strategic Posture Influence Digital Business Strategy	Mithas et al.	2013
	Design Capital and Design Moves: The Logic of Digital Business Strategy	Woodard et al.	2013
	Visions and Voices on Emerging Challenges in Digital Business Strategy	Bharadwaj et al.	2013
	Unifying the Role of IT in Hyperturbulence and Competitive Advantage Via a Multilevel Perspective of IS Strategy	Nan and Tanriverdi	2017
Journal of Strategic Information Systems	Aligning with new digital strategy: A dynamic capabilities approach	Yeow et al.	2018
	Information systems use as strategy practice: A multi-dimensional view of strategic information system implementation and use	Arvidsson et al.	2014
	Information systems strategizing, organizational sub-communities, and the emergence of a sustainability strategy	Henfridsson and Lind	2014
Journal of Information Technology	Strategic IT alignment: twenty-five years on	Coltman et al.	2015
	Aligning business and IT strategies in multi-business organizations	Reynolds and Yetton	2015

Table 13.4 Overview of the Reviewed Articles

14. Would you like to participate?

Paper Number	**P7**
Title	**Would you like to Participate? – Stakeholder Involvement in the Development Process of Digital Strategies for Municipalities**
Authors	Kristina Röding[a] (Lemmer)[1] kristina.roeding@uni.siegen.de Frederike Marie Oschinsky[1] frederike.oschinsky@uni-siegen.de Hans Christian Klein[1] christian.klein@uni.siegen.de Andreas Weigel[1] andreas.weigel@uni.siegen.de Bjoern Niehaves[1] bjoern.niehaves@uni-siegen.de [1] University of Siegen Kohlbettstraße 15 57074 Siegen
Publication Type	Conference Proceedings
Publication Outlet	International Conference on Advanced Collaborative Networks, Systems and Applications, Italy 2019
Status	published
Full Citation	Roeding, K., Oschinsky, F. M., Klein, H. C., Weigel, A. Niehaves, B. (2019). *Would you like to Participate? Stakeholder Involvement in the Development Process of Digital Strategies for Municipalities*. In: Proceedings the 9th International Conference on Advanced Collaborative Networks, Systems and Applications (COLLA 2019), Rome, Italy.

Table 14.1 Fact Sheet Publication

[a] due to change of name

Would you like to Participate? – Stakeholder Involvement in the Development Process of Digital Strategies for Municipalities

Abstract. Today there is a high pressure on municipalities to adapt to the digital demands of their citizens and to involve them in decision-making processes. One way to achieve this transformation is with the instrument of digital strategies to guide municipalities' way and to get them involved right at the start. In our case study, we analyzed strategic documents of 22 national and international smart cities regarding participation in the age of digitization. We conducted semi-structured interviews with seven of those cities asking about chances and challenges they had while developing their digital strategies using participatory elements. We also conducted expert interviews and a survey based on our findings from the interviews. One of the key aspects we looked at was the process of involving different stakeholders in the development process of digital strategies. As the development of a digital strategy, as guideline for the digital transformation process of municipalities, we look at the starting point of participatory processes when we look at the development of a digital city. Our results show, that the aim of cities is high to involve different stakeholders. However, it is often hard to encourage stakeholder to participate. We therefore propose important guidelines, which need to be taken care of for participatory processes regarding the development of digital strategies for municipalities.

Keywords: Digital strategy, digital transformation, participatory process, stakeholder involvement.

14.1. Introduction

When it comes to digitization municipalities are often said to be slow and far behind technological developments. Nevertheless, nowadays there are many federal state projects helping to face municipalities' digitization. Federal states try to help their municipalities with state subsidies. The result is that many municipalities use those state subsidies to do projects regarding digitization in different sectors. However, those projects often last only for their duration of funding. Afterwards, the projects cannot be carried on. This is a phenomenon often seen in the public sector. Nevertheless, what can help municipalities to set their projects long lasting? At this point, digital strategies and stakeholder involvement become more and more important.

Recent literature had a look at digital strategies, for example from the business perspective. Digital strategies, in the context of businesses can be defined as "organizational strategy formulated and executed by leveraging digital resources to create differential value", aligned with the existing Information Systems (IS) Literature [1].

Aligning with recent literature that has contributed to a deeper understanding of digital strategies in the IS ([1]-[4]) and digital strategies regarding smart cities [5], we want to aim to continue this tradition in light of current developments regarding stakeholder involvement. Specifically, we seek to shift the focus from previous conceptualizations, to a new form of conceptualization that also takes into account participatory elements of digital strategies, especially for municipalities, regarding stakeholder involvement.

Recognizing the need to get a better understanding of the construct of digital strategies with the focus on stakeholder involvement, the first goal of our study is to contribute to the exiting literature. We want to give clear information about the questions on "how to develop a digital strategy focusing on stakeholder involvement?" and "What kind of actors are important to involve in the process of developing a digital strategy?". Our objectives are motivated by the fact, that due to emerging consumer technologies, citizens of different stakeholder groups are more familiar with technological possibilities and have great ideas of how public services should be made available in the digital era.

The remainder of the paper is structured as follows. The second Section gives an overview of digital strategies and participation in the context of smart cities and municipalities. The third Section describes the research design of this study. In Section 4, the findings of the case studies and the survey are presented and in Section 5, we give rise to guidelines for stakeholder involvement. The Discussion is shown in Section 6. Section 7 points out limitations and aspects for future research.

14.2. Background and Brief Theoretical Reviews

The construct of strategy has been discussed widely in existing literature (e.g., in the IS and management literature) [4]. As an example [3] conducted a comprehensive literature review on IS strategy starting with looking at strategies from the perspective of the management science literature [3]. In their study, IS Strategy was defined as "the organizational perspective on the investment in, deployment, use, and management of information systems" [3]. As a result of their literature review, [3] showed that a variation of expressions (e.g., Information technology (IT) strategy, IS strategy, IS/IT strategy or information strategy) have been introduced in literature to represent the same construct [3]. However, looking at digital strategies shows, that they are understood to be even more, looking not only for examples on the investment and management of information systems but rather on the whole business [1]. Aligning with [1] and [6], such a digital business strategy could be defined as an "organizational strategy formulated and executed by leveraging digital resources to create differential value" [1] and "to support or shape an organization's competitive strategy, its plan for gaining and maintaining competitive advantage" ([6] and [15]).

Looking at participation, we notice that participation is widely used as construct for example in the management science literature but also in the smart city literature ([7]-[11],[21],[22]). Against this background and in the context of IS and management science literature, [11] defines participation as "allowing workers to have input regarding a proposed change" (p.134). When we looked at participation, we find that the adaption of the definition of [11] fits best our definition of participation. Aligned with [11], we define participation as allowing citizens to have input regarding a proposed change.

Existing theories have addressed contemporary developments regarding digital strategies or participation in various ways. As an example, Effing et al. [7] developed a Social Smart City framework, which includes a set of digital strategies (e.g., crowdsourcing strategy and open data strategy) for participatory governance in smart cities. Spil et al. [8] showed, using three cities (Hamburg, Berlin and Enschede) as case studies that a quadruple helix structure of citizens, companies, universities and government ensures effective participation. This phenomenon can be seen also by [9], who proposed suggestions regarding actions and projects in smart cities from the quadruple helix, thus creating a "360-degree" model for prioritizing smart city interventions in Greek cities. Ergazakis et al. [10] proposed a Digital City Concept and an integrated methodology for Digital City development in order to help regions and cities to adopt best practices from information technology. However, existing conceptualizations of digital strategies for municipalities and their process of development often did not look at the participatory process, explicitly the involvement of different stakeholders (e.g., politicians, companies, normal citizens, science) in the development process of a digital strategy for municipalities. In order to address our objective, this paper is guided by the following research question (RQ):

RQ: How can different stakeholder be involved in the development process of a digital strategy for municipalities?

14.3. Research Methodology

In order to explore how participatory elements and different stakeholders get involved in the development process of digital strategies for municipalities, we conducted a mixed-method approach of qualitative and quantitative research [13]. The study at hand only shows the results regarding participation. Other elements of the study are published in other formats or conferences. First, we conducted a case study [14] consisting of qualitative and quantitative content analyses of digital strategy documents (aligned to the definition by [15]) in practice (we aligned our process on [15] who followed this methodological approach to conceptualize structural features of digital strategies for municipalities). We looked for criteria as for example, the development process and steps municipalities took to write their digital strategy. Moreover, we looked at how municipalities involved different stakeholders at different levels of their process. From the results of the content analysis, we conducted a qualitative process analysis combined with expert interviews (employees who developed the digital strategy). Afterwards, we reflected our results back to experts (e.g., chief digital officers, chief information officers, digital experts and mayors) in a workshop. Next, we conducted with the results from our case studies and based on existing literature a survey addressed towards the digital experts of the municipalities. Our mixed-method approach, aligned with [15] can be seen in Figure 14.1.

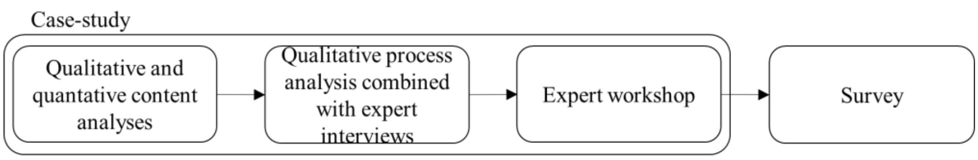

Figure 14.1 Research Design (aligned with [15])

We used case studies because they are a useful method while investing complex phenomena that have not been fully explored, and do not allow the analysis of causal relationships ([14] and [16]). Furthermore, aligning with [17], case studies allow us an in-depth analysis of phenomena that are related to the context where those phenomena occur [17]. Since our mentioned aspects are relevant to our objective and study, case study research is a well-suited method for the first part of our endeavor [15]. Especially, it is supposed that the strength of case studies lies in their internal validity whilst their weakness is often to be the external validity [15]. In order to increase the external validity of our case study, we introduced two forms of measures: First, our study was conducted in a team. This means, that at least three researchers conducted all phases, which are described in the following. With the use of multiple investigators, we were able to implement triangulation (investigator triangulation ([15] and [16])). As second measure, we included multiple cases to reduce case-specific findings ([14] and [18]). We selected our cases using content-related validity ([15] and [19]). We carefully choose the following 22 cities as cases: Birmingham, Brussels, Cape Town, Copenhagen, Den Haag, Dubai, Duesseldorf, Edmonton, Eindhoven, Gothenburg, Hamburg, Leipzig, London, Manchester, New Orleans, New York City, Oldenburg, Sonderborg, Stavanger, Sydney, Tallinn and Vienna.

With the findings of our case study, we started to develop a survey. Therefore, the survey is comprised out of the findings from different stages of the case studies. In detail, the survey consists out of elements and items, which we hypothesize having an effect on the involvement of stakeholders during the development process of a digital strategy for municipalities. These elements and items are direct findings out of existing digital strategies reflected into the existing literature. For example in our study, we focused on participation as an important dimension evolving out of the qualitative and quantitative analysis of the strategic documents. Participation as possible dimension was confirmed through the expert interviews and later on in the expert workshop. We found a construct fitting our understanding of participation in existing literature. We adapted the construct of participation from [11], e.g., "Which aspects regarding digital strategies play a role regarding participation of citizens? Citizens are able to take part in decision-making processes.". Aligned with [11] every item of the survey was asked using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In a next step, we cumulated the answers 1 and 2 from the Likert scale to one new scale called "fully disagree" and 4 and 5 to "fully agree". Aligned with [15] number 3 of the Likert scale stayed as "neither". Using relative frequencies [15], we were able to show how often and strong individuals of the municipalities agreed or disagreed with the proposed participatory elements in the development process of digital strategies for municipalities, where each participatory element stayed for itself.

We have to note that our study shows only a small part of a more comprehensive study we conducted regarding digital strategies for municipalities. Therefore, when rolling out our survey, we first run a pretest on 300 municipalities in Germany. We choose municipalities regarding their number of inhabitants in relation to the overall population of the state the municipality is located in. We calculated the number of municipalities taken for a state in relation to the number of municipalities in general [15]. As the survey was going to be run in the federal state of North-Rhine Westphalia (NRW) in Germany, the pre-test was conducted in every state in Germany leaving NRW out of the scope [15].

Afterwards, we adapted our survey regarding the results of the pre-test we conducted. We conducted our final survey in the state of NRW. Aligning with [15], we asked all 396 NRW-municipalities and 31 districts to participate in our study. With a response rate of 34%, 133 municipalities and 12 districts took part in our study.

14.4. Findings

Our first findings included findings from the analysis of the strategic documents of 22 smart cities. Those findings from our qualitative and quantitative document analysis showed that in 43% of our analyzed strategic documents of municipalities citizens got involved in developing the digital strategy. In 29% stakeholder from economy and in 52% science got involved. The interviews corroborate this aspect. Developing a digital strategy means setting the direction for the digital transformation. However, a small group of people cannot choose this direction. Different stakeholders need to be involved. Learnings from the interviews showed us that for each smart city it was hard to associate with different stakeholders and to motivate them to get involved in the development of a digital strategy as guideline for the digital transformation of their city.

Findings from our survey show that when we asked for responsibilities while developing and implementing a digital strategy we found that mayors take a big part of involvement at this stage. For example, when we asked for “who is responsible for the development of a digital strategy in your municipality?”, we found that 82% of the municipalities filled in that the mayor is responsible. In 75% the city counselor, in 84% the head of department, in 42% an employee and in 72% a work group is responsible for the development. When we asked for “who is responsible for the implementation of a digital strategy in your municipality?”, we found that 66% of the municipalities filled in that the mayor is responsible. In 64% the city counselor, in 84% the head of department, in 64% an employee and in 60% a work group is responsible for the development. Our findings show that the development stage is one of the responsibilities of the mayor. However, when it comes to the stage of implementing a digital strategy the head of department is responsible for further processes. With this finding, we get to know responsibilities at each stage of the development process of a digital strategy helping us to better understand, who the person in charge is for stakeholder involvement at each step.

Third, we also asked for important aspects regarding citizen participation ("Which aspects regarding citizen participation are important for digital strategies?). We found that in 88% of the municipalities citizens can ask questions. 62% of the municipalities involve citizens in decision-making processes and 51% are getting involved in the implementation of digital strategies. We found that even more than half of the municipalities who took part in our survey are given the possibility to get involved in the process of the development of a digital strategy.

As we concentrated in our study on the involvement of different stakeholders in the development process of a digital strategy for municipalities, we also asked for the involvement of different stakeholders beside citizens. We asked "To which information do you refer to while developing your digital strategy?" and "At your public administration expert knowledge is present." We found that 87% of the municipalities involve external experts in their development of a digital strategy. 50% refer to information from science or involve expert knowledge. 39% involve city-owned companies in the development of a digital strategy.

Aligning with [15], we wanted to control for the employees answering our survey. For this reason, we put a question in the survey, asking for the name and position of the employee. In our study, employees or mayors, who are concentrating on the topic of digitalization in their municipalities, answered each conducted survey.

14.5. Guideline Development

With our findings, we were able to give rise to four guidelines for the involvement of different stakeholders in the development process of digital strategies for municipalities. We found, that first, digitalization is a matter of executives, second digitalization needs participatory processes, third digital strategies need competences and fourth digitalization is a joint task.

Digitalization is a matter of executives. The findings show that talking about the development and implementation of digital strategies the person in charge are mayors and the head of the departments. This distribution of responsibility shows that digitalization is a matter of executives who lead the way to digital transformation.

Digitalization needs participatory processes. When we look at the way of how citizens get involved in the development of a digital strategy for their municipality we clearly see that digitalization needs participatory processes. Citizens are often able to ask questions. Nevertheless, when we look at the process of decision-making and implementation, we see that there are still more possibilities to get citizens involved. Municipalities need to work on these possibilities and on ways to get more citizens involved and to make it easier for them to take part in the different processes.

Digital strategies need competences. Looking at the involvement of different experts, science and city-owned companies, we see that the development of a digital strategy needs different competences and different perspectives from a variety of fields of action. Municipalities can still work on the references of information from science and city-owned companies. Different perspectives help municipalities to set their goals long lasting, taking into account different possibilities digitalization can have to help municipalities in their daily life.

Digitalization is a joint task. As last guideline, we see digitalization as a joint task of different stakeholders. Our findings showed us how important it is to get different stakeholders involved. We also could see on which stages of the development process different personas are in charge. Nevertheless, it is important that these different stakeholders involved are working together to develop a digital strategy for their municipality.

14.6. Discussion

Implications for theory. Aligning with references [7]-[11], we were able to look at participation in the development process of digital strategies. Especially we looked at digital strategies in the public sector for municipalities. Participation in the public sector involves many different stakeholders. Based on our case study we referred to different types of stakeholders extending recent literature ([7]-[9]). Our types of stakeholders involved citizens, economy, and science, functional roles of the public administration, external experts and city-owned companies. We were able to extend the construct of participation from [11] and to adapt it in the public sector.

Implications for practice. With our findings, we were able to give rise to guidelines for municipalities developing a digital strategy. Aligning with the guidelines should help municipalities to define participation their own way and to get different types of stakeholders involved in the development process of a digital strategy.

14.7. Conclusion

Regardless of the theoretical and practical relevance of our study, it is pointed with difficulties and shortcomings that leave room for future research. Aligning with [15] we have to note, besides the regular limitations of case studies (e.g., its weak internal validations), that our study is of an explorative nature. Its intention is to extend current perspectives on the development process of digital strategies, especially for municipalities regarding the involvement of different stakeholders. Our research can therefore be used to further develop the way different stakeholders can get involved in the development process of digital strategies, but is somewhat weak in its theoretical contribution. Second, in our study the unit of analysis is the municipality. As we asked for the development process of digital strategies for municipalities focusing on stakeholder involvement, only one of the employees of the municipal administration answered our survey representing the whole municipality. We were relying on those employees who answered our survey. Third, as we looked at digital strategies from an IS and management perspective, we defined participation in our study aligning with the results from our case study and aligning with our context of our study. Nevertheless, when we look at participation, this is a construct, which can be seen in a variety of ways. We aligned with the definition of [11], but there are many different possibilities to define participation. We also looked at participation only at the level of the development process of a digital strategy. However, looking at a smart city and their participation processes there is much more which need to be considered as [7] and [8] shows.

In order to overcome these limitations, future research might ask, aligning with [15], more than one employee per municipality and make sure the employees answer the survey by themselves. Future research should also consider a variety of definitions for participation and not only stuck on definitions used in the area of development of digital strategies for municipalities from an IS and management science perspectives. There are more possibilities to define participation. Moreover, looking not only at the development process of digital strategies for municipalities but looking at a smart city gives a wider range of how participation can be defined and realized.

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15. Lohmar | Digital | For Everyone

Paper Number	**P11**
Title	**LOHMAR | DIGITAL | FOR EVERYONE** **The development process of a digital transformation strategy and its fields of action in Lohmar**
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Table 15.1 Fact Sheet Publication

LOHMAR | DIGITAL | FOR EVERYONE

The development process of a digital transformation strategy and its fields of action in Lohmar

Abstract.

(a) **Situation faced**: As a city of generations and living actively in the countryside, Lohmar is a rural municipality on the outskirts of Cologne and Bonn in Germany. According to Lohmar's slogan "Lohmar | Digital | For everyone", Lohmar aims to actively shape its digital future. This paper is not only focusing on the development of a digital transformation strategy, but also on the challenges Lohmar faces in the field of mobility. Lohmar is facing a high level of commuter traffic with only a low utilization of 1.2 persons per car, due to the car as the main transportation vehicle.

(b) **Action taken**: To face its challenges, the city of Lohmar began developing a digital transformation strategy. With the involvement of various stakeholders, Lohmar developed its own online-platform where citizens could share ideas on the digital transformation strategy and its projects. Thus, the fields of action administration, education, mobility, and entrepreneurship occurred. In the field of mobility, ideas emerged for organizing commuter traffic, with a focus on the idea of a dedicated smart mobility hub that combines multimodal mobility systems. With this idea, Lohmar responded to the Smart Cities call by the Federal Ministry of the Interior, for Construction and Home Affairs (BMI).

(c) **Results achieved**: By developing a digital transformation strategy in Lohmar, the city prioritized the topic of digital transformation in all areas of its municipality. With the engagement of different stakeholders and various citizens, Lohmar succeeded to make digital transformation processes omnipresent, through implementing a change management process. In different workshops Lohmar encouraged its citizens and employees to rethink digital transformation processes supporting ideas, especially regarding commuters' challenges. Based on this, Lohmar was able to submit the project proposal of RBS.Mobil, multimodal mobility concept in the affluent suburbs of Cologne and Bonn creating a network for mobility, which is now being funded.

(d) **Lessons learned**: In its process of developing an own digital transformation strategy and submitting a project proposal for a smart multimodal mobility hub with the focus on commuters' traffic, Lohmar achieved six lessons learned, which can help municipalities facing comparable challenges (e.g., a strategic roadmap into a digital future, commuter traffic in a rural area). Lohmar's six lessons learned are described as followed: First, digital transformation is a joint task! Second, digital transformation processes need competences! Third, digital transformation processes need responsibilities! Fourth, learn from other municipalities! Fifth, there is always more than one solution! Sixth, asking for help improves your actions!

15.1. Introduction

Lohmar is a rural municipality in the outskirts of Cologne and Bonn. It lies between the river "Agger", with the "Wahner" heather in the west and the "Naafbachtal" nature reserve in the east. This explains the city's name, as "loh" stands for forest (nature reserve) and "mar" for waters (Agger). For its approximately 30,000 inhabitants (Table 15.2), the city of Lohmar wants to be and remain attractive and worth living in. For Lohmar, this can only be achieved in combination with digitization, as the mayor Horst Krybus, sees this as an essential part of the future and would like to transfer this to Lohmar as early as possible. That is why Lohmar has set itself an overriding objective: "Lohmar | Digital | For everyone" (Stadt Lohmar 2020).

This objective shall be achieved with four defined fields of actions, which were developed within the framework of Lohmar's digital transformation strategy 2025, see Figure 15.3[1] . Those fields of action are described as: Digitally close (administration)! Digitally smart on the move (mobility)! Digital learning (education)! Digital into the future (entrepreneurship)! (Stadt Lohmar 2020), which we will discuss in chapter 3.

Key facts	
Citizen	30,453*
City Area	6,562 ha
Recreational/Forest Area	158 ha (2.4%) / 2,100 ha (32%)
Cycleway	122 km
Employees of Lohmar	354 (160 IT)*
Modal Split	Private motor vehicle 68% Public transport 9% Walking / Cycling 23%
Commuter	To Lohmar 4,787 Out Lohmar 9,379 Δ - 4,592**
Noise level (Proportion of citizens who are exposed to noise levels above 65dB)	Day 5.3% Night 11.47%
	*31.12.2019; **2017

Table 15.2 Key facts about the city of Lohmar (Interview CDO and MM of Lohmar).

The administrative employees of the city of Lohmar are working together to achieve the objectives of the four fields of action defined in their digital transformation strategy:

[1] As researchers from the University of Siegen accompanied the development process of Lohmar's digital transformation strategy and the project proposal, a lot of data and information regarding Lohmar was collected during the workshops and interviews with the mayor, chief digital officer, the mobility manager, various employees, and citizens of Lohmar. We therefore inform the reader about the most important references used and want to apologize for missing references due to knowledge from interviews and workshops.

administration, mobility, education, and entrepreneurship. Even in times of the COVID-19 crises, when digital transformation became an integral part of all areas of administration, the employees did not ignore the objectives of the four fields of action. In the field of mobility, for example, Lohmar submitted an application for the call “Smart Cities made in Germany” call by the Federal Ministry of the Interior (BMI), namely “Rhenish.Bergish.Smart.Mobil” (RBS.Mobil), in spring 2020. The application was reviewed during the year and finally approved at the end of 2020. The realization of RBS.Mobil is scheduled to begin in early 2021. In this article we will take a closer look at the digital transformation strategy on the basis of RBS.Mobil and then take a closer look at RBS.Mobil itself.

This article is structured as followed. First, we will give an overview of the situation faced in Lohmar and will answer the questions of the reasons for a development of a digital transformation strategy. Second, we will show which actions were taken to a) develop a digital transformation strategy and b) develop the smart mobility concept of Lohmar. In this third chapter we will also present the RBS.Mobil project. In chapter four, we will show the results which were achieved by Lohmar during both processes and will give an overview over lessons learned in our last chapter.

15.2. Situation faced

Lohmar sees its countryside as an advantage. Rather, Lohmar wants to use this aspect as an advantage to emphasize its naturalness and attractiveness, especially in times when environment and sustainability are political issues. Lohmar’s mayor Horst Krybus summarizes Lohmar’s attractiveness as follows: “The versatile offer of Lohmar’s business and service world leaves barely any wish unfulfilled, as Lohmar is not only extremely attractive as a family-friendly city in the countryside, but also as a business location. This is due to, first, Lohmar’s geographical advantages, such as the favorable transport links between Cologne and Bonn, and second, due to the future oriented urban development, which makes Lohmar a modern city with a high quality of life”. However, the problems of rural areas and specific problems of Lohmar cannot be eliminated by this - they have to be tackled much rather actively. In the following, we present the problems of the four fields of action (see Figure 15.3) in more detail, whereby we will focus more on the field of mobility.

Administration: With the increasing use of new technologies (e.g., mobile devices such as smartphones or tablets), the daily work habits of administrative staff must adapt to the demands of citizens. Citizens using mobile devices expect municipalities and their administrations to provide services that can be used anywhere and at any time. German municipalities are not ready yet to respond to these demands from citizens. Often, administrative tasks in the municipalities can only be completed when appointments are organized which have to be attended in person (e.g., passport renewal, re-registration after moving). Simply organizing the framework conditions to provide the actual service requires time and human resources on both sides, on the part of the citizens and on the part of the municipalities. Another problem is that digital skills are lacking. On the one hand, the administrative staff of the municipalities must build up competencies for using digital services. The employees need to understand their processes in order to redesign them for digital use. They also require an understanding of what is technically possible to bridge the gap between their offered services and the administrative organization as well as the citizens' perspective on the use of the offered services. Citizens, on the other hand, need an understanding of the services available and user-friendly interfaces. Especially for smaller cities like Lohmar, building digital competencies for online service delivery is a key challenge.

Education: Digitization is advancing further and faster, which is why continuous adaptation is important. No citizens should be forgotten in this process, independent of age. In the school sector, this means that schoolchildren must be prepared as well as possible for their future professions. These days, this also includes digital skills. However, some schools in Lohmar are not up to date with the latest technology. There is a lack of basic equipment and implementation possibilities. For example, the broadband connection is not sufficient for the new requirements and new cables have to be laid. In addition, the skills of the older teachers are no longer up to date and there is a need for further training. Another example is that schoolchildren are not given enough space for individual self-discovery in the form of offers, study groups, and special rooms. The German government's digital pact could help here. However, this is limited to €25,000 per school, whereby the monetary funding is not aligned to the number of schoolchildren per school and the type of school, thus the city has to help out. Besides digitalization of schools, older citizens should also be included in the digitalization process. The main issue here is to make the new options and services easy to understand in order to ensure access. Especially in a rural region like Lohmar, access and the technical equipment must be operable independently.

Mobility: Due to its rural location between Bonn and Cologne, a problem of Lohmar is that only a few employees work in the urban area of Lohmar. The majority (30%) commutes to regional centers, resulting in a high level of commuter traffic. Especially in the morning and evening hours this leads to a high traffic volume and congestion, reinforced again by the low occupancy rate of cars, which are only occupied by an average of 1.2 persons per car. Since the main means of transport in Lohmar is the car (the motorized individual traffic in Lohmar amounts to 68%), this leads to the consequence of a high load on the main traffic axes in the form of high emissions, congestion times, high noise pollution, and traffic accidents. One reason for the prioritized use of the car is the rural location of Lohmar, which means long distances within the urban area of Lohmar. There is simply a lack of possibilities to get from destination A to B without a car. The increasing number of inhabitants in the Rhein-Sieg district and thus also in Lohmar will further intensify this problem. The local public transport system does not provide a remedy, since on the one hand the lack of use by the citizens does not allow for an expansion and on the other hand the connection by a train line in the center of Lohmar is not available. This is a circular problem and must be actively interrupted. The first step here is the RBS.Mobil project. In summary, all the problems in the first and last mile bundle up to be solved.

Entrepreneurship: In addition to the above-mentioned problem of worker' commuting to surrounding major centers, the lack of innovation in the direction of the future is also a disadvantage for Lohmar as a location for companies to settle there. There is a lack of area-wide broadband coverage, especially in the old industrial areas, that innovation and progress is feasible here. Actually, the location on the A3 highway offers many companies a locational advantage, but this is not being used. For this reason, the city of Lohmar sees an enormous potential here and would like to make Lohmar attractive as a business and work location.

The city of Lohmar actively tackles these problems and wants to be modern, open minded, and attractive for young people and families as well as for senior citizens (Stadt Lohmar 2020). Therefore, Lohmar has set itself the goals to overcome its challenges by implementing the measures from the digital trans-formation strategy in the fields of action: Administration, education, mobility, and entrepreneurship. The implementation measures are presented in more detail in chapter 3.

15.3. Action taken

We divided this chapter into two parts. Part A describes the origins of the digital transformation strategy and its necessity, as well as the result. Part B describes the actions in the field of mobility (third field of action of the digital transformation strategy – marked in green, see Figure 15.3) in more detail. Here we give an insight into the implementation plans of RBS.Mobil, which is funded by the BMI and will be realized from spring 2021.

A) Development of a digital transformation strategy for Lohmar 2025.

Lohmar, as well as other cities, started early with their own digital transformation (Mergel et al. 2019). Aligned to Mergel et al. (2019), we use the term of digital transformation as it describes emphasizing "the cultural, organizational, and relational changes" and moreover the digital transformation as "more comprehensive than the mere digitization of processes and services" in this paper (Mergel et al. 2019). According to comparable cities in size, Lohmar started to digitize different services in the first step. With the current political movement and the German governmental pressure of getting all citizen services digital (Stockmeier and Hunnius 2018), Lohmar started to develop their own digital transformation strategy in order to transform itself digitally in a structured way (Bharadwaj et al. 2013b; Bharadwaj et al. 2013a; Matt et al. 2015; Hess et al. 2016; Roeding 2019; Roeding et al. 2019). Therefore, Lohmar's aim is to set their roadmap for the digital age developing and implementing a digital transformation strategy.

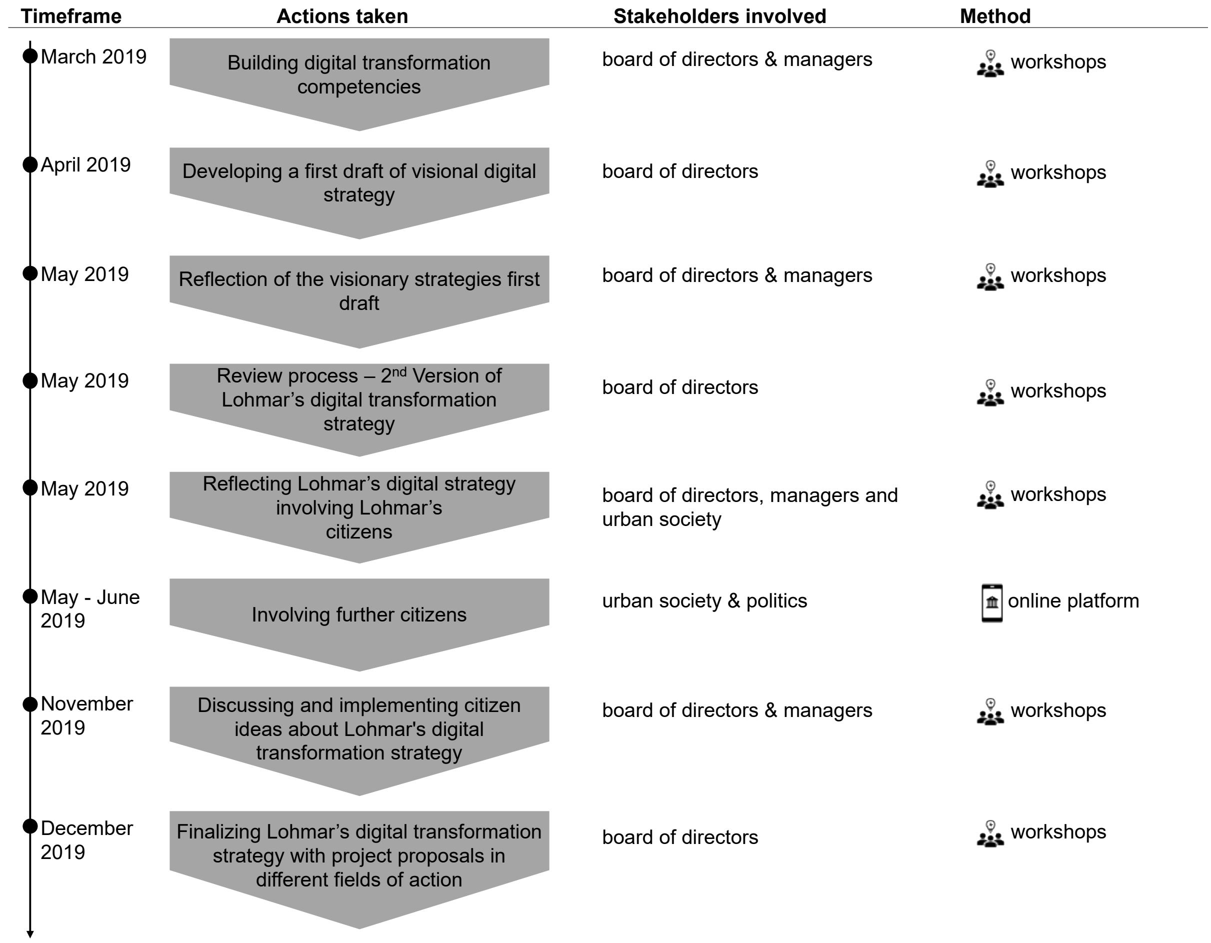

Figure 15.1 Development of the digital transformation strategy

The overall process for developing the digital transformation strategy of the city of Lohmar (see Figure 15.1) is managed by the mayor's office and the Chief Digital Officer (CDO), with close coordination with the Executive Board. To set the right path towards a digital transformation strategy and the process of developing the strategy, researchers from the University of Siegen were invited to moderate workshops regarding their development of a digital transformation strategy. To monitor the strategic path planned in the strategy, a project management office (PMO) was established, led by the CDO. To manage the communication of Lohmar's digital transformation strategy, Lohmar enabled different teams and services to engage with citizens. For example, Lohmar introduced a social media team to communicate news and services to citizens. It also developed an online platform for citizens to share, ask for, and help shape project ideas around Lohmar's digital transformation strategy. These two services, for example, have helped to support citizen participation and the progress of digital processes around the city of Lohmar.

Looking closely at the development process of Lohmar’s digital transformation strategy, the development of the strategy was closely aligned to the four structural features of digital transformation strategies found by Niehaves et al. (2018, 2019) always considering the IS perspective. The four structural elements inhibit strategic alignment, strategy formulation, core themes and fields of action (Niehaves et al. 2018; Niehaves et al. 2019). Lohmar decided to develop a visionary strategy starting first with a brief description of their vision and aims, followed by defining core themes and fields of action with a set action plan of projects. First, aligned with other strategies, the process of developing Lohmar’s digital transformation strategy was designed to combine bottom-up processes with top-down development. Therefore, following previous regional strategies, the development of the strategy/vision was done through a multi-step process of a mix of different workshops combined with the opportunity to engage in an online tool to develop digital projects for the digital transformation strategy. In sum, eight workshops with a variety of different stakeholders were conducted to develop the strategy. These workshops took place from March to November 2019 and included different workshop methods as round tables, world cafés, expert interviews, etc.

The first workshop contained the development of digital competences. Moderated by researchers from the University of Siegen, who provided support during the development process of Lohmar’s digital transformation strategy, a workshop for all managers of the city of Lohmar was organized. The main topics discussed were “Digital Transformation: How can a future-proof administration be designed with digitization?”, “Digital Leadership: How does leadership change in a digitized working environment?”, “Digital City: How does digitization change the public space?”, “Acceptance and digitization: What are the current and future drivers and obstacles with regard to municipal digitization (internal and external) and how can they be countered?”, “Special issues: What are the effects of digitization in other areas of the city outside the (core) municipal sphere?”. It always started with a presentation giving theoretical background to the topics building digital competences with the managers. In the second step, group discussions and tasks were organized, helping to apply the learned content.

In a second workshop (April 2019) the vision, core themes and fields of action for Lohmar’s strategy was developed. Together with employees from the University of Siegen, the Executive Board and the CDO, a first draft of the digitization strategy, aligned to previous regional strategies was developed (ad-dressing structural features strategic alignment, strategy formulation, core themes and fields of action).

The third workshop was conducted to further develop the vision. The draft of the vision was presented to all executives of the city of Lohmar. The managers were asked for feedback based on the following guiding questions: regarding clarity/ comprehensibility: How do you evaluate the framework of the vision? Is there a direction resulting from it?; focusing motivation: Does the vision motivate you to participate in future digital developments?; looking at participation: Please take the perspective of different stakeholders from politics and business - can you find yourself in the vision? Afterwards their suggestions were incorporated into the vision.

In May 2019 a fourth workshop was developed, where the urban society was invited to help shape the digital future of the city. After a draft of the strategy was presented by the CDO, citizens were able to develop initial projects for each of the four defined fields of action at four thematic round tables, using the world café method.

A fifth workshop was initiated to actively involve politicians in the development of the strategy and its projects. In this workshop, members of the University of Siegen firstly presented an introduction of Lohmar's developed strategy. This was followed by a presentation of the strategy by the Lohmar's CDO and a presentation of the projects from the workshop with the urban society. After the presentations took place, politicians were asked to complement the strategy and projects.

In June 2019, a workshop focusing on the projects of Lohmar's digital transformation strategy took place. For this workshop, the executives of the city of Lohmar were asked to work out further projects together with the University of Siegen. These ideas were presented to the urban society using an online platform. Subsequently, citizens had the possibility to engage in these projects via the online tool and to present their ideas.

In July 2019, the resolution of the vision in the council took place. After the summer break, the ideas from the urban society were collected and again sorted. Once all the ideas and comments from the urban community on their project ideas had been implemented, measures for implementing the projects were drawn up by the management, the University of Siegen and the urban community in a final workshop in November 2019.

In a last step the digital transformation strategy of Lohmar was designed and presented to the council aligned towards Lohmar's design and present documented municipal strategies.

In the following, Lohmar's formulated vision, mission, and strategic aims are presented (Stadt Lohmar, 2020): **"LOHMAR | DIGITAL | FOR EVERYONE"**

Today and in the future, Lohmar is the city of generations and stands for active life in the countryside. We see and we use the chances of digitalization to create noticeable improvements for all local citizens. In Lohmar, we are shaping digitization for each other and work closely with local authorities and other partners. Digital security is our top priority. In 2025 we present ourselves as (Stadt Lohmar, 2020, S. 3):

- **Digitally close!** - Through digitization, we are making the city's services usage easier, faster and more accessible.
- **Digitally smart on the move!** - With intelligent mobility solutions, we enable people more time and protect the environment.
- **Digital learning!** - By using smart technologies, we make education sustainable for all ages.
- **Digital into the future!** - In Lohmar, we are creating the necessary structures to ensure that entrepreneurial commitment benefits from digitalization.

In the following, the measures from the fields of action administration, education, mobility, and entrepreneurship are presented. The mobility field of action is discussed in more detail in Part B of this chapter.

In the area of administration, a citizen account was set up, which citizens can use to carry out their official business online. In addition, an online participation website was created so that citizens can pass on information directly to the city administration about flickering or broken streetlamps, ailing streets, overfilled garbage bins, or illegal waste disposal etc., or take an active part in new projects and give ideas.

The city of Lohmar has presented an urban development concept for 2030, which offers more housing for the growing population. It is expected that 1,400 apartments will be needed by 2030 (Stadt Lohmar 2013).

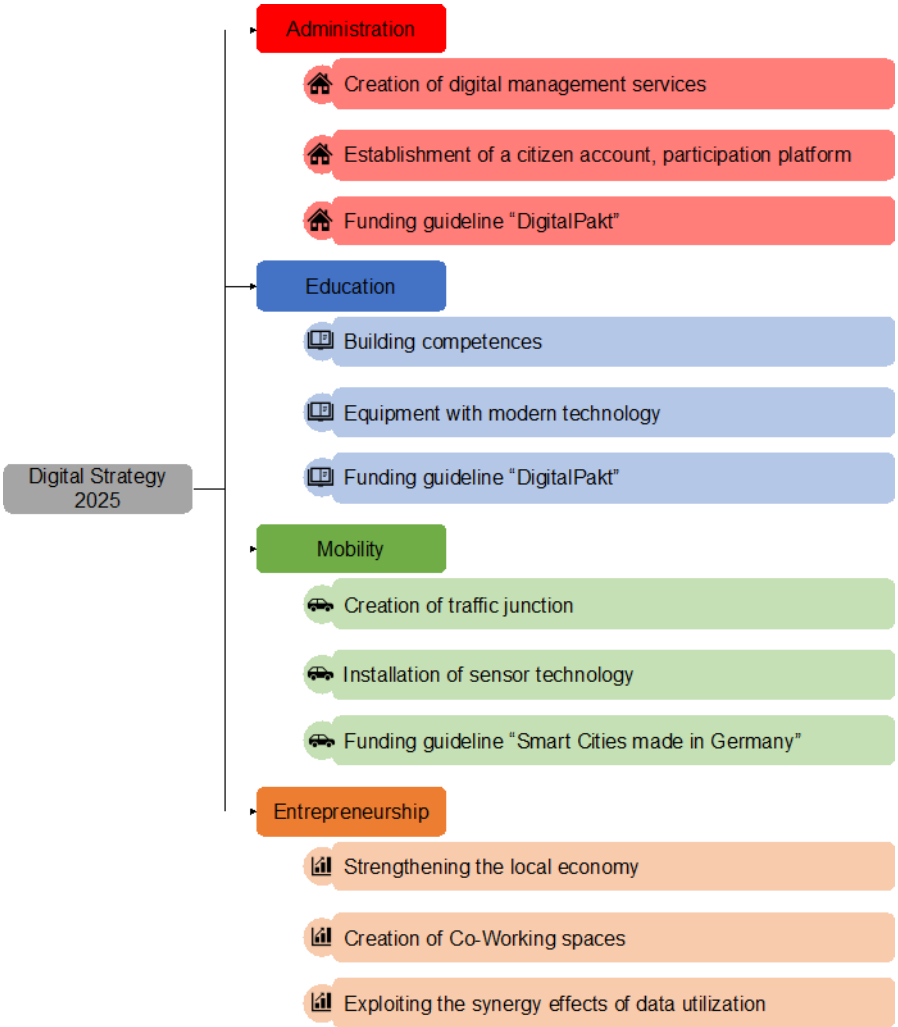

Figure 15.2 Core themes and fields of action of Lohmars' Digital transformation strategy 2025

Finally, it should be mentioned at this point that the city of Lohmar has introduced a job ticket for its core employees, because most of the employees (29%) live within a radius of five kilometers from the municipality. Resulting from this, motorized private transport can be greatly reduced. In the area of education, schools were equipped with digital blackboards, mobile devices, and small robots. In addition, an education day was established. In the area of mobility, Lohmar has adopted a parking space statute in summer 2019, to change the mobility of the residents.

With the help of the parking space statutes, it is possible to reduce the number of potential parking spaces or the fees for the replacement of parking spaces by offering mobility measures. Mobility measures can be, for example, the provision of job tickets for tenants or the facilitation of car sharing. The implementation of these measures is aimed primarily at investors, who are realizing (larger) construction projects in Lohmar and can therefore promote sustainable mobility and save (construction) costs. In the area of entrepreneurship especially the use of different data sources to support startups and companies is discussed.

B) Development of a smart mobility concept for Lohmar – RBS.Mobil

"Digitally smart on the move!" describes the smart way of using modern digital mobility solutions, which enables protection of the environment while allowing its users an optimized transfer regarding time and distances.

To solve the mobility problems described in "Situation faced", the city of Lohmar applied in May 2020 for the project "Smart Cities made in Germany", by the Federal Ministry of the Interior, for Building and Homeland Affairs (BMI) in Germany. Within this project, the BMI supports municipalities that are actively committed to integrated and sustainable urban development in the interest of the common good of the citizens, focusing on digital transformation processes. The values of the Smart City Charta (Bundesinstitut für Bau- Stadt- und Raumforschung & Bundesamt für Bauwesen und Raumordnung, 2017) and the areas of a Smart City are to be represented in the best possible way. The aim is to make cities in Germany ready for the future by developing strategic, participatory and integrated approaches that will help all German cities with their digital transformation during the project and after the project ends. Lohmar has laid the foundation for this in its digital transformation strategy described above and can therefore concentrate on the four fields of action. For the application, the service areas Smart Mobility and Smart Environment were the main focus and the project RBS.Mobil was developed.

After the City of Lohmar decided to focus on mobility, a project consortium was formed consisting of the CDO and the mobility manager (MM) of the City of Lohmar, a digital transformation expert, and a mobility expert. The project consortium has developed a first project idea that meets the requirements of Lohmar and the needs of its citizens.

This project idea was discussed in a joint workshop with the urban society, the city employees, associations, and potential companies from the fields of digital transformation and mobility. However, due to the COVID-19 pandemic, the workshop could not take place in physical presence of everyone, thus a digital format was chosen. The digital workshop was rated a success and was attended by over 60 participants. For many workshop participants this was the first digital workshop using different digital tools, like Zoom and Mentimeter. Following the workshop, the project consortium used the impressions and thoughts from the workshop and participants to develop the project idea Rhenish.Bergish.Smart.Mobil (RBS.Mobil).

RBS.Mobil reduces or even solves Lohmar's mobility problems by the means of five smart measures. Measure one is the so-called RBS-IoT platform, shown in the middle layer of Figure 15.3. This is intended to be an open-data platform for efficient, integrated data storage, and provision, as a basis and interface for the planned applications of the digital transformation strategy, where all data from Lohmar and the surrounding area are fed in. The data platform is intended to be open for all data (e.g., dynamic and static data) and the data is prepared and made available in a standardized and data protection compliant manner. The data platform is also adaptable to future standards and requirements.

Based on this, three RBS.Hubs (measure 2a) will be created at well-situated points in the city area - in Donrath, Pohlhausen, and Siegburg (see top level of Figure 15.3). Every hub will embody a focal technology. The first hub will be in Donrath, shown on the left side of the top layer on Figure 15.3. Donrath is the area located next to the German A3 highway, which is why the focus here is chosen to be on cars. For example, the multimodal offers like car sharing, carpooling, Park & Ride possibilities or charging infrastructure etc. are obtained. The second hub will be located in Pohlhausen, shown on the right side of the top layer on Figure 15.3. Pohlhausen is an area bordering on the communities of Siegburg and Neunkirchen-Seelscheid. In this place are two main roads (B56 and B507) on which five bus lines are operating. Therefore, the hub with the main focus on buses will be established in Pohlhausen. In this concept, multimodal offers like expanded bus stops and roads, bicycle storage, charging infrastructure, or Park & Ride possibilities etc. are obtained. The third hub will be Siegburg, shown in the middle of the top layer on Figure 15.3. At the train station of Siegburg the hub with the main focus on public transport is located due to the already existing connection of Siegburg to the local and long-distance railway traffic. Multimodal offers in Siegburg are for example charging infrastructure, Park & Ride possibilities, or car sharing etc. Additionally, all RBS.Hubs are equipped with bicycle garages and communication units to ensure digital networking using the RBS-IoT platform.

Measure 2b is therefore the establishment of a location-based car sharing system (RBS.CarSharing) with mainly electric vehicles and other different types of vehicles (drive as well as body), shown as a car with plug-symbol in Figure 15.3. The locations are chosen in a way that they are easily accessible, and a smooth multimodal mobility route is always guaranteed. In addition, the city of Lohmar wants to try out different approaches, such as car sharing in neighborhoods or quarters, cooperatives, use of the municipality's vehicle fleet, or pulsating car sharing, to determine the best approach for the citizens. Access to car sharing will be possible via an app, a RFID card, and analogue booking systems to enable car sharing for both younger and older citizens. The aim of this measure is to enable citizens or families to be without their second car, thus reducing emissions and journeys.

Measure three is the RBS.Shuttle, which is an extension of the offer on the public transport side. This is shown in Figure 15.3. with a bus symbol. It is a(n) (electric) minibus that picks up passengers at the desired location on request (RideSharing) and takes them to desired stops. AI-supported, connection times of public transport and traffic situations are taken into account. This way, a gap between villages/ hamlets and the RBS.Hubs is closed regardless of local boundaries. Public, social, and cultural institutions are also served. The bus itself offers sufficient space for passengers and the transport of walkers or prams, and the RBS.Shuttle enables all population groups, whether they are restricted or not, to have the best possible mobility.

Measure 4a is a mobility app into which all newly emerging hardware and software solutions will be integrated according to the existing offers. This is shown in Figure 15.3with the speech bubble on the left, where you can see a smartphone with RBS.Mobil. It includes, for example, bicycle boxes, charging infrastructure, carpooling (measure 4b), or RBS.Shuttle including reservation options, booking options, payment methods, mobility budget, and a bonus system (measure 5). The new solutions will then supplement the existing train, bus, or call-collection-taxi schedules, and bike and car sharing locations. Through this merger, all users of the transport association will benefit from the new measures and supra-regional, transparent, and easily accessible mobility, especially to Cologne and Bonn.

Measure 4b is the formation of carpooling schemes. Carpools are formed, which can be used at niche times of the public transport and on unused routes from the many villages of Lohmar to the centers, or on commuter routes and routes of children, to supplement the public transport. In this situation the aim is to enable multimodal mobility. The carpooling is a new component of the regional mobility system. The final measure five is the implementation of a bonus system that rewards the use of sustainable mobility options with points. The more environmentally friendly mobility, the more coins you can achieve. This applies both to citizens and employees with their employer's mobility budget. The mobility points can be exchanged in local shops or for tickets (e-commerce) like a voucher, which increases turnover.

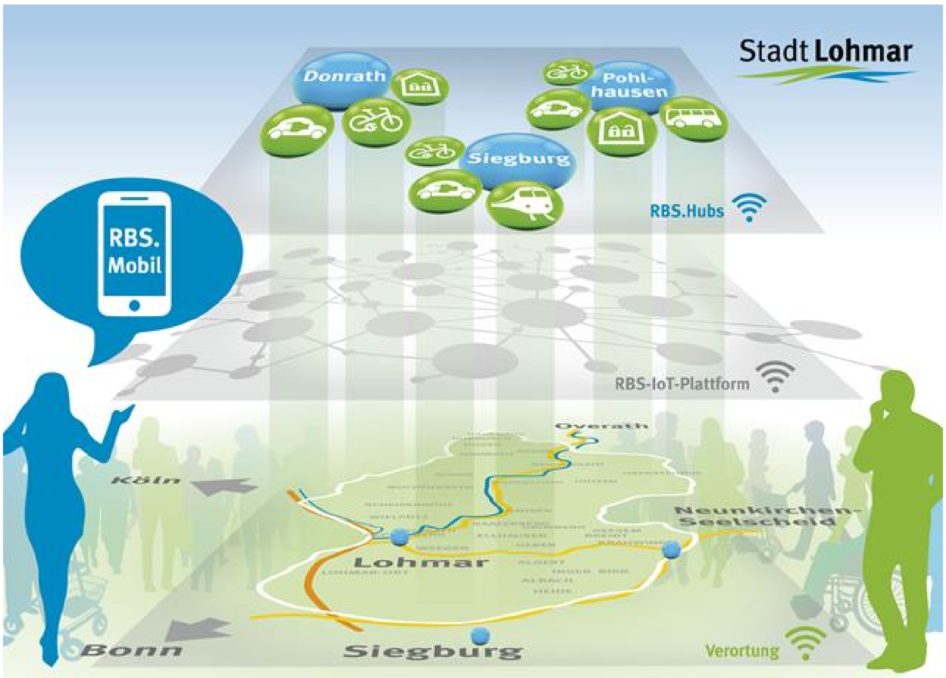

Figure 15.3 Overview of RBS.Mobil (City of Lohmar)

15.4. Results achieved

Results obtained in this study are presented in two parts. Part A takes a closer look at the achievements related to the digital transformation strategy and Part B deals with the achievements related to RBS.Mobil.

A) Achievements related to the digital transformation strategy of Lohmar 2025.

The success of the digital transformation strategy is the creation of attention for the topics of digital transformation and the start of citizens to rethink digital transformation. Within the administration the topic of digital transformation is now omnipresent. Training courses are offered, workplaces are made more mobile and processes are getting digitally transformed. The aim here is to ensure that employees are aware of digital transformation processes and the possibilities for their daily tasks. In this way, the management of digital transformation processes should be perceived as "normal or standard" and not as a burden.

COVID-19 accelerated the digital transformation of the administration abruptly because all city employees had to work instantly from home. During this, laptops, webcams, and video conferencing softwares were purchased and almost 40% of the workstations were fully mobilized. Typical tasks, such as those of the community center, were also eliminated and need now to be designed digitally. However, many employees have become acquainted with the many advantages of living and working digital from everywhere at any time and are now demanding its continuation. These are all good achievements in the administration field of action. This is confirmed by an employee of the citizens' office:

“Digitally, I can process many inquiries much faster and it saves citizens the trip to the citizens' office - a really good solution.”

In the future, home offices in the administration should continue to be an option for employees. The process for applying for a home office has also been simplified and digitized. In addition, an office on each floor of the building will be converted into a desk-sharing office to give employees who work completely at home the opportunity to book a room in the office some days during the week or for meetings which need to take place in physical presence. The city hopes that this will minimize the workplace problems, it is currently facing. Right now, the city of Lohmar has not enough workplaces for the employees working for the city of Lohmar. Home office is one solution helping the city of Lohmar to find proper workplaces for all its employees. This phenome-non is not unique to administrations; private businesses are now increasingly turning into home offices or alternative arrangements. Due to the lockdown at the beginning of the year and the low necessity of presence at the place of work, alternatives are becoming more popular - including the established co-working places in Lohmar, which can be assigned to the field of entrepreneurship.

Awareness for the digital transformation processes of Lohmar is being created outside the administration, i.e., in the city society, through web presence and social media channels. Many young citizens know what is currently being discussed in Lohmar through their subscriptions to Instagram, Twitter, or Facebook. The older citizens are informed about the activities with the local newspaper. In addition, they can get to know the digital offers in individual learning sessions. In this way the city of Lohmar brings the whole city society closer to digitalization as a “normal” development or chance to improve the development of the city of Lohmar in the areas of climate protection, living together, mobility, and comfort. These offerings are part of the education action area.

B) Achievements related to the smart mobility concept for Lohmar – RBS.Mobil.

The demand for more digital services continues to grow in Lohmar and so Lohmar has decided to be a driver for digital transformation processes. Especially in the area of mobility, Lohmar has shown great initiative and submitted the RBS.Mobil project to the BMI. The application was well received and approved for funding at the end of 2020. The project is scheduled to start in early 2021.The RBS.Mobil project already showed a positive response during the application phase, which the result that Lohmar was able to motivate the surrounding municipalities and regional companies to participate in the project.

Mobility manager of Lohmar, Mr. Kukula, summarized this as follows:

> *"Our goal in developing the digital transformation strategy was to bring together the many mobility projects and players in the region and work together on a solution to integrate them into a single system and thus strengthen sustainable mobility and the environmental network as a whole. A great success!"*

External participants felt the same way - the mobility manager of a regional mobility agency summarized the start workshop for idea generation, which took place online due to the lockdown, as follows:

> *"The digital workshop [on the RBS.Mobil project] was fun and really well organized. The organizing committee has my respect. It's a great way to collaborate remotely and it delivered a great result."*

Especially the citizen participation and early stakeholder involvement was seen as very positive. Overall, this allowed Lohmar to focus on smart mobility in the region, and RBS.Mobil is just the start. After approval by the BMI, Lohmar held a press conference and the RBS.Mobil project was thus brought to the wider public and has since received a positive response.

The COVID-19 pandemic has of course also had an impact on the RBS.Mobil project. Analyses by the local transport operator showed that despite the pandemic and concerns about contagion in public transport, guest numbers in Lohmar remained constant. This means that these groups of people actually rely on public transport on a daily basis and will continue to use it. Here, the individual measures, such as the RBS.Shuttle or the bike-sharing stations, can provide further benefits. At the same time, it could be concluded from the traffic situation on the roads during the lockdown that many Lohmar residents commute by car, because the critical traffic situations did not occur during the lockdown. However, how the influence of the bicycle vendor is or has developed cannot be seen at this point in time. In any case, these new circumstances will be taken into account at the start of the project and corrected to the new user behavior.

15.5. Lessons learned

In sum, the case of Lohmar shows six lessons learned, which can be transferred to other municipalities in general and especially for cities with commuters' challenges. The first three of Lohmar's lessons learned belong to digital transformation processes in general. Regarding the development process of digital transformation strategies, these three lessons learned can be aligned to the development processes of various municipalities in Germany. These three findings were also shown by Niehaves et al. 2018 who conducted a study with North Rhine-Westphalian municipalities regarding the development of digital strategies (Niehaves et al. 2018; Niehaves et al. 2019). The following three findings (number four to six) concentrate on the development of the field of mobility in Lohmar's digital transformation strategy. With developing a project proposal regarding a smart multimodal mobility hub focusing on commuters' traffic, Lohmar was able to develop a roadmap supported by different stakeholders for the field of mobility in its digital transformation strategy.

First, digital transformation is a joint task! Looking at digital transformation processes and especially while developing a digital transformation strategy, municipalities need the help of different stakeholders sharing their knowledge and their point of view. The invitation of different stakeholders into the development process gives municipalities the chance to address different needs of various stakeholders.

With the New Public Management movement, municipalities are beginning to focus on acting as service providers for their citizens. With the ability to recognize different interests and needs of different groups of citizens, digital transformation processes and projects can now be properly aligned.

Second, digital transformation processes need competences! Changing processes, developing new ideas in the digital age and enhancing the engagement of citizens need digital competences. These competences can be divided in process-orientated and technology-oriented competences.

Digital competences are an essential part whether new digital transformation processes will be successful or not. If employees and citizens have no competences regarding the use of new technologies, they might not be able to use them. If they have no knowledge about digital processes and their adjustments, citizens and employees will not start to make use of new designed processes. Not having enough knowledge of the changes caused by digital transformation can result in dissatisfaction and the feeling of having been "left behind". To prevent these cases, webinars and workshops are opportunities to invite different stakeholders, giving them information and transparent insights about changes, building digital competences and helping them to join the transformation processes.

Third, digital transformation processes need responsibilities! Digital transformation in municipalities requires clear responsibilities and should at best be made a matter of the management (e.g., mayors and CDO's). A study shows that 83% of participating municipalities state that mayors and/or councilor are responsible for developing a digital transformation strategy (Niehaves et al. 2018). When it comes to the implementation of the digital transformation strategy, department heads play a central role. Nevertheless, six out of ten mayors and councilors were responsible for this themselves (Niehaves et al. 2018). This study also shows that the designation of clear areas of responsibility makes it possible to turn employees into digital transformation drivers who are willing to push the topic of digital transformation forward in their municipalities. Individual personalities, as introduced by the mayor, the CDO and the MM in Lohmar, pushed ahead digital transformation projects, put the topic on the agenda as top priority and started a change in their municipalities' culture. To identify such personalities and to promote their personal commitment, suitable conditions should be created at the municipal level.

Fourth, learn from other municipalities! In Germany there are other cities facing the same problem as Lohmar does. Municipalities can learn from Lohmar and others. There are more municipalities who are close to bigger cities in Germany, still being rural, facing commuters' challenges. These cities can learn from the development Lohmar started by introducing the project idea of RBS.Mobil. With getting different stakeholders together and letting members of the University moderate sessions and workshops, they were able to connect to every stakeholder in a neutral way. Talking transparently about challenging obstacles and letting stakeholders describe their fears and wishes helped Lohmar to communicate every step closely with their citizens and stakeholders, enabling intermunicipal projects to develop. Since mobility does not stop at the city boarders, this intermunicipal commitment helped develop multimodal mobility applications to create an easy and convenient way for citizens to get from destination A to B.

Fifth, there is always more than one solution! Looking at different ways of mobility today, there is always more than one solution, way, or partner municipalities can work with.

Multimodality is the question and the answer at this point. Working with different stakeholder, organizations and municipalities gave the possibility to test different applications in the field of mobility. There is always more than one solution and there is always someone who has already experiences using these various applications. Lohmar learned to enjoy the help and ideas of their stakeholders and to integrate them in their project proposal to be friendly with experimenting in turn to achieve the best solution and to accept mistakes on the road to the best solution as learnings. Another important topic is time. Being timely open, seeing projects and strategies as something alive helps to develop and adjust them along their way.

Sixth, asking for help improves your actions! Getting more partners together and being honest and open about the current challenges faced, can help to find real solutions to problems. Partners can help financially and with personnel; they can build competences with municipalities and be of help when facing questions and challenges. Partners on your side like to help and to share their knowledge. With the intermunicipal exchange Lohmar was able to define their way as common aim, searching for the best possibilities for their citizens. Including citizens in the process, asking for their opinions, especially with their knowledge on the most important geographical and technological challenges occurring in their surroundings, helps tremendously to develop a future proof project in terms of acceptance and technical issues.

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III IMPLEMENTING STRATEGIES

16. Improving Cognitive Performance

Paper Number	**P4**
Title	**Designing Self-Presence in Immersive Virtual Reality to Improve Cognitive Performance - A Research Proposal**
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Table 16.1 Fact Sheet Publication

[a] due to change of name

Designing Self-Presence in Immersive Virtual Reality to Improve Cognitive Performance - A Research Proposal

Abstract. With the increasing availability of immersive virtual reality (IVR) technologies, new opportunities to change individuals' behavior become possible. Notably, recent research showed that by creating a full-body ownership illusion of a virtual avatar looking similar to Einstein, users' cognitive performance can be enhanced. However, although research is quite consistent in reporting that visuomotor synchrony in IVR achieved with body tracking suffices to elicit body ownership illusions that change behavior, it is still unclear whether strengthening these visuomotor illusions with additional technological design elements, such as visuotactile feedback, can contribute to increase desired outcomes even more. In this research in progress paper, we aim to conduct a 2 (physical feedback: low vs. high) x 2 (avatar design: normal vs. high intelligence) between-subjects experiment in IVR to test this assumption. In addition to subjective measures, we use heart rate and electrodermal activity to assess the strength of self-presence induced through the illusions.

Keywords: body ownership illusions, heart rate, electrodermal activity, cognitive performance, physical feedback

16.1. Introduction

With the ability to present user's visual, auditory, and tactile senses with completely virtual content, Immersive Virtual Reality (IVR) provides new opportunities to represent the bodily self of users. IVR describes a set of technologies that, by enclosing the user with head-mounted displays (HMD) or cage systems heightens sensory immersion. Sensory immersion is a characteristic of the technology, which is high when users are separated into a technology from the real world and their real movements are matched to the virtual environment [1]. In contrast to this technological viewpoint, the sense of telepresence describes the psychological perception of the "illusion of being in a distant place" or "being there" of the individual, [2, p. 438], which should arise in individuals when technology provides a high degree of sensory immersion.

In IVR, full-body ownership illusions can be created by combining HMDs with fullbody tracking, creating a high degree of self-presence [2]. Self-presence relates to the "Illusion [of] inhabiting the virtual body" [2, p. 438], when interacting with a virtual body in an environment. Self-presence elicited through body ownership illusions arises when the users' real movements are tracked in real-time and then transferred to a virtual body in the IVR. As a result, the movements of the users' virtual body are displayed in synchrony to the users' real body movements (visuomotor synchrony). This synchrony is sufficient for individuals to experience self-presence [3]. However, when design elements such as visuotactile or visuomotor synchrony are disrupted, self-presence can be diminished [4].

Research already showed, that self-presence created by full-body ownership illusions offer many opportunities to enhance desired behavioral and cognitive outcomes when working alone or interacting with other people. As an example, individuals embodied in a virtual body with dark skin drum differently [5] and show decreased racial bias and prejudice [6, 7] compared to individuals in a virtual body with white skin. Additionally, individuals embodied in the body of Sigmund Freud show different cognitive processing of problems [8]. Furthermore, full-body ownership illusions can even change male users' cognitive performance if they are embodied in an avatar that is associated with high intelligence [9].

Whereas a main factor to elicit full-body ownership illusions with sufficient strength seems to be first person perspective, the strength of body ownership illusions is dependent upon multiple factors. Research has indicated that the strength of body ownership illusions is related to questionnaire items, but can also be measured by biophysiological variables, for example through skin conductance response or heart rate in reaction to a threat [4, 10, 11]. However, whether increasing the effectivity of the body ownership illusions through specific design elements to enhance the cognitive or behavioral outcomes induced through a specific avatar design, is still unclear. Therefore, we want to investigate the following research question to contribute to close this research gap:

RQ: *How can the interaction between users and virtual avatars be designed to increase users' self-presence and cognitive performance in immersive virtual realities?*

To answer our research question, we plan to conduct a 2 (physical feedback: low vs. high) x 2 (avatar design: normal vs. high intelligence) between-subjects experiment.

16.2. Background and Research Model

In this section, we develop our hypotheses based on literature on the antecedents and outcomes of self-presence through full-body ownership illusions. Our research model is displayed in Figure 16.1, which we explain in the following paragraphs.

16.2.1.Full-body Ownership Illusions and Effects on the Self

Rooted in the classical rubber hand illusion experiment [12], in which a rubber hand is touched in synchrony with the individuals' real hand, subsequently arising a sense of ownership over the rubber hand, full-body ownership illusions elicit a sense of ownership over a complete body [3, 13]. When IVR is used with body tracking, these illusions can create a quite realistic experience of having another body.

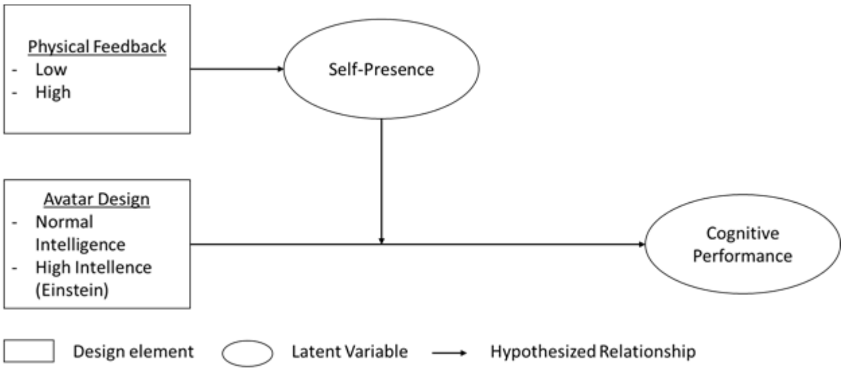

Figure 16.1 Research model

From a theoretical point of view, self-presence initiated through body ownership illusions constitutes a passive form of perspective taking [14, 15], in which, rather than imagining to be in the shoes of another person, users can directly experience owning another body [9, 16]. As a consequence, if full-body ownership illusions arise for avatars with specific design elements (e.g. skin color or similarity to a person with competencies in a specific area), individuals cognitive processing and behavior can be influenced [6, 17]. It is assumed that this process occurs by activating existing resources of the individual previously not accessible through this form of perspective-taking [8, 9]. For example, when individuals were embodied in a virtual avatar of Sigmund Freud when they counselled themselves, they showed more positive mood changes than when they were embodied in a body-scanned version of themselves [8]. Additionally, individuals who are embodied in an avatar of Einstein show higher performance outcomes in a cognitive task than when they are embodied in a regular unknown body with which they most likely connect lower intelligence levels [9]. We therefore hypothesize that:

Hypothesis 1. Being embodied in a virtual body that is associated with high intelligence leads to higher cognitive performance than being embodied in a virtual body that is associated with normal intelligence.

16.2.2. Strength of Self-Presence

Previous research on virtual arms has indicated that self-presence can be induced by synchronous visuomotor stimulation, even when tactile stimulation is absent [10]. Comparing the effects of visuomotor and visuotactile interaction has shown that the disruption of visuotactile synchrony leads to a lower body ownership illusion [4]. Thus, we suspect that sustaining congruence for visual stimuli coming in contact to the body and touch that is subsequently felt is highly important for keeping the level of selfpresence high. This should be especially important in situations in which users have to interact with their hand's multiple times in fine granularity, as this is the case with many virtual reality applications. However, when users' bodies are fully tracked, including their fingers, physical feedback can be incomplete after interaction with virtual objects if no feedback mechanism is implemented in addition to the tracking device. Therefore, we assume that self-presence is higher when physical feedback is presented, and, that, this strengthened self-presence leads to an increased effect of avatar design on cognitive performance.

Hypothesis 2. High physical feedback leads to higher self-presence than low physical feedback.

Hypothesis 3. Self-presence strengthens the effect avatar design has on cognitive performance.

16.2.3. Relation of Self-presence to Biophysiological Measures

The level of users' self-reported self-presence seems to be related to biophysiological measures after a threat to the integrity of the virtual body occurs, with the strength of self-presence influencing the strength of the biophysiological reactions to the threat [3]. Sliding a knife over the artificial body increases electrodermal activity compared to a spoon or asynchronous physical feedback [18] and a knife sliding over the body in a condition of first person perspective with synchronous physical feedback results in higher electrodermal activity than a third person perspective or asynchronous physical feedback [19]. In both related studies, these differences were also reflected by the questionnaire items for self-presence. However, other research indicated that synchronous and asynchronous physical feedback is not necessarily reflected by a change in skin conductance response [4]. To gain more insights into these effects, we hypothesize:

Hypothesis 4. Higher levels of self-presence are reflected by an increase in electrodermal activity after the presentation of a threat to the virtual body.

Another biophysiological measure that has been shown to be related to self-presence is heart rate deceleration. After seeing a woman slapping the face of a virtual body from a first person perspective, heart rate deceleration increased compared to a third person perspective, which was also related to the questionnaire items for self-presence [20]. Additionally, heart rate deceleration is positively related to self-reported self-presence in a questionnaire after the legs of the virtual body were visually separated [3]. Thus, we hypothesize:

Hypothesis 5. Higher levels of self-presence are reflected by an increase in heart rate deceleration after the presentation of a threat to the virtual body.

16.3. Method

16.3.1. Participants and Design

We will recruit at least 128 male participants to take part in our experiment and use a 2 (physical feedback: low vs. high) x 2 (avatar design: normal vs. high intelligence) between- subjects design to test our hypotheses.

16.3.2. Materials and Measures

IVR: A HTC Vive HMD will be used to display the virtual environment, which will be designed with Unity 3D. Full-body tracking will be implemented with five HTC Vive trackers (2 for hands, 2 for feet, 1 for hip) and hand-tracking will be implemented by using Hi5 VR Gloves. Avatars are created using Adobe Fuse.

Electrodermal Activity. We will use electrodermal activity (EDA) as a biophysiological measure for self-presence. In line with previous research in the area of body ownership illusions, EDA will be measured in the 6 seconds baseline period and in 2-8 seconds period after the threat [4]. The latency window during which a response will be assumed to be elicited by the stimulus will be based on frequency distributions of response latencies to simple stimuli (1-4 sec) [21].

Heart Rate. We will use the Polar H7 belt to measure participants' heart rate deceleration. In line with previous research, we will measure the mean heart rate for a baseline period of six seconds before and six seconds after the presentation of a threat [4, 22]. As dependent variable for our data analysis, the base measure will be subtracted from the threat measure.

Tower of London Task. This task assesses the level of cognitive performance and is implemented similar to Banakou et al. [9] in which three differently colored beads on three chopsticks are displayed at descending height. Within three moves, the beads have to manipulate from a predetermined starting position to another set of pins to match the position of the beads in the model. As in Banakou, a point-based algorithm will be used to evaluate the performance (similar to Krikorian et al. [23]).

Questionnaire. We will use the five questions adapted from Banakou et al. [9] to assess self-presence (body ownership) and agency.

16.3.3.Design Elements

Physical feedback. Physical feedback will be designed by providing feedback in form of vibrations through the IVR gloves. Thus, when individuals in the high physical feedback condition touch objects, the gloves will vibrate. For individuals in the low physical feedback condition, this vibration will be missing.

Avatar design. Avatar design will be operationalized by either using a normal-looking male avatar (normal intelligence condition) or an avatar looking similar to Einstein (high intelligence condition).

16.3.4.Procedure

Apart from the physical feedback conditions, the threat to the virtual body, and the psychophysiological measurement, the overall procedure is adapted from Banakou et al. [9]. Participants will be told that they will take part in a study investigating the effects of virtual reality on user experience. They will be invited to the laboratory at two time points: during their first visit participants will sign informed consent, complete measures for self-esteem as well as cognitive ability, and complete the premeasure of the tower of London task. One week later, the IVR session takes place. First, participants are lead into a changing room to put on the HRV belt. Next, the experimenter attaches the electrodes for EDA measurement to the inside of the middle and index finger. Afterwards, participants will get instructions on how to put on HTC Vive Trackers and Hi5 VR Gloves. Subsequently, they will put on the HTC Vive

HMD and will see a virtual environment which consists of a room with a mirror, a chair, and a virtual body (which either looks like a human or like Einstein, according to the condition) from a first person perspective. When looking in the mirror, participants can see the virtual body mirrored, thus, in a third person perspective. Participants are then asked to get accustomed to the virtual body by moving their body parts and to look around in the virtual room.

To engage participants into being in the virtual environment, and to make the physical feedback conditions salient, participants will be asked to complete a task in which they have to locate numbers in the room and sort them in ascending order using their hands. In the high physical feedback condition, participants will receive physical feedback when touching the numbers, whereas this feedback will be missing for participants in the low physical feedback condition.

In the next part of the experiment, participants will be seated on a chair and asked to answer the virtually presented questionnaire regarding self-presence (body ownership) and telepresence. After they have finished answering the questionnaire, participants will be told that they have the chance to play a game with a box-shaped robot. In this game, participants will be asked to put their right hand on a virtual pad which is tantalized to them by the box-shaped robot. Then, the robot will pull out a knife and starts to stab the knife quickly in the space between the fingers of the participants. This serves as a threat for the virtual body. We chose a game in which the virtual body is not actually hurt because we wanted to refrain from permanently damaging the virtual body, as we expected that this might interfere with the intelligence salience of the Einstein body (participants could remember their experience as threatening rather than as being embodied in the body of an intelligent person). Afterwards, participants will take off the HMD and do the post measure of the tower of London task. Finally, participants will be thanked and debriefed.

16.4. Discussion

With our results, we aim to gain insights into the working mechanisms through which body ownership illusions affect cognitive performance. First, our research contributes to the literature indicating that self-presence in the form of body ownership illusions can be measured by biophysiological variables [3, 4] by delivering a more practice-oriented view on physical feedback. Second, we aim to contribute to literature indicating that visuotactile feedback can indeed strengthen self-presence [4]. Third, by testing whether strengthening self-presence can increase cognitive performance, we contribute to practice increasing the knowledge on how immersive virtual reality can be designed to shape behavioral and cognitive outcomes in a beneficial way [8, 9, 24].

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17. CEOs of SMEs

Paper Number	**P9**
Title	**CEOs of SMEs: How IT-Governance compensates the Lack of Digital Competencies**
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Table 17.1 Fact Sheet Publication

[a] due to change of name

CEOs of SMEs: How IT-Governance compensates the Lack of Digital Competencies

Abstract. The literature assumes that the small and medium-sized enterprises enterprise (SMEs) depends on the (digital) skills of the chief executive officer (CEO). In this paper, we examine the influence of CEOs competencies regarding digital transformation of SMEs and show, based on explorative research, which competencies of CEOs are necessary for a successful digital transformation. We conducted five IT ex-pert interviews within the framework of the study to examine these influences. Subsequently, 20 CEOs of different SMEs were interviewed to discover their (digital) skills. The interview data showed that not only competencies are responsible for a successful digital transformation, but that the organization's Information Technology (IT)-Governance makes a significant difference. The interviews show that IT-Governance decisions are closely linked to the competencies of the CEOs. Based on the implicit and explicit competencies, interesting insights into the structuring behavior of the CEOs were gained. Especially for CEOs with a good digital competence profile, some pitfalls became visible, which can only be avoided by IT-Governance measures. Access to IT knowledge became another decisive factor. Based on our findings, we propose IT-Governance strategies depending on CEOs competencies. This enables to implement IT-Governance structures which best suits CEOs individual level of competencies, giving insights of potential behavioral structures.

Keywords: Digital Competencies, IT-Governance, Exploratory Research, SMEs.

17.1. Introduction

Digital transformation dominates current discussions on the future direction of companies (Bilgeri et al., 2017; Riasanow, Galic and Böhm, 2017). Due to external pressure from competitors, customers, or suppliers, well-established companies are obliged to digitize their processes and products. From this obligation, multiple challenges arise for the governance of companies, for instance: Who decides on how established processes and products are to be digitized? Who decides on the prioritization of digital transformation projects? How can the necessary digital competencies be obtained?

Especially for SMEs with more limited resources compared to large companies, these challenges are hard to face (Chen et al., 2016; Li et al., 2018). SMEs need to find a compatible way of digital transformation, in contrast to start-ups created by digital technologies. The digital transformation (Mergel et al., 2019) of these SMEs depends on the (digital) competencies of the CEO (Wilkin et al., 2016).

Traditionally, the governance structures of SMEs are more strongly oriented towards the CEO than those of large companies. The CEO gets involved in various activities regarding the organizations business units, processes, and products. Consequently, investments in the digital infrastructure of SMEs require decisions by the CEO. Here, the question arises on how decisions on the digital transformation of SMEs are made if the CEO has a low level of digital competencies.

It can be assumed that deficits in the digital competencies of CEOs can be compensated for by suitable IT-Governance structures. IT-Governance deals with the direction of IT-related decisions, actions and involves determining which individuals make IT-related decisions (Huang, Zmud and Price, 2010). It is therefore a task of the CEO to develop governance structures which, on the one hand, strengthen the CEO's authority to make IT-related decisions if they are competent to do so or, on the other hand, shift the authority towards individuals with higher digital competence who can make better decisions.

Yet, there is little research on the relation between the digital competencies of the CEO and suitable IT-Governance. So far, research has identified several governance structures that have an impact on an organization's digital transformation. For example, the relationship between IT-Governance and organ-ization performance from different perspectives, such as strategic alignment, IT leadership, IT capability and process performance, resource relatedness, and culture (Vejseli and Rossmann, 2017). Board-level IT-Governance, for instance, positively influences organizational performance; however, this relation is negatively moderated by authoritarian governance style (Turel et al., 2017). Although the CEO plays an essential role for the digital transformation of SMEs, the focus of studies on IT-Governance and leadership lies on the chief information officer (CIO) (Vejseli and Rossmann, 2017).

Further studies dealing with competencies in enterprises focus on the organizational level under the term "skills of information systems" (Aydiner et al., 2019). Although such studies provide valuable insights into the importance of digital competencies for the organizational performance, they do not provide any indication about the importance of the digital competencies of the CEO. Accordingly, the goal of this study is to identify relevant digital competencies of CEOs for the digital transformation of SMEs and to derive appropriate IT-

Governance measures dependent on the CEO's existing or missing digital competencies. Hence, we propose the following research questions (RQs) guiding our research:

RQ1: Which digital competencies do CEOs of SMEs need for the successful digital transformation of their organization?

RQ2: Which governance structures support existing digital competencies or compensate for missing digital competencies of CEOs of SMEs?

The study presented in this article is part of a research project to explore and identify competencies among executives in SMEs in the digital age. The study is intended to exhibit possibilities for competence development in connection with the digital transformation of SMEs. SMEs are of great importance for the German economy. SMEs have often been established in the market for several decades, as our data show. As a result, SMEs have experienced a technical "revolution" or two since they were founded, which, for instance, led to the decline of mining in large parts of Germany or the emergence of IT in general. Digital transformation is another, but much faster, development, for which companies are looking for solutions and best practices.

Given its explorative nature, our study uses an exploratory research approach. In doing so, we first use the literature on IT competence and IT-Governance, particularly regarding organization leaders, to get a first insight into the subject. Based on this and five expert interviews, we develop a semi-structured interview guideline and interviewed 20 CEOs of SMEs. Our findings show that missing digital competencies of CEOs can be compensated by suitable IT-Governance measures. Subsequently, we discuss our findings by deriving practical and theoretical implications. We conclude by stating limitations of our study and recommendations for future research.

17.2. Related Work

17.2.1. Digital Competencies of Business CEOs and Leadership

IT competencies of business CEOs are defined as explicit and implicit (tacit) IT knowledge, whereby "explicit knowledge is the formal knowledge that can be clearly transmitted using systematic language" (Bassellier et al., 2001, p. 164) and tacit knowledge is the "ability to perform well" (Bassellier et al., 2001, p. 164). Explicit knowledge comprises five components: technology, applications, system development, management of IT, and access to IT knowledge, whereas tacit knowledge covers the manager's experience and cognition (Bassellier et al., 2001). Based on the concept of CEOs' IT competence, it has been shown to have a strong influence on the CEOs' intentions to promote IT in their organization (Bassellier et al., 2003) as well as on the success of IT projects (Engelbrecht et al., 2017). Especially knowledge on applications has been shown to be a major success factor.

From a broader perspective, several studies demonstrate the importance of good leadership for the digital transformation of companies. Digital transformation, for instance, requires CEOs to be actively involved in planning, experiencing, leading, engaging, and establishing an appropriate organization culture (Kohli and Melville, 2019; Mergel et al., 2019; Pillay et al., 2012; Wiesböck, 2019; Yoo et al., 2010a, 2010b). At the same time, the digital transformation of companies changes good leadership. Digital transformation, as defined by Mergel et al. (2019), is expected to increase transparency and complexity or to remove hierarchies and to enable and enhance features of transformational leadership. Transformational leaders "attempt and succeed in raising colleagues, subordinates, followers, clients, or constituencies to greater awareness about the issues of consequence. This heightening of awareness requires a leader with vision, self-confidence, and inner strength to argue successfully what he sees is right or good […]" (Bass 1985, p. 17). Transformational leadership positively influences leader-member exchange (Wang, 2005). Although these studies deal with good leadership and the competencies of organization leaders regarding IT and digital transformation, the connection between the digital competencies of individual organization leaders and suitable IT-Governance measures is still missing.

17.2.2. IT-Governance

IT-Governance defines "the enterprise management system through an organization's portfolio of IT systems is directed and controlled" (Peterson, 2004, p. 8) and deals with the centralization and decentralization of management decisions on business applications, IT architecture, and technology components, whereby in centralized structures and senior-level executives have decision-making authority for IT investments (Peterson 2004). Centralization "leads to greater specialization, economies of scale, consistency, and standardized controls, whereas decentralization enables business control, a sense of business ownership, and provides greater responsiveness and flexibility to business needs" (Peterson 2004, p. 10). Small as well as large organizations see strategic alignment of business and IT, clarity of ac-countability and of responsibility, and improved stakeholder engagement as key benefits of IT-Governance (Wilkin et al., 2016). This finding is reflected by empirical findings that show that IT-Governance mechanisms, including decision making structures, formal processes and communication approaches, positively influence organizational performance. This relationship is mediated by IS strategic alignment (Wu et al., 2015). However, not only alignment but especially strategic IT agility leads to high competitiveness, which means "consistently using IT to strategically outdistance rivals, who are constantly playing second fiddle" (Tiwana and Kim 2015, p. 656). Here, IT-Governance enhances IT strategic agility only when it is discriminatingly aligned with departments' peripheral knowledge, which is the department's knowledge in the other's domain but outside its own (Tiwana and Kim, 2015). IT government success, which includes top management commitment, increases the strategic controllability of IT which, in turn, contributes to IT effectiveness and business impact (Buchwald et al., 2014).

There are different ways to implement effective IT-Governance. For example, it is recommended to implement governance led by a board of directors to achieve organisational performance improvements but to avoid an authoritarian style as it is detrimental to performance (Turel et al., 2017). A study with an explicit focus on SMEs argues that formal IT steering committees, composed of executives who have a consensus on their standards and values, positively influence the effectiveness of IT-Governance (Huang et al., 2010). Senior leadership is suggested to be an essential factor for successful IT-Governance (Weill and Ross, 2004; Liang et al., 2011). Top CEOs have great influence on the effectiveness of IT in the organization and are recommended to actively exhibit supportive actions to ensure that strategic visions are internalized, to adapt their level and content of support to fit what is needed, and to demonstrate the importance of ensuring their visibility throughout the entire IS implementation process (Dong, Neufeld and Higgins, 2009). Moreover, social capital or social alignment between business and IT has been identified as mediator between IT-Governance and business performance (Wagner et al., 2014; Schlosser et al., 2015). For example, this is confirmed by a study on the effects of leader-member exchange, which recommends positive relationships between leaders and their followers, on the performance of virtual teams (Goh et al., 2012).

Since IT-Governance deals with the question about who makes IT-related decisions, competencies play a major role. IT-Governance "is less about who is vertically positioned to be in control, and more about the complementary - business and IT - competencies an organization possesses, and how it can integrate these to develop the strategic flexibility required for realizing and sustaining business value from IT in a complex and dynamic environment" (Peterson 2004, p. 20). Studies on IT-Governance and leadership emphasize the important role of the CIO or chief digital officer, since the CIO is assumed to have the highest competence on IT and is responsible for the digital transformation of an organization. CIOs are expected to be visionary, to have leadership, strategic, and analytical skills, to be competent in the or-ganizational business domain and business models, and to have general knowledge about technologies and their impact (Tahvanainen and Luoma, 2018). A high social capital between the CIO and top CEOs is expected to have positive effects on organization performance (Karahanna and Preston, 2013). Here, the CIOs' understanding of their CEO plays a more pivotal role in predicting the quality of CEO–CIO collaboration than CEOs' understanding of their CIO (Benlian and Haffke, 2016). The CEO is an important factor in the digital transformation of SMEs, the identification of suitable IT-Governance structures dependent on the digital competencies of the CEO remains an open task.

17.3. Methodological Approach

17.3.1. Research Design

This research takes an explorative approach to understand what digital competencies CEOs need to deal with digital transformation processes. In a supportive way, this study examines the structures prevailing in the organization to identify possible correlations. Based on the explorative nature of this study, we have used tools from the coding methodology of Grounded Theory (Glaser and Strauss, 1967; Gioia and Chittipeddi, 1991; Urquhart et al., 2010; Gioia et al., 2013), which are explained below.

In order to determine the series of relevant interview questions to answer our research questions, we have chosen a multi-level research approach. (1) In the first exploratory phase, we conducted five expert interviews with proven experts from the fields of technical development and IT consulting. These were not CEOs of SMEs. Each of these experts has a minimum experience of 10 years in IT, digitization, digitalization or digital transformation (Mergel et al., 2019) topics. We had an open discussion about the research questions and the experiences in this area so far. This exchange resulted in an open interview guide that enabled us to address the research questions as precisely as possible. (2) After we had created the interview guideline, we conducted a two-stage interview series. In a subsequent pre-test phase, we conducted 5 interviews with CEOs of SMEs based on the guideline. In this way, we were able to test the interview guide. After these interviews, we were able to further optimize the guidelines accordingly. (3) The last step of our research comprised interviews with 15 CEOs of SMEs based on the guideline. In order to categorize the companies, we collected the structural data of the companies such as employees, fluctuation, age of the organization, age of the interviewee, and gender. In addition, all respondents had to evaluate their organization regarding digitization, digitalization and digital transformation in comparison to their competitors in their respective industries.

17.3.2. Data Collection and Analysis

We conducted a total of 20 interviews (16 men, 4 women) along the interview guideline. The participants were the CEOs of various owner-managed German SMEs. For this purpose, the regionally and nationally known companies were contacted. Of 64 contacted companies, 20 allowed us to interview them. This study concerns SMEs, as these organizations are particularly affected by the digital transformation. A start-up, for example, starts with all digital possibilities, and a large organization has the means and the personnel to successfully implement its own digitisation efforts. In contrast, the SMEs surveyed have been in the market for 96 years on average. Due to their special structures, such as the limited number of employees, employee retention in SMEs, and the connection to organization tradition, these companies face a special challenge in the digital transformation. Among them were organizations from the fields of industry, trade, and services. An overview of the respondents is given in Table 17.2.

No.	Age	Gender	Educational background	Sector	Organization age
1	49	M	Mechanical engineering (M. Sc.)	Industry	45
2	48	F	Business administration (M. Sc.)	Industry	25
3	47	M	Master craftsman	Trade / Craft	100
4	58	M	Nurse	Service	13
5	46	M	Business administration (M. Sc.)	Trade / Craft	71
6	51	F	Mathematics (M. Sc.)	Service	275
7	59	M	Retail salesman	Service	13
8	55	M	Engineering (M. Sc.)	Service	30

9	50	F	Certified Pedagogy (M. Sc.)	Service	123
10	41	M	Insurance salesman	Service	18
11	43	M	Business administration (M. Sc.)	Service	7
12	51	M	Business administration (M. Sc.)	Industry	215
13	64	F	Business administration (M. Sc.)	Trade / Craft	97
14	45	M	Industrial engineering (M. Sc.)	Industry	70
15	50	M	Computer Science (M. Sc.)	Service	34
16	37	M	Industrial engineering (M. Sc.)	Industry	29
17	62	M	Metallurgy (M. Sc.)	Industry	102
18	45	M	Business economist (M. Sc.)	Trade / Craft	69
19	68	M	Industrial engineering (M. Sc.)	Industry	560
20	40	M	Business administration (M. Sc.)	Industry	24

Table 17.2 Overview of interviewees

We carried out a two-stage approach. First, we conducted five semi-structured interviews. We took up open questions such as "How do you assess the importance of digital transformation for your organization" or "Is it part of your role as a manager to drive digital transformation forward by yourself?”

We have analyzed the data based on the Grounded Theory approach. First, we started with the Open Coding process (Glaser and Strauss 1967; Strauss and Corbin 1990) by using the MAXQDA software. Two of the researchers implemented the open coding procedure independently from each other. They have read the transcribed interviews and proposed code phrases that represent the content. Subsequently, similar codes were collected from the interviews and defined a common code, the axial coding. In our coding paradigm, the explicit IT competencies of the CEOs and their experience in the IT area could be assigned to the causal conditions, as well as access to internal and external expertise. The strategies and attitudes of the CEOs were assigned to the action strategies, the IT governance characteristics to the consequences. The coding paradigm for the type "weaker structured corporate relationships" is presented below as an example. Subsequently, the axial codes were bundled according to subject areas, which can be found in the results section of the table. Differences of opinion were discussed with a third researcher and settled by agreement.

We ended this process after all researchers agreed that there was a low probability that significant new insights could be generated by additional interviews, since our data at this stage already included important aspects about the digital competencies and governance structures. Finally, it was a matter of identifying similar and different competence profiles and IT-Governance structures in order to summarize them in types. We found that the distribution of competencies within the organization is one of the most important factors in distinguishing between the different governance structures. It was helpful to first deal with outstanding cases. For the findings, we attempted to describe the various sets of IT-Governance structures. In the process of typing the various phenomena, we have identified the types of structuring. Structures and their nature create different relations, connections and relationships, through which the digital transformation in the organization is formed. Especially in small and medium-sized companies, these structures are shaped to a large extent by the CEO and influenced by his or her skills, as he or she assigns corresponding roles and functions and forges alliances. These structures are based on the concept of a horizontal and vertical organisational structure, which is concerned with the distribution of responsibilities and the design of action relationships. Additionally, if they are strongly structured, they are less flexible and adaptable, as they are already top-down, abstract and difficult to accept at the local level. Weak structures are more ad hoc and in the situation. Both times, the aim is to translate the corporate strategy into roles and interests in order to align them together. For the actors, the question is: Who are we and what should we do? If this question can no longer be answered clearly and with consensus, the organization becomes dysfunctional (Jacobides, 2007). The challenge is to keep the structure constant and at the same time flexible.

17.4. Findings

17.4.1. Overview

The interview data shows us that we can group the interviews. First, the continuum of the CEO's explicit IT competence (IT-C). Secondly, the continuum of the CEO's practical IT experience (IT-E). It should also be noted that access to further IT knowledge distinguishes the cases under consideration (IT-K). Based on this data, the selected IT governance structures (IT-GS) were examined and defined in more detail. The following table provides an overview of these; more detailed statements follow below.

CEO		Organization		Explanation / Definition	No.
IT-C	IT-E	IT-K	IT-GS		
Low	No	Internal	Weaker structured corporate relationships	These CEOs do not see their role as a digital actor, but as a driving force in digital transformation. With these impulses, the respective experts have a high degree of personal responsibility. It is therefore essential to avoid hierarchic structures, but rather to create network structures.	*6, 7, 12, 13, 15*
Low	No	External	Learning structures	Especially the smallest companies can be confronted with the problem that neither the CEO nor an employee has a high level of IT knowledge. Here it is necessary to fall back on external knowledge. However, one should use this knowledge to build up one's own knowledge in these areas.	*1, 10, 17*
Medium	No	Internal	Structures of trust between business manager and IT	If the CEO recognizes a value of digital transformation for his organization, but is not an expert himself, it is advisable to build up a strong trust structure to internal experts. The potential changes of digital transformation can be very profound.	*9, 13*
Medium	Yes	Internal / External	Structures of nearness, adaptations and mediators	The CEOs know from their experience how to develop their employees in a targeted way and how to guide them through the digital transformation. Digitization is understood holistically, and digital transformation can lead to changes in the organization. The CEO is more likely to act as a mediator.	*4, 8, 20, 18*
Medium	Yes	No	Strong structures of distance and resistances	The CEOs act as "lone fighters" in the field of digital transformation of SMEs. The companies are characterized by strongly hierarchic structures. The employees are at most involved in operational activities.	*2, 16*
High	Yes	Internal	Everyone must adapt	A field of tension can arise if the CEO and the CIO each have very high IT competencies. Here it is recommended that CEOs can adapt and that the focus is on networked, cooperative structures.	*5, 19*

Table 17.3 Overview of discovered IT competencies and the associated IT-Governance types with characterization

17.4.2. Digital Competencies of CEOs of SMEs

Evaluation of their competitive position. 19 respondents stated that their own organization was at least average in terms of digital transformation in comparison to the competition in their sector. 12 of the respondents said that their rating was even better than the industry average.

Only one respondent said that his organization was currently lagging behind the average of its competitors, but that he was confident that this would change soon due to current efforts.

Low IT competence was particularly noticeable when the respondents used the organization's IT but did not understand the structure and essential background of these systems. The following interview extracts illustrate the lack of detailed knowledge:

> *"I can only give impulses. Stimulating and stimulating the thought, because I am not an IT specialist myself. I also don't want to lay power lines at home." - 7*

> *"[...] I can only use Google, I'm not involved in day-to-day business, no matter if it's a phone line, Microsoft Office or licenses, I'm just not in business..." -16*

High level of IT competence we attributed to participants with detailed knowledge of the programming languages and methods used in software development.

> *"I'm scrum master and product owner myself [...]." - 5*

> *"with Navision which is based on HTML5, the customer service can then complete their order with the iPad at the customer's site." - 15*

However, most executives did not believe that explicit IT competence was important for them. Of the 19 participants who felt well positioned in the digital transformation, only two had explicit IT skills. We concluded that the explicit IT skills of CEOs are not decisive for the success of digital transformation. More important, however, is knowledge of the fundamental interaction between hardware and software.

Most respondents were concerned with interrelationships, dependencies and interfaces between enterprise systems or between software and the Internet. The CEOs were less interested in how the interfaces could be provided technically than in error-free and secure communication.

> *"If the Internet fails, it means standstill." - 12*

> *“Of course, I don't always understand everything technical, but I must have so much experience in linking these things.” - 20*

Experience with IT projects and IT management reflects the manager's practical, local experience at the implementation level. This point is important because many CEOs tend to stay out of implementation issues. Their role in the projects varies greatly. The roles range from controllers and consultants to project CEOs and even employees.

> *"I'm the only one giving ideas, sometimes my brother together with me. We are the ones who often give the impulse. Then I am basically active in project management up to a certain point, but not down to the last detail". - 2*

> *" I am less involved, this is usually done by one of our employees and my son has made himself very strong, especially in working with a start-up organization and the various companies that are still working there. [...] Because alone we are certainly not sufficiently trained and do not have enough knowledge." - 19*

The implicit knowledge also includes the vision that the manager imagines of digital transformation. The CEOs' ambitions differed greatly from one another. Some of them talked about digital transfor-mation processes, while others were talking about the next update of their ERP system.

> *"A vision, a little yes, I'm already worried about the next development, e.g. the ERP system needs a release change, which is now overdue" - 16*

Access to external IT knowledge becomes critical to CEOs' competence preferences. Frequently, this advice is provided by service providers or research institutions, which can affect projects or strategies as well as parts of the organization or the entire organization.

> *"We were advised by a research institute and there were workshops in which we turned ideas into concrete concepts." - 1*

> *"The external consultants advised us so that we talked to them every few weeks and they gave us orientation and help." - 16*

Access to internal IT knowledge is guaranteed by the qualification of the organization's own personnel. This is done through training or autodidactic. Nevertheless, both CEOs and employees are dependent on internal and external impulses. In this context, the willingness for lifelong learning as well as open-mindedness and self-criticism were placed in the foreground by the interviewees.

> *"It is important to take your employees with you as far as possible and offer appropriate training opportunities. My experience is that if you do it well, people are willing to participate." - 8*

> *"Through internal training and external training and to the point that we also work with other companies and exchange with external professionals." - 10*

In addition to these explicit competencies, implicit IT competencies were also surveyed. These are personal experiences and points of contact with the topic of digital transformation that cannot be articulated directly but have an impact on the strategic view of the CEOs.

17.4.3.Supporting IT-Governance Structures

Current IT research expects that IT-competent CEOs are willing to manage IT, enter into a partnership with IT experts and participate in IT projects. In our study, we follow the CEOs and their IT competencies to find out how they define themselves and other actors, how they connect and interact with each other and what scope for action they allow themselves and others in their companies. The first step is to determine which competencies and which distribution of competencies in the organization goes hand in hand with which structures. They take on different roles and construct them for others, connect them with each other and mobilize them. The roles the leader assigns and the connections they try to establish depend on the knowledge and understanding of digital transformation that the CEO has.

Strong Structures of Distance and Resistances: Experience with IT projects, IT management and no access to internal IT knowledge. Structures become visible when there are disturbances. If the objectives of the actors do not coincide with those of the actors in the organization, or if the manager no longer represents the actors, resistance arises. Resistance blocks the executive's goals, making it very difficult for CEOs to realize projects. Two respondents with a lot of project experience and less experience in cooperation and partnership are confronted with such resistance:

> *“This stupid planning machine my locksmiths get to run in a week, but this new IT process has given us sleepless nights. So, it was really exhausting. It is resistance, excessive demands, a very important topic. The employees often feel extremely overwhelmed.” - 2*

> *“I'm worried about the jump. Our ERP needs a release change that is overdue. [...]It took an extremely long time until we were ready, and if we now do a complete release update again, it costs money and time again and the employees are confused. [...] The older the people are, the more difficult it becomes.” - 16*

What structure have these two respondents established? Both managing partners have structured their companies into departments as a structure of distance, some of which are staffed by siblings. All IT decisions are made by the CEOs themselves and they have a lot of room to maneuver.

> *"I decide. Both in the selection of the software and in the planning of the processes within the IT changeover, because I have an overview. This is the part that I also cover in our organization, to say I know how the processes run, I know the different IT systems in the organization and can decide best which process has an effect at which point." - 2*

A medium understanding of IT is enough for them to make IT-related decisions. It is important for them to have an overview of the processes in the organization. By controlling IT projects, these CEOs have an overview of IT implementation processes. They have an overview about the level of implementation and the internal processes and believe that they no longer must worry about local perspectives. In the perception of the CEOs, nobody else in the organization understands IT apart from them. Like many of our respondents who experience an IT competence vacuum, executives do not trust IT staff:

> *"In retrospect, it wouldn't have been wrong for an internal employee who understood the entire system to support me. [...] I don't regret anything, but it would have been good if someone with IT expertise had been there." - 16*

> *"And one of the biggest problems is that IT serves the process. This means that the IT staff is often overwhelmed with a complete overview of the organization and does not understand at all which processes need to be tackled and how. [...] And that's a big problem." - 2*

Employee development is reduced to the bare minimum. IT contact persons are the executives them-selves. There are hardly any regular meetings in groups or arrangements. This reduces participation. There are neither structures that help to transfer the strategic understanding of the manager to the em-ployees, nor structures that integrate the local perspective of the employees into strategic considerations. Overall, these CEOs do not have access to external and internal sources of knowledge, which can impair the organization's ability to innovate and act in the long term. The CEOs in this group are relatively young, as is their organization.

Structures of Nearness, Adaptations and Mediators: Experience with IT projects, IT management and access to internal IT knowledge. There are also participants who go a different way with a lot of project experience, but more experience in cooperation and partnership.

> *"Many think "I'm introducing a new technique" and change the organization and then it fails, but it wasn't the technique. There are a lot of examples and projects of companies, also big known companies, that did something like that and failed, because nobody was willing to tackle the organization." - 8*

In order to avoid resistance, it is important to create structures that involve employees and assign new roles to CEOs and employees.

> *"It is important to take existing employees with you as far as possible and to offer appropriate training opportunities. My experience is it works, if you do it well." - 8*
>
> *"I'm trying to get people to stand behind it and support it." - 20*

From this perspective, CEOs with project experience should exemplify new processes and working methods, collaborate and create closeness. In short, the manager must be one of them in small teams:

> *"We have no heights or distances here, otherwise we would not be successful. […] We have to be really open and close and do living by example, so we have to really show the others how to do it and set an example, otherwise you won't be successful." - 8*

The strong hierarchy structure of the organization is similar, but there is a structural change that can undermine this structure. A possible solution, if the manager does not want to interact with the employees themselves, is to give some employees the role of a "mediator". In this case they are called "key users". They are characterized by a high ability to communicate. The key users are the contact persons for the employees so that they have an overview of the processes and interfaces in the organization. They meet each month for a key user meeting where projects and problems are discussed and prioritized together.

In companies that do not have an internal IT expert, the management works more closely with the mediators. The manager needs external expertise. In this case it is IT specialists and project CEOs as free-lancers. However, internal competencies are also being built up. The mediators are called influencers. They are supposed to teach employees how to enjoy IT and to convince them. The influencers are the extended arm of the managing director, who also sees himself as a motivator. Since the IT expertise is not available internally, the managing director sees his main talent in developing his employees:

> *"You have to imagine it this way, we don't have any professionals now, we have a freelancer who supports us a little bit, but my ability is that I can develop people quite well. […] I chose this colleague because he was interested and wanted to continue his education." - 20*

Employees who are responsible for IT but do not have the expertise act as translators or as interfaces to external parties. They have a basic understanding of IT and good communication skills. In addition, every training course is made possible.

There are also cases where the management alone acts as mediator. These executives attribute them-selves little IT professional competence, but a high social competence.

> *"My competence lies more in introducing a program that we can pass on to our colleagues with enthusiasm and not as a burden or something. Above all, to take away the fear of it. I have the highest social competence that we have, so I have also developed the blind version, that calms down tremendously. Art is leadership in the truest sense of the word." - 4*

Internally, there is no one with IT expertise. In decision-making processes, the management relies on the recommendations of the external IT specialist. Individual mediators are often used when the organization is decentralized, but a connection to the office still must be established. They are therefore ex-ternal mediators. These companies have either different locations or a branched organization. This would explain why these CEOs have mediators who represent them and increase their sphere of influence. The challenge of taking everyone along in the event of spatial or organisational separation is more pronounced here.

Everyone has to adapt. Connecting, Cooperative Structures: High level of IT competence and experience with IT projects and IT management. Another way to undermine strong hierarchies is to create a whole area as a mediator and translator for digital transformation. CEOs are made just as competent as employees and the structure for cooperation is transformed. Heads of department and employees all work together in an interdisciplinary manner, understand each other, trust each other and think holistically. Digital transformation staff also implement a guide concept in which employees act as multipliers. CEOs of these areas are often Chief Transformation Officers or Chief Digital Officers, equipped with a lot of IT expertise, but also with IT project experience. They coordinate cooperation, remove barriers, give impetus and implement participative forms of communication.

> *"We have introduced a social corporate network with the aim of connecting employees and creating the conditions for cooperation." - 5*

They introduce formats such as digital fitness programs, leadership programs, explanatory films, a digital transformation day, or a digital breakfast. They also integrate external experts so that everyone can learn something about digital transformation, regardless of their position. The CEOs here all have contact with public institutions or are one themselves. This could be the result of a tendency to anchor ideas in organizations rather than individuals.

Structures of Trust: A close relationship between business manager and IT. If the IT expert has a close relationship to the business manager and is also part of the management, a strong trust relationship develops. Then the alignment between business and IT is high:

> *"What is also important for me, because it is my son, i have more than a hundred percent trust. [...] I realize that it's not the case in many companies and that they are not so well positioned with IT decision-makers. I think we are very well positioned in this respect." - 13*

Here, decisions can be made centrally without leaving employees behind, because IT decision makers are in active contact with employees and CEOs have the opportunity to reflect on each other. Many top-down controlled companies with little internal competence want such a relationship of trust, which they cannot build up with IT professionals. It is striking that such relationships of trust lead to stronger co-operation with external partners. In this group the IT experts are all part of the family.

Weaker Structured Corporate Relationships: A high density of internal IT experts. Executives who work in an organization with a high density of IT experts or an IT staff unit have a clear under-standing of leadership:

> *"I think that's the leadership understanding we have today. Leading where the boss has all the ideas and knows all the designs and the customers and knows everyone, the times are over, so these one-man shows. Instead, today we lead transformational, we rely very strongly on the individual strengths of our colleagues and that is how I understand myself." - 15*

Decisions are increasingly made by the IT experts themselves, while CEOs accompany this process.

> *"IT has a duty to provide impetus" - 14*
>
> *"For this, people have the confidence and sit accordingly on the project and then they have to be able to decide." - 15*

The IT experts have a lot of room to maneuver and are on the move throughout the entire organization. In contrast to other companies, it is the task of the IT experts to coordinate their work with the specialist departments. Business CEOs ask questions, help shape goals, set requirements, translate ideas, ensure transparency and mediate between business units. IT as a topic of understanding becomes central, since here interdisciplinary cooperation is required. The hierarchies here are rather flat, but great importance is attached to creating living project and networking structures. If the hierarchies are too strong, digital transformation will be established as a synergetic working topic or interdisciplinary working group. The CEOs here have a stronger business focus than in other groups.

Learning Structures: Access to external IT knowledge. At the end of the day, those CEOs are left who do not bring any special skills with them - both personally and internally. Yet they do have a special competence. They are very open-minded and learn constantly. That is why they get external help not only with implementation issues, but also with strategy issues.

> *"We also received this confirmation because we were given a hand in the introduction of digital transformation by a research institute. They accompanied us through the process and said that we have made a good progress in the meantime because we have also implemented a great deal together with them." - 1*

This gives the business CEOs self-confidence and structure, which are things that they can transfer to their employees. They also give their employees responsibility, as they have learned from external consultants, even if they often remain the decision-makers. Here, too, comparatively young CEOs can be found in young companies.

17.5. Discussion

If we now look at the relations between the different types of structuring, some exciting relationships emerge. First of all, three superordinate structuring levels seem to emerge. On the weakly structured level there are "learning structures" and "weaker structured cooperative relationships". On the level of nearness are "structures of nearness, adaptations and mediators" and "structures of trust between business managers and IT". Strongly structured, on the other hand, are "everyone must adapt" and "strong structures of distance & resistances". The weak structures tend to be formed by CEOs who have neither explicit IT knowledge nor IT experience. At the near level, explicit IT knowledge is increasingly found, while IT experience predominates in strongly structured companies. In strongly structured companies, it is more common for both competencies to fall on the CEO. It is interesting to note, however, that at this level both the companies with the highest degree of digital transformation and the companies with the most deficits can be found. What could be the reason for this? Firstly, these two types differ in their excellence - these companies have the highest level of competence in both areas (everyone must adapt) and are so far advanced in their digital transformation. But there is another important point: the companies with the greatest challenges combine both competencies in their CEOs, but have neither internal nor external experts. In all types, the lack of internal experts tends to lead to CEOs deciding everything themselves, probably also because they feel they have to (also in the "learning structures" type). The companies that are furthest along have many internal experts - these companies are strongly geared towards cooperation and participation - all of them participate (as with the "weaker structured cooperative relationships" type). This prevents employees from blocking projects, as everyone works together and makes decisions. Due to the high density of experts, only a few really need to be convinced. If this is the case, however, closeness structures are better suited for this purpose, because even the highly structured "high performers" are not willing to do the work of persuasion - everyone must adapt. This is where structure makes the difference. The "structures of nearness" type of organization has a similar skill set to "strong structures of distance and resistances", but in addition to internal and external expertise it has a very different mindset. These companies work with mediators such as influencers, key users and the like. It is important to the CEOs in this group that employees enjoy digitalization, are enthusiastic and share a common vision. The CEOs act as role models and work very closely with their employees, taking them by the hand. So, despite having a common set of skills, these two groups are very different from each other. In this group, the enthusiasm and eagerness to experiment seems to have something to do with external expertise, because the "learning structures" group also likes to try out new things. Overall, it is noticeable that CEOs with a lot of IT experience and medium explicit knowledge often have a need to take employees by the hand. With these groups, one has the feeling that they are on the way to the next level. Either they manage to move many employees ("structures of nearness, adaptations and mediators"), or they look for a close confidant (applies to "strong structures of distance and resistances"). For the latter, this would probably be a first step, because companies that do not have internal experts have less confidence in experts. Internal expertise is widespread and appears to be an important building block in the transformation process. Overall, however, it can be said that only the group "strong structures of distance and resistances" does not see itself as far along the road to digital transformation.

There is often a hierarchy of skills - first the explicit knowledge to be able to communicate, then experience. The former will help to carry out management tasks and provide impulses, the second will complete the transformation. It is important not to do and decide everything yourself, otherwise you will lose contact with the organization and the employees. Not having any IT skills as a CEO can work if CEOs remain flexible and adaptable and gain strength from this ("learning structures", "weaker structured cooperative relationships").

17.5.1.Implications for Theory

This study contributes to literature with three implications for theory: First, the study provides further insights into what “good” IT-Governance structures are and which factors influence the suitability of IT-Governance. In this case, good IT-Governance is dependent on the digital competencies of the CEO. For instance, “mediators” with high digital competence between the CEO and their employees are a tool to pass on and implement the decisions made by the CEO or, in turn, to compensate for missing digital competencies of the CEO. The centralization-decentralization continuum of IT-Governance (Peterson, 2004) can be adjusted according to the competencies and self-image of the CEO. Secondly, the concept of IT competence of business CEOs was placed in the context of CEOs of SMEs (Bassellier et al., 2001). The concept has been supplemented by the identification of digital competencies which are needed by CEOs of SMEs to successfully transform their companies. We found that, for instance, the most CEOs have little knowledge of technical details but rather require general knowledge about the software and hardware used in their organization. Third, we identified factors of “good leadership” in the digital age. Our study confirms other studies, who identified social capital as essential for successful IT- Governance. The interviewees especially mentioned transformational leadership as their model in the digital age (Schlosser et al.,2015; Wagner et al.,2014; Goh et al.,2012).

17.5.2.Implications for Practice

Based on our findings, we can derive implications for practice. Firstly, it should be noted that the technological knowledge or IT competence of a CEO is not necessarily decisive for the success of a organization's digitisation. It is much more important to create a basis of trust for dealing with other key players. No internal or external expert knowledge is useful if the CEO does not trust this knowledge. Overall, trust played a major role in the surveys and there was often little trust from external experts when they were outside the university environment. This makes it more important to build internal competencies among employees in order to align digital transformation with the interests of the CEO and the business. In any case, however, it is important to use other sources of knowledge in order to trans-form oneself and the organization and to organize the transformation through the development of employees. The IT competence profiles developed in the findings can help CEOs to classify themselves and their competencies and to assess the consequences. Finally, we were able to identify functioning IT-Governance structures based on the CEO's competence profiles. This enables CEOs of SMEs to use identified best practices and transfer them to their organization.

17.6. Limitations and Future Work

This qualitative study is based on a total of 20 interviews and was conducted in Germany. Like every other empirical study, this study shows typical limitations of qualitative research (e.g. weak internal validation). Apart from those, it is important to acknowledge further limitations: The composition of the sample of 4 women to 16 men corresponds to the gender distribution in relation to management positions in the German economy. It has several limitations, motivating further research. Our approach uses a qualitative method to connect the identified competencies with the existing IT-Governance structures. It is difficult to discern which phenomena have caused other phenomena. For example, some governance structures may also have an impact on the distribution of competencies. In such cases, it may be helpful to examine interdependence by means of a qualitative analysis. Qualitative studies are also able to address a wider population and provide more generalizable insights. Additionally, it may be assumed that external factors such as organization size, sector, competition, or financial resources as well as personal factors such as character or interests play a significant role for IT-Governance in SMEs. These factors have been ignored, since the focus lied on the connection between IT-

Governance and the CEO's digital competence. Taking further factors into account could broaden the perspective on IT-Governance in SMEs. In addition, cultural aspects have been neglected.

Hence, this study offers potential for further research. It can be used to contribute to a more general theory on suitable IT-Governance measures for SMEs. This would open the opportunity to add external or personal factors to the analysis. Such a theory could then be tested by a quantitative approach. Furthermore, the study could be conducted in other cultures to get broader insights into the topic.

17.7. Acknowledgements

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18. Truth or Dare?

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Table 18.1 Fact Sheet Publication

Truth or Dare? – How can we Influence the Adoption of Artificial Intelligence in Municipalities?

Abstract. Artificial intelligence (AI) is becoming an increasingly important factor of everyday life. The progress of AI adoption continues to accelerate with increasing investments in AI techniques and applications worldwide. However, the use of AI is still not present in employee's daily life of German municipalities. Since this technology has a promising potential that German municipalities can also take advantage of, it is important to facilitate the transition of municipalities to AI. For this reason, we have conducted semi-structured expert interviews in twelve German municipalities to examine perceived challenges of AI adoption from employee's perspective. Using methods from Grounded Theory and Gioia we extended research regarding the Technology-Organization-Environment (TOE) framework. Our results proof six and identified four additional perceived challenges of AI adoption in municipalities. With these results, we are able to extend literature on the use of AI in the public sector introducing perceived challenges of AI adoption from employee's perspective in municipalities extending the TOE-framework.

18.1. Introduction

Artificial intelligence (AI) is a young technology at the beginning of its development, but already of increasing attention [8]. In an AI study by Accenture, 86% of 300 public sector leaders want to "increase or significantly increase" spending on AI for 2020 [1]. 90% of the participants in the study expect medium to high return on their investment. Therefore, AI has the potential to double annual economic growth rates by 2035 [1, 8].

The first discussion on computer-based AI is often attributed in the literature to the mathematician Alan Turing, who is regarded as fundamental to computer science, among others [8]. He described in 1950 "The Imitation Game", commonly known as the Turing Test, which is intended to test the communication capability of a machine [8]. Shortly thereafter, at a conference in Dartmouth in 1956, Stanford professor and founder of the field of AI John McCarthy gave a first characteristic term for AI [3, 15, 28]. Today we have reached a point, where the innovation of AI, among other digital trends, is increasing exponential [10, 37]. An example for the progress of AI is the victory of an AI system over the world champion Lee Sedol in the GO board game in 2016. The Alpha GO AI system from Google's DeepMind, had previously learned by playing the game "against itself repeatedly, learning from its mistakes and developing novel strategies" and therefore needed no more human instructions [19].

However, the use of AI is not limited to complex board games anymore. Private companies are starting more and more to exploit the advantages and applications of AI. For example, organizations like Google and Microsoft, among others, have bought up more than 140 AI companies since 2011 [28]. The interest of private companies is growing, as is the investment in AI technologies, especially in machine learning techniques, whose progress has contributed to the wide application and usage of AI [8, 11].

Furthermore, these private companies support a diversified use of AI applications in everyday life, society, and to the change of the processes in the industrial sector. In everyday life, the average person uses AI more often than one might think. From intelligent search engines and navigation systems from Google to digital assistants like Amazon's Alexa or social media services from Facebook. Social applications of AI include the use of intelligent security systems and surveillance services of public institutions, or medical diagnostics provided by AI based software. Within companies, AI is used in processes ranging from predictive maintenance and supporting intelligent robots in the industry, to the application process of new employees solved by AI and the distribution of smart, AI-related products by the manufacturers [25, 30] influencing technological, organizational, and environmental outcomes.

Despite these advances in the private sector and the applications created and used by the general public, the public sector itself has only recently begun to implement AI [34]. In order to understand this discrepancy in usage, we analyzed existing literature on the public sector and administration that are using AI. In the process of our study, we realized that the majority of research articles found, dealt with either challenges, opportunities, impact, or potential of AI in the public sector from organizational point of view [34]. For example, we found a Norwegian study on opportunities and challenges for Norwegian municipalities, which aimed to investigate to which extent municipalities have implemented AI and are using the potentials of this technology [26]. However, research lacks a similar study on German municipalities. Previous studies should be adapted to German municipalities, because they differ from other European countries due to their hierarchical structures in the system (e.g., district vs. regional municipalities) and the governmental pressure they are exposed to (e.g., eGovernment development, general attitude towards technology or digital services adoption), which may limit the adoption and use of AI. As research regarding AI adoption from an employee’s perspective, especially in Germany, is still sparse, we seek to fill this gap by identifying perceived challenges for adoption of AI from employee’s perspective.

Conducting ten interviews with Chief Digital Officers (CDO) in German municipalities provided insights into the reasons why there is still a lack of successful use of AI in German municipalities. For future research, we will conduct a quantitative research study based on this study, in which also civil servants without IT background such as managers, end users or politicians will be interviewed about the use of AI in public administration services.

This paper is structured as follows: Firstly, we describe the background of this study demonstrating the need to identify perceived challenges for the adoption of AI in the public sector. In section 3, we describe our methodology. In section 4, we show the findings of our study and in section 5, we provide our model of perceived challenges for the adoption of AI in municipalities. We conclude by discussing our findings and our model and by showing limitations of our study, proposing ideas for future research.

18.2. Theoretical Background

AI is becoming more and more important in theory and practice and promises to change the world within the next decade [4]. Yet, AI is not an exactly defined term [15], but rather a collective term for various applications and technologies [21]. However, AI, as described in theory, has existed since the 1950s but changed over time [3]. It was first introduced at a conference in Dartmouth in 1956 with the words of McCarthy as the "science and engineering of making intelligent machines, especially intelligent computer programs" [3]. In addition, Valle-Cruz et al. defines AI as computational intelligence, meaning that intelligent machines have "the capacity to learn, rationalize, and process certain instructions to be followed or to perform an action" [37]. Aligning to previous research and the development of the term of AI during the past 70 years, we use the following definition of AI "AI refers to systems that are able to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation", aligned to Kaplan (2019) [22].

However, with new technologies arising, one has to adapt their behavior to new possibilities of usage. Sometimes this causes perceived challenges for IT adoption from a user's perspective. The adoption of technology is described as the "choice to acquire and use a new invention or innovation" and diffusion as "the process by which something new spreads throughout a population" [17]. Taking the fact into account that organizational, cultural, and legal issues need time to change, this process of diffusion and adoption can take years. In theory, there are already many models for the adoption of IT innovations. Models used for organizational level analysis are e.g. the Diffusion of Innovation Theory [31] and the Technology-Organization-Environment (TOE) framework [18].

The adoption of technology is multidimensional, with many factors that need consideration. As an example, the TOE-framework can be used as a commonly used theoretical framework to examine different aspects of IT deployment in organizations [29]. In addition, research on the adoption of innovative technologies (e.g. Big Data) in organizations with the TOE-framework has already proven useful [2], for example in similar digital trends such as cloud computing and business intelligence systems [29, 40].

In the TOE-framework the technological, organizational, and environmental dimensions are considered [18, 31]. The technological context describes all relevant technologies to an organization, which are available outside as well as inside a company. According to this, even innovations and technologies, which are not used internally are influential in the technological dimension, as they can reveal new possibilities for an organization. The organizational context refers to the characteristics and resources of the institution, such as internal structures and processes, size of the organization, and unused, free resources. The environmental context includes external influences from the environment, e.g. pressure or competition from industry or regulatory frameworks. [29]

In conclusion, existing empirical research on AI adoption in the public sector is still sparse. Present studies on AI adoption have so far only been focused on the organizational level in the private sector. But since more and more public managers are becoming inclined to use AI applications in the public sector the need for studies on AI adoption in the public sector from an employee's perspective increases [25, 26, 34]. Focusing on the private sector, a study regarding factors which influence the adoption of AI from an employee's perspective in organizations [4] and a study investigating organizational AI-readiness [2] as well as organizational readiness factors related to AI exist in recent literature [29]. However, emphasizing the difference between the private and public sector (e.g. motivation of employees, non-profit-making intent, different work time models, more intrinsic motivation goals, and the diverse spectrum of values) we recognize a need for studies analyzing perceived challenges for adoption of AI in municipalities from the employees perspective [25, 26, 29]. Based on this, we finally derive our research question (RQ).

RQ: Which perceived challenges face employees regarding the adoption of AI in German municipalities?

18.3. Method

Method Selection. In our study we used an explorative approach to gain suitable insights into perceived challenges for adoption of AI in public administrations of municipalities from employees perspective [12, 29]. Since qualitative research offers more opportunities to observe the phenomena under study more closely, and since more recent research calls for the use of more qualitative and mixed methodological approaches to study the perceived challenges to the adoption of AI by community employees, this research takes an explorative qualitative approach. To support our explorative approach, we have decided to use tools from Grounded Theory [13, 14].

Data Collection. Within ten digital interviews (about 45 minutes in average) we have surveyed eleven municipalities in Germany as well as the district administration of these municipalities itself. There were ten interviews, since one interviewer represented three municipalities. The district administration describes the next higher level of municipalities in which smaller municipalities are organized in Germany. For example, one task of the district administration is to support its municipalities regarding the infrastructure of hospitals and Smart Mobility. The district is also managing combined digital transformation projects of municipalities, regarding the use of joint systems. The interviewed municipalities together with their district are involved in a regional digital transformation strategy and work with the same external (and regional) service provider. Both the size and the number of inhabitants differ within these municipalities (see Table 18.2).

The interviewees have different professions and hierarchies within their municipalities. This distribution across hierarchical levels was coincidental, but together with the different number of years in profession and professional experience, it can be ensure that personal and "elite" bias are avoided and different perspectives are considered [27, 29]. These eleven interviewees represent their municipalities and are the respective digitization experts of these municipalities and thus key informants [29, 33].

Job titles	CDO, IT administrator or project manager (specialized on digitization topics)
Hierarchy levels	IT management, human resources & organizational management, CDO

Population by categories	0 – 15.000:	5 municipalities
	15.001 – 30.000:	4 municipalities
	30.001 – 45.000:	1 municipality
	>100.000:	1 city
	>250.000:	1 district
Interview structure	1. Interviewee introduction; 2. AI in general; 3. Implementation; 4. Challenges; 5. Potential; 6. Strategy; 7. AI & Citizen	

Table 18.2 Interview Information

For the interviews we used a semi-structured guideline with open questions to allow the participants to speak freely and to get a wider range of answers [29]. Due to the rare use of AI in the municipalities, the interviewees required time to prepare the interview topic, so the questionnaire was sent to the interviewees in advance and the interview was conducted with it. Thus, we followed the guiding principles for a qualitative research according to Sarker et al. [33] and avoided pitfalls of semi-structured qualitative interviews [29, 33]. With twelve interviewed municipalities or district we are on a par with other qualitative researches that have dealt with the topic of adoption of similar technologies [29].

During the interviews we made notes on what could be improved in the questionnaire and the way of interviewing in order to get optimal results and information from further interviews. After the first interview, the questionnaire was slightly optimized by adding a few more questions.

The questionnaire is divided into seven categories. We started with the introduction of the interviewee and general questions about the definition of AI. Afterwards we asked questions related to a possible AI implementation process in municipalities, for example: “What are the requirements to implement AI?”. Furthermore, we identified potentials and threats with questions such as “Where do you see threats and potentials for AI in your municipality?”. Finally, we went into asking strategic questions proposing potential use of AI, such as “What are action recommendations to deal with challenges and exploit potentials of AI in municipalities?”. We concluded the interview with an outlook which included the citizen perspective and the impact AI usage in the municipality has on them.

Data Analysis. The recorded interviews were transcribed with the software f4transkript and the transcripts then were analyzed with MAXQDA. In order to analyze the interviews we used coding methods (e.g. open coding, axial coding and selective coding) from Grounded Theory and started to analyze the data using open coding [9, 13, 14], meaning that we searched for perceived challenges of AI adoption line by line. In this phase we aligned to Gioia and proposed 1st-order concepts reflecting the perceived challenges. Within our team we have carried out this process of open coding independently from each other to achieve a wide range of results. After this step, related codes and 1st-order concepts were categorized and grouped as a 2nd-order themes (axial coding) to harmonize themes helping us to specify and label perceived challenges [9, 13]. This method can be illustrated by the following statement of an interviewee:

> *"We have a very ambitious IT specialist for three or four years now, who I think has already made a lot of progress here. In terms of the personnel resources with regard to the strategy in a competence team, I honestly don't really see the use of AI yet, because, in my opinion, we are all so busy with our work that there are no human resources to deal with AI." -M9*

Two independent 1st-order concepts ("Recruiting AI specialists for competence teams" and "Employee training and knowledge transfer") were identified. Based on these concepts, the 2nd-order theme ("competencies & capacities") was identified as theme and terminology. In a last step, we concluded our analysis by linking our results to existing literature further elaborating our 2nd-order themes into theoretical "aggregate dimensions" (selective coding, Grounded Theory approach) [9, 13]. In our example, the aggregate dimension was called "perceived technical competences" (see Figure 18.1). Interpretational differences along the researchers were discussed intensively to find a solution that is in the interest of all researchers. We finished our analysis when the point of saturation was achieved, e.g., when no further aggregate dimensions emerged.

18.4. Findings

Perceived direct benefits. In the interviews, we have repeatedly noticed that perceived direct benefits of the AI technology are conducive to the promotion of AI adoption in municipalities. The potential of AI is increasingly perceived as the automatization of processes and as an assistance system for the administration. Economic advantages can be generated through savings, and new and more creative solutions.

Self-learning assistance systems, which are constantly evolving and optimizing themselves and which streamline and automate processes, can relieve employees. The assistance systems can better structure and prepare the data volumes that will be generated in the future and thus relieve the administrative employee. In this way, the focus of the employees can be shifted to the core processes of the administration and the administrative staff can spend more time to better respond to the individual needs of their citizen. One such assistance system could, for example, be a chatbot that accepts citizens' queries and thus offers advantages such as 24-hour service and faster, consistent processing quality. One of our interviewed municipalities explains the function of such a system:

> *"Further I see there is also the aspect of the assistance systems. In other words, that these are systems that solve problems efficiently on their own and learn from error situations […]." -M6*

The savings potential is economically in cost savings (personnel costs, resources). For example, over time, an AI system can be more cost effective compared to an employee leading to resource savings through process automation. Illustrated by one municipality:

> *"If you talk about automation and processes […] and then maybe go one step further, I think you naturally come to saving resources" -M3*

The independent AI systems can also generate new, creative, and cross-dimensional solution approaches, that, for example consider and further develop aspects of sustainability. Emerging and already highly developed AI techniques such as translation services, image, face, text, speech, and pattern recognition could be a solution to a smart administration. These techniques would allow the stronger connection and involvement of the citizens in the activities of the municipality and the inclusion of people with disabilities in their daily life. The latter is explained in more detail in the following:

> *"I do believe that digital transformation as a whole and through AI will have a great impact. […] So, when I think of people with disabilities, for example with speech recognition and systems that react (correctly) to voice input, it can certainly achieve improvement […]." -M1*

The dimension of "perceived direct benefits" can be found in the existing literature by Kuan & Chau [23]. For example, in their study on the adoption of electronic data interchange (EDI) in small businesses, they presented a perception-based model in which perceived direct benefits play an important role in the TOE-frameworks they apply. In our study we define perceived benefits [23] as the benefits that are perceived rather than the benefits that are actually delivered or enabled by technology. The term “direct” relies to operational advantages. Therefore, perceived direct benefits lead to an increase in performance of daily internal processes of an organization. “Relative advantage” [23], which was used by Rogers [31] (adoption of innovations) and by Iacavou et al. [20] (adoption of technology), is described as an important factor for technology adoption [23].

Perceived indirect benefits. The interviews revealed that project orientated measures as well as communication and cooperation with other municipalities result in strategic and indirect benefits and lead to a promotion of adoption of AI in municipalities.

Project orientation means the participation on overarching projects, which are operated by an external service provider. In addition, the municipalities should start with best practices and small pilot projects of AI, because their impact is known and these projects have been successfully implemented before. Furthermore, digital transformation projects should generally be more encouraged, as these will ultimately contribute to the promotion of AI in municipalities. One example of a municipality shows such a commitment to an overarching project:

> *“Then there is the regional project of autonomous driving in the field of mobility, where we are virtually involved, e.g., autonomous driving.” -M3*

Another municipality has a similar approach:

> *“Maybe you should start small with pilot projects […] to see what the reactions are like, how is the user behavior […], and what kind of feedback is there.” -M4*

To further promote the use of AI in one's own municipality, communication is a beneficial factor. There should be a strong exchange with other municipalities and existing institutions regarding regional joint projects and potentials of AI. In this context, cooperation should be initiated with other municipalities to utilize shared potentials (e.g., in the tourism sector). Communication and cooperation ensure that the topic of AI is addressed and increases the chances of implementing this technology at a later point in time. A joint project collaboration between the municipalities that exists in the field of tourism looks like this:

> *“There is a […] Project [and] the topic [is] the evaluation of visitor flows [...] especially tourism […]. We will use AI technologies for person recognition and maybe*

face recognition [...]. This is an association of five municipalities here in our region." -M1

In the literature [23] referred to as "perceived indirect benefits" in their perception-based model. The terminology "perceived benefits" are the "perceived benefits rather than benefits that are actually provided" [20, 23] by the technology. The term "indirect" derives from the fact that the benefits are strategic, e.g., they are caused by external relationships with business partners or competitors.

Compatibility. In our interviews the municipalities stated that the technical compatibility of their IT systems with the new AI technology is of great importance and has a decisive influence. A technological foundation, namely a modern IT infrastructure, is a prerequisite for AI technology and digitization itself. Therefore, the existing processes in the administration have to be digital transformed and re-engineered as well as outdated systems have to be prepared for the new AI systems. The old technical systems of the municipality have to change to a modern, multi-dimensional compatible software. In order to achieve this, the municipality can cooperate with other municipalities as above mentioned or with the involvement of a third-party provider. For example, one municipality sees its IT infrastructure as a major problem to AI adoption:

"This is simply because we are still sick of the fact that we are still using outdated IT systems. That we are also still using old software, which cannot provide any interfaces [to AI]". -M10

The term compatibility in connection with the adoption of technologies is frequently used in the literature and describes "the degree to which an innovation matches the actual needs of the potential user organization" [18, 29]. Many studies referred to it as e.g. diffusion of innovation [31], adoption of customer-based interorganizational systems [16], or exploring organizational readiness factors for AI [29]. So this is the first aggregated dimension added to the TOE-framework, according to Salleh and Janczewski [32].

Perceived technical competences. The interviews repeatedly pointed out the importance of human resources in relation to technical competences. Technical competencies and the staff capacity within the administration are perceived as necessary and conducive for the implementation of AI projects.

Know-how is a basic precondition for leveraging the potential of AI. It is therefore beneficial to educate employees through knowledge transfers or training courses. Apart from trained staff the employment of AI-specialists could lead to proper and beneficial AI applications and solutions development for the respective municipality. In competence teams' holistic concepts could be elaborated and executed in an expert office. Further, human capacities are needed to deal with the subject of AI alongside with the daily administrative work of the municipality. One municipality reflects this:

> *"First of all, know-how must be built up here. Without know-how I cannot successfully implement anything myself." -M1*

The perception-based model [23] directly refers to the "perceived technical competences". In their studies they use this dimension because organizational resources and therefore technological competences are crucial to enable the implementation of the advantages a technology offers. Since [23] the use of a perception-based model, also distinguishes in this context that the perceived competencies are of importance. In their literature review on IT adoption, Zhu and Kraemer [40] also found that "technological competence" has been used extensively in previous studies.

Perceived financial cost. Further, the financial aspects of the adoption of AI must be considered. Therefore, the perceived financial costs are an influencing factor.

The CDO´s pointed out that the promotion of AI deployment is particularly dependent on the financial resources required for implementation and utilization. The costs must therefore be taken into account. But besides the costs which arise for the implementation, AI also offers the potential of financial advantage over time because AI can excel in efficiency and automation compared to personal resources, especially in routine processes. This is expressed in the following:

> *"Once implemented the AI certainly does not cost as much money as the daily employee. [...] On the economic side, there is a high savings potential." -M10*

The perceived financial costs are reflected in the perception-based model of [23] as well. Taking an employee's perspective shows that since costs can be perceived differently, we used the termination of perceived costs. This is due to the fact that what is perceived as high financial costs for one person may be low for another [20, 23]. Furthermore [40] refer to financial resources in their studies meaning the financial commitment of an organization.

Strategic alignment. Another aggregated dimension identified in the interviews is strategic alignment according to Avision et al. [5] Thoughtful planning of AI adoption creates an increased likelihood of enabling this strategy and therefore the AI technology. In this strategic process, the creation of transparency about the AI processes must be considered as well as the formation of acceptance for AI. Additionally, the municipality should be orientated on existing strategic documents in the process of the strategic planning. Transparency in this context refers to the fact that methods, as well as a framework is provided beforehand by the municipalities to guarantee the explainability and control of self-learning systems over time, leading to the promotion of AI adoption. One explanation of this is provided by:

> *"The algorithms change by themselves so much that the original developers who created them no longer understand them themselves. I think that you also have to develop methods, technical methods, that create this transparency." -M1*

Another point is the importance of transparency within the process of strategic alignment as well as the need of a shared common understanding and definition of AI inside a municipality is highlighted by M3:

> *"Then transparency is also a success factor that you have to create in the process. What goals do we want to achieve and how do we want to achieve them and what is AI and what can it achieve by itself […]." -M3*

In addition to transparency there also needs to be acceptance for AI solutions and applications. Acceptance can be created by identifying stakeholder at an early stage of the project planning who take responsibility and commitment for the transition to AI applications. As the service is ultimately intended for citizens, they should not be neglected in this process and therefore opportunities for citizen participation should be offered in the project planning to improve acceptance. Moreover, the sovereignty of humans over the AI systems as well as a low error rate of the systems and their reliability should always be assured. E.g., M4 explains in the following quotation the necessity of creating acceptance:

> *"But what I think is important in order to make any progress at all in this topic is to create acceptance: On the one hand, on the administrative side […]. And on the other hand, of course, on the side of the citizens, the customers […]." -M4*

Another point that leads to the facilitation of AI in the municipalities is the existence of strategic documents. These documents can be a status-quo report on the current use and identified added value of AI for the municipality or the inclusion of recommendations for action that consider how municipalities should deal with AI. The strategic alignment process can be based on higher-level strategic documents of the federal and state governments. Moreover, AI can be used as a tool to achieve objects of existing strategies. For example, the need of the existence of strategic documents is confirmed by one municipality in the following statement:

> *"First of all, I believe that what is missing is that there are no recommendations for action [for AI in municipalities]" - M7*

There are studies in the literature that refer to strategic alignment [18]. For example, Grover [16] used the term strategic alignment in his study on the adoption of customer-based interorganizational system, referring to it as "the extent of strategic IS planning" and emphasizing the importance of linking the organizational strategy with the IS strategy. Thong [35], in his studies about IS implementation in small businesses, also points out the importance of planning, meaning that the higher the effort of planning, the more successful the implementation.

Organizational innovativeness. From the interviews we can derive that open-mindedness and organizational innovativeness towards AI as well as digital transformation is another key factor to adopt AI. Organizational innovativeness is characterized by the fact that employees are motivated to embrace new innovations within their organization.

The individual motivation of employees must be met and plays a role to enhance AI adoption. It is important that e.g., management and administrative staff identify themselves with the topic of AI and think flexibly and innovatively to carry out the implementation successfully. The motivation and the own will to change the image of the administration and to change old working methods should be given. The process of dealing with the topic of AI adoption should simply get started, there should not be endless discussions back and forth. The following quotation illustrates the importance of individual motivation:

> *"As an administrator, I must therefore commit to this topic and state: 'This is now our new technology, this is the new way in which we want to work with assistance, and we will then implement it at the workplace throughout the administration.'" -M4*

Transferring organizational innovativeness back to theory shows that Lai and Guynes [24] use the term openness as an important adoption decision factor and describe it as "the degree to which an organization is willing to infuse innovation". [24] use this term in an organizational context to examine ISDN (integrated services digital network) adoption in U.S. companies.

Perceived industry pressure. The diffusion of technologies exerts pressure on municipalities that encourages the adoption of AI. For example, the decreasing costs of technology, wider availability, and mass access to innovations over time are consequences of the technology's diffusion. Due to this diffusion, more companies enter the private market. The increasing number of competitors on the market leads to more improved services. These services could meet the requirements of municipalities, such as continuous support and quality of the AI systems by the manufacturers, and therefore enhance AI adoption. An example, based on the diffusion of technology, which illustrates this view:

> *"What seems to be impossible for a long time is suddenly made possible by such a situation [COVID 19 crisis]. And it is the same if somewhere technology suddenly becomes cheaper, more tangible, or more feasible […]. Then there is also change or even acceleration." -M6*

The influence of the industry has also been stated by [23]. They rank the "perceived industry pressure" as an aspect of environmental pressure e.g., through business partners or competitors that leads to technology adoption. Zhu et al. [39] and Zhu & Kraemer [40] describe this factor as "competitive pressure". In sum, this is the third added aggregated dimension according to Venkatesh and Bala [38].

Perceived government pressure. The evaluation of the interviews has shown that pressure from the government is conducive to the implementation of AI. Official guidelines must come from the government as well as the definition of a standard of legal and security matters.

It can be supportive for the implementation of AI if the government introduces official guidelines and recommendations for the handling of AI in municipalities. Politicians should position themselves clearly and set the switch to AI as a goal for municipalities and communicate this to the public. Action recommendations for municipalities are considered desirable, as they can use them as an orientation. One example underlines the importance of governmental pressure:

> *"[…] and the demands from politics: "you have to position yourself there". Then there is also change or even acceleration [of AI adoption]." -M6*

In addition to official guidelines, standards should be set by the government for data security and legal matters related to AI applications. This gives municipalities a legal protection when AI projects are implemented and guarantees citizens a service that is difficult to manipulate by given data security regulations. The DSGVO, the German version of the European GDPR (General Data Protection Regulation), is one way of dealing with the issue of data protection.

In addition, further policies must be created for AI, which guarantee the confidential use of data by the municipalities as well as the prevention of data manipulation and security gaps for the public AI systems and their data. Through these standards, the government is putting pressure on municipalities to enable these standards and thereby enhancing AI adoption. For example, M7 appeals the aspect, that regulation leads to adoption of (AI) applications:

> *"Of course, I also see danger in legal matters. Of course, the legal prerequisites have to be created there as well. Similar to autonomous driving, for example, that the way is created for it. That such applications in certain areas can and may be used even now." -M7*

The dimension of "perceived government pressure" is used by [23] also as an environmental factor that leads to adoption of technology. Regulatory measures and government policies exert pressure, which is perceived differently by organizations [23].

Perceived pressure from society. The perceived pressure from society is based in our case on the needs and moral standards of the society and their citizens.

In a digital world, citizens demand for a digital municipality with permanent accessibility and 24h service rises. To meet this demand, the use of AI is crucial. User behavior and preferences of citizens are also changing, especially if one considers that future generations will be digital natives, e.g., generations that take digitalization for granted. Therefore, the perceived pressure to meet the demands of these citizens requirements is increasing and promotes the need and use of AI adoption in municipalities. A proof for this view is provided by following municipality:

> *"Above all in the upheaval of the generations, the younger generations of digital natives, are also demanding digital tools [...]." -M10*

In addition, for the wide social application of AI, the clarification of moral questions is an important point, because ultimately the decisions of the algorithms must be met by the ethical standards of the citizens. The broad social discussion of these questions must be created in order to prepare the topic morally and develop ethical frameworks that developers can use and incorporate into the algorithms. One municipalities thoughts are quoted below:

"Ethical issues are a very important point, I think. Algorithms that perhaps at some point will actually make autonomous decisions about important things. This is always accompanied by ethical questions. We must first find answers to these questions." -M1

In their study on the adoption of electronic government services, Tung and Rieck [36] used the effect of "social influence" as an important factor in adoption decisions. The term means that the public's view of a company is relevant, as it influences the decisions of the company. Since the opinions of the citizens are important to a municipality, the perceived pressure from society leads to the adoption of AI technology by the citizens, if required [23, 36].

18.5. Model development

Based on our applied method of Grounded Theory and the Gioia methodology for the analysis of the interviews, we were able to proof and extend the use of the TOE-framework, used in recent literature to analyze organizations, to transfer it to an individual level – showing perceived challenges from an employee's perspective. We therefore were able to first, support dimension by Kuan & Chau [23] introducing the viewpoint of employees and secondly extending the framework regarding further perceived challenges.

Honoring present literature regarding AI in the public administration [6, 7, 34], we were able to identify four additional aggregated dimensions (Compatibility, Strategic alignment, organizational innovativeness, and Pressure from society) additional to the six dimensions introduced by Kuan and Chau [23]. Thus, we were able to develop in total ten dimensions of perceived challenges for AI adoption in municipalities from an employee's perspective. We were concentrating on the employees perspective in order to extend recent research on the benefits and challenges of AI in the public sector [6, 7]. As Sun and Medaglia [34] concentrated on three different groups of stakeholder (e.g. government policymakers, hospital managers/doctors, and Information Technology (IT) firm managers, we concentrated on the employees who need to implement AI in their work routines. We integrated the aggregated dimensions into the TOE-framework to cast our perceived challenges of employees into a theoretical context [29]. For this, we used the perception-based model of [23] as a foundation for our model, proofed and extended it with our findings from the interviews from an employee's perspective. The assignment of the different aggregated dimensions to the three pillars of the TOE-framework is based on the explanation in the theoretical background section.

With our model we provide a framework of perceived challenges employees are facing when adopting AI in German municipalities [18]. Figure 18.1 shows our extended TOE-framework.

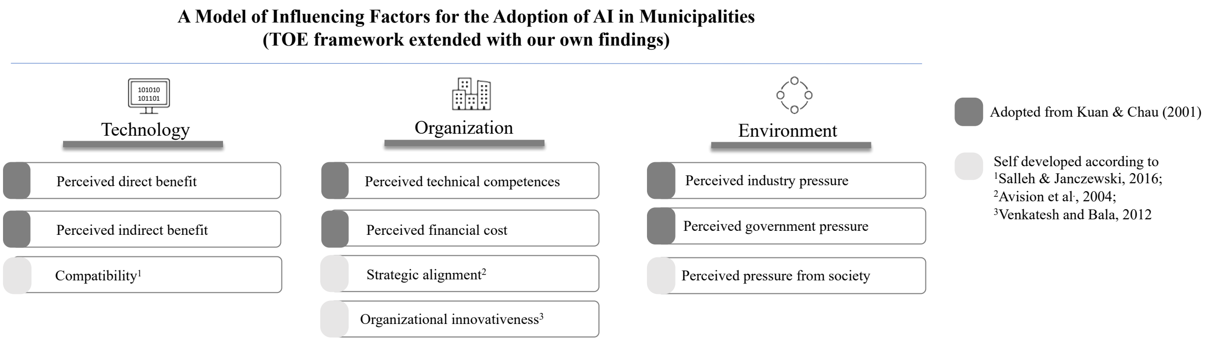

Figure 18.1 Extended TOE-framework

18.6. Discussion

In our interviews we interviewed eleven municipalities within a complete district as well as the district administration itself in Germany. Using coding methods from Grounded Theory applied by Gioia, we were able to proof six dimensions introduced by Kuan & Chau [23] from an employee's perspective and identify additional four aggregated dimensions in our study. These aggregated dimensions represent perceived challenges for adoption of AI in municipalities. In a further step, we have integrated these aggregated dimensions into the theoretical context of the TOE-framework, which is often used in the literature for the adoption of IT in organizations.

Our research shows implications for theory by conducting perceived challenges of AI adoption from employee's perspective using a qualitative explorative study. It further extends research on the adoption of AI, using classical adoption models like the TOE-framework in the public sector, which differs from private sector regarding e.g., the motivation of employees. We were able to present an expanded TOE-framework for AI adoption in the public sector reflecting our identified aggregated dimensions in existing literature.

As implications for practice our study enables municipalities to use our study to gain a better understanding of which challenges are important to take care of while encouraging the use of AI along employees. With these challenges we offer an orientation guide for municipalities that are switching to AI technology. We also enable managers and CDOs recommendations for actions while introducing AI in their municipality helping them to find motivations which support the overcoming of perceived challenges of adoption from employee's perspective.

18.7. Limitations & Future research

In summary, we proofed six dimensions of perceived challenges from Kuan & Chau [23] and identified additionally four perceived challenges for AI adoption extending the TOE-framework for pubic administrations along an employee's perspective. We were able to add these challenges to the TOE-framework proofing and showing new challenges faced by employees regarding the adoption of AI. In our study we focused on the use of AI in municipalities and took an explorative approach based on qualitative interviews. Through interviews conducted in all municipalities of one district and the district itself in Germany we were able to generate implications for research and practice.

Aligned to other empirical studies, this paper has limitations that show options for future research. Even though we aimed for qualitative rigor in our study, we still must mention typical limitations of qualitative research (e.g., weak internal validation). For example, it should be noted that we only interviewed one type of stakeholder in the process of adopting AI in municipalities. We neglected other stakeholders such as regional IT service providers or citizens and their influence, although they were considered an important factor in our findings.

Furthermore, it should be noted that we only interviewed the municipalities of one district and therefore only one area in Germany. It should be noted that the majority of the municipalities surveyed had a low population figure (below 100,000 inhabitants). Also, the respective municipalities do not have any AI applications in use yet, or just a very low number. Therefore, the time of the study (mid-2020) should be considered in this context. During this time, AI is mostly used in private companies and is just becoming more and more widespread in regional municipalities in Germany. The structure of this study is aimed at finding perceived challenges for AI adoption. No statement has been made about the importance of these challenges among each other, nor how to overcome these challenges in practice completely.

Apart from those, it is important to acknowledge the following aspects: Future research teams could examine how these challenges can be practically taken into account in the implementation process of AI application in municipalities interviewing civil servants without an IT background such as managers, end-users, or political figures. Aligned to the small number of interviewed municipalities, future research could extend our study by interviewing more municipalities adding politicians and managers to the interviewees. It would also be interesting, to repeated our study at a later point in time to examine perceived challenges when the diffusion of AI technology is more advanced. Future research could also follow an implementation process of an AI technology in the public sector to analyze challenges directly in the implementation process.

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19. Enabling AI Capabilities

Paper Number	**P12**
Title	**Enabling AI Capabilities in Government Agencies: A study of determinants for European municipalities**

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Table 19.1 Fact Sheet Publication

Enabling AI Capabilities in Government Agencies: A study of determinants for European municipalities

Abstract. Artificial Intelligence (AI) is gradual becoming an integral part of the digital strategy of organizations. Yet, the use of AI in the public sector in still lagging significantly compared to private organizations. Prior literature looking into aspects that facilitate adoption and use of AI has concentrated on challenges concerning technical aspects of AI technologies, providing little insight regarding the organizational deployment of AI particularly in public bodies. Building on this gap, this study seeks to examine what aspects enable government agencies to develop AI capabilities. To answer our research questions, we developed a survey-based study grounded on the Technology-Organization-Environment framework (TOE) and asked Chief Digital Officers (CDOs) from European municipalities about factors that influence their development of AI capabilities. We collected data from 91 municipalities from three European countries and analyzed responses by means of structural equation modeling. Our findings show that show five factors – i.e. perceived financial costs, organizational innovativeness, perceived governmental pressure, government incentives, regulatory support – have an impact on the development of AI capabilities. We also find that citizen pressure and perceived value of AI solutions are not important determinants of AI capability formation. Our findings bear the potential to stimulate a more reflected adoption of AI supporting CDOs, managers and employees in European government agencies to develop AI capabilities.

Keywords: Artificial Intelligence, public sector, European government agencies, AI capabilities, TOE-framework

19.1. Introduction

Artificial intelligence (AI) and its transformation potential have been a topic of much discussion both in literature and practice for decades (Dwivedi et al., 2019). As technology has taken significant leaps in enabling AI development, AI is gaining momentum and becoming an essential part of organizational operations and everyday life (Desouza, Dawson, & Chenok, 2020). While the development of AI technologies accelerates, the interest in AI and the adoption of the different AI technologies has grown (Pan, 2016). AI can be characterized by being a system that mimics cognitive function and can perform carry out tasks with human-like and rational behavior (Russel & Norvig, 2015). AI technologies are used for example in the context of speech recognition, machine translation, computer vision, machine learning, and robotics (Eggers, Schatsky, & Viechnicki, 2017). These technologies hold a multitude of possible benefits depending on their application. For example, robotic process automation applications can improve accuracy, free resources, and reduced costs (Jovanović, Đurić, & Šibalija, 2018). Overall, AI applications are connected to the effectiveness of work, freed-up high-value work, and improved decision-making (Eggers et al., 2017), all of which can lead to improved organizational performance.

Owing to the potential benefits and diverse AI applications, AI is gaining attention both in private and public sectors. While the private sector has been ahead in this development (Ransbotham, Gerbert, Reeves, Kiron, & Spira, 2018), AI technologies are now being adopted in the public sector as well (Desouza et al., 2020). In fact, there has been a growing discussion on the multitude of potential applications that AI solutions can offer for public administration (Wirtz, Weyerer, & Geyer, 2019). Nevertheless, there are many challenges that such public bodies must first overcome before being able to deploy novel AI into operations. Thus, it is not only important that technical challenges are resolved, but also that organizational planning is in place to accommodate AI-enabled changes. Such organizational planning entails that public bodies are aware of the coercing forces and constraints of the environment and are able to plan accordingly (Duan, Edwards, & Dwivedi, 2019). The notion of an AI capability has recently emerged in the literature denoting the organizational capacity to leverage AI technologies to meet key objectives (Mikalef & Gupta, 2021). Based on the definition of the notion, organizations must foster complementary AI-related resources in order to be able to derive value from their investments. Yet, to date there is not much knowledge regarding how the internal and external environment of public organizations influences their ability to develop AI capabilities (Mikalef, Fjørtoft, & Torvatn, 2019; Mikhaylov, Esteve, & Campion, 2018; Wirtz & Müller, 2018).

To study what aspects either enable of inhibit public body organizations in developing their AI capabilities, we grounded this study on the Technology-Organization-Environment framework (TOE) in order to understand how different forces pertinent to the relevant categories shape outcomes. Specifically, we built on prior work that examined aspects that influence deployment and use of AI in public bodies, and put forward a research model to explore their effects (Mikalef et al., 2019; Schaefer et al., 2021). To operationalize the study objectives, we developed custom-built questionnaire which was distributed to chief digital officers in European government agencies of three countries. We focused specifically on municipalities as they represent important government agencies and offer a vast array of services to different stakeholders such as citizens, businesses, and other public bodies (Jakob & Krcmar, 2018).

This work has a strong research and practical motivation. From a research point of view, we are still lacking a theory driven understanding of how public bodies develop the capacity to leverage key technologies such as AI, and how aspects of the internal and external environment shape such capacities. From a practical perspective, public bodies are facing increasing pressure in improving efficiency and quality of service provision, particularly through the use of novel digital technologies (Janssen & Van Der Voort, 2016). In addition, for public bodies like municipalities to become more capable of deploying AI technologies and for government agencies to encourage the utilization of AI technologies, we must have a proper understanding of the main drivers of the deployment so that there can be support for these processes. Therefore, we propose our research question:

RQ: What factors affect European government agencies to develop AI capabilities?

The rest of the paper is structured as follows. In the next section, we describe the background of this study highlighting the need to look at AI capabilities of European government agencies, and introducing the TOE-framework as a suitable lens in the study of factors that either enable or inhibit AI capability development. In section 3, we present our research model and corresponding research hypotheses. In section 4, we present the method we followed to actualize the study's objectives, followed in section 5 by the empirical analysis and the outcomes. We conclude in section 6 by discussing our findings from a research and practical standpoint and outline some key limitations that underpinned this study.

19.2. Background

19.2.1. Artificial intelligence capabilities

The notion of an AI capability is a relatively new one, following an accelerated use and adoption of AI technologies in the organizational context over the past few years (Mikalef & Gupta, 2021). The concept builds on a tradition of IS research towards capturing the capacity of organizations to leverage novel technologies, rather than solely identifying degrees of adoption of technical infrastructure. Specifically, IT capabilities, the concept on which AI capability is grounded, argues that organizations need to leverage technological as well as other complementary resources in order to realize value from new technology deployments (A. S. Bharadwaj, 2000). Such conceptualizations of an organization´s ability to leverage technology are more accurate representations of how much value can be expected, as they involved the intangible aspects that enable technological innovations to be put in action. The notion of an

AI capability follows this logic, as it builds on the necessary technical and organizational elements required to effectively deploy AI resources towards prioritized objectives.

In their recent study, Mikalef & Gupta (2021) define AI capabilities as "the ability of a firm to select, orchestrate, and leverage its AI-specific resources". This definition denotes that an AI capability goes beyond just selecting, or else adopting AI, and includes the capacity to bring AI-related projects to fruition. Grounded on the resource-based view (RBV) of the firm, an AI capability has therefore been conceptualized as being developed through the ability of organizations to foster complementary types of resources (A. Bharadwaj, 2000) Specifically, several studies have distinguished between tangible, human, and intangible resources (Grant, 1991; Gupta & George, 2016). Building on this broad distinction, we follow the conceptualization of Mikalef & Gupta (2021) and argue that an AI capability comprises of complementary AI-related tangible, human, and intangible resources.

Building on conceptualizations from past literature, we argue that tangible resources include the data necessary to actualize AI algorithms, the technological infrastructure to support storage and transfer of data, as well as the processing power needed to run advanced AI techniques, and other basic resources such as financial flows (Duan et al., 2019; Wirtz et al., 2019). In terms of human-related resources, AI capabilities require that organizations are able to both balances technically oriented skills for handling data, and implementing AI techniques, as well as managerial skills for understanding what domain knowledge is required when developing AI applications and envisioning important areas for application (Dwivedi et al., 2019). Finally, the intangible resources required to foster an AI capability include the ability of organizations to carry out interdepartmental coordination, the capacity to initiate and carry out organizational change, as well as a proclivity for engaging in high-risk high-return projects (Davenport & Ronanki, 2018; Ransbotham et al., 2018; Sun & Medaglia, 2019). The combined presence of the previously mentioned resources is therefore argued to constitute a good measure of an organizations AI capability.

19.2.2. Artificial intelligence in public bodies

In public sector bodies, and particularly municipalities, the deployment levels of AI are still in a very early phase as documented by early empirical research (Mikalef et al., 2019). Being able to leverage AI in such contexts is subject to a number of different forces, and is hindered by political, legal and policy challenges (Dwivedi et al., 2019). As a result, there has been a renewed focus on digitalization of public sector administration, and a call for more empirical research examining aspects that either promote or hold back AI utilization (Janssen, Brous, Estevez, Barbosa, & Janowski, 2020). Prominent examples of this move include the United States and China, which have been aspiring to take big steps in advancing the use of AI for public administration (Allen, 2019).

Prior studies focused predominantly on the technical aspects associated with the adoption of AI, placing significantly less research on the socio-organizational changes entailed with AI deployment. In other words, there is still a limited understanding of what aspects of the internal and external environment prompt public bodies to develop AI capabilities (Sun & Medaglia, 2019). Related studies have examined critical aspects of AI adoption, which places a greater emphasis on the related technological investments associated with AI (Schaefer et al., 2021). While AI adoption is a necessary first step, it has the limitation that it does not provide a complete picture of the organizational capacity to effectively manage and leverage AI technological and complementary resources towards the generation of organizational value (van Noordt & Misuraca, 2020).

In effect, AI adoption precedes the development of an AI capability, as the latter needs to be fostered and matured by the organization through a gradual process. Aligning to our research question, research on factors enabling the development of AI capabilities is at an inaugurating state. Smit, Zoet, and van Meerten (2020) argue that in order to support the use of AI, organizations must embrace 22 principal categories of ethical values (e.g., accountability, understandability, and equality) during the design of AI. Based on their findings, they proposed design principles for each category to improve AI design and execution. Although this work provides some very relevant guidelines for the development of AI applications in accordance with ethical design principles, it does not explain how organizational organizing around AI initiatives is developed to form AI capabilities.

19.2.3.Technology-organization-environment (TOE) framework

When new technologies emerge in the market, organizations and individuals tend to adapt their behavioral patterns to embrace them. The choice of acquiring and using a new invention or innovation, and the process by which a new technology spreads throughout a population is described together as technology adoption and diffusion (Hall & Khan, 2003). The diffusion phase of technology tends to be a lengthy process, as organizational, cultural, and legal issues require time to incorporate new adaptations (F. Lin, Fofanah, & Liang, 2011). Research has put forth a multitude of different technology adoption and diffusion models operating at different levels of analysis, from the individual, to the organizational. As this study investigates the capacity of municipalities to develop AI capabilities, theories that examine use of technology at the individual levels, such as the technology acceptance model (Davis, 1989), and the unified theory of acceptance and use of technology (Venkatesh, Morris, Davis, & Davis, 2003) are not suitable for the purpose.

As we look at the diffusion of AI in the public sector, the TOE-framework provides a suitable theoretical framework as it allows for the inclusion of aspects pertinent to the internal and external environment that shape organizational assimilation patterns (Baker, 2012). The TOE-framework allows us to differentiate between three important angles when studying technology diffusion: aspects relating to the technology itself, organizational factors, as well as important aspects of the environment (Hameed, Counsell, & Swift, 2012). The TOE-framework has been one of the principal theoretical frameworks in the study of how organizations adopt and diffuse technology, primarily due to it being flexible to incorporate relevant contextual variables that are contingent upon the specific technology or organization that is been examined (Wang & Lo, 2016; Zhang, Zhao, Zhang, Meng, & Tan, 2017).

Due to the increasing relevance of AI in the private and public sector, the question of how AI can be incorporated into processes and organizations is becoming more and more important. As the TOE-framework has been widely in studies of the adaptation of other disruptive technologies, such as big data (Bremser, 2018), cloud computing (Lian, Yen, & Wang, 2014), and business intelligence systems (Hatta, Miskon, & Abdullah, 2017), it provides a relevant orientation point for studies of AI in the public sector. In terms of the three main categories of factors that influence diffusion, the technological part describes the influences of perceptions of technology and the past experiences with utilization of digital solutions (Kuan & Chau, 2001). The organizational aspect of the framework refers to the internal organizing and the values and priorities of the organization as a whole (Salleh & Janczewski, 2016). Finally, the environment incorporates the external circumstances and conditions in which the focal organization operates (Wang & Lo, 2016).

To identify what aspects within these three broad categories, have an impact on the level of AI capabilities of municipalities, we survey past empirical work. Building on a qualitative research design, Schaefer et al. (2021) elicited perceived challenges regarding AI adoption through interviews with municipal employees in Germany. Following a survey-based study, Mikalef et al. (2019) identified some of the major challenges IT managers face in their attempt to integrate AI into their operations. Similarly, Wirtz et al. (2019) present a comprehensive overview of the challenges faced by public organizations during their efforts to leverage AI tools. A common denominator in these work points out to the fact the perceptions of managers regarding the potential value of AI are important drivers in their decision to deploy AI into operations. From the organizational perspective, managers point out that financial costs associated with AI as well as past experiences in developing innovative digital solutions are important elements in setting up the organizational elements surrounding AI. Furthermore, there is significant evidence hinting that aspects relating to perceptions of pressure from the government and citizens (Mikalef et al., 2019; Schaefer et al., 2021), as well as regulatory guidelines and incentives (Franzke, Muis, & Schäfer, 2021; Jensen, 2020) have an important conditioning effect on the levels of AI capabilities in municipalities. These early studies are used in the development of our research model and form the basis for the corresponding hypotheses that guide our research.

19.3. Research model and hypotheses

This section elaborates the factors used as enablers for the deployment of AI capabilities. The factors are structured aligned to the TOE-framework in the following categories: technological, organizational, and environmental context. Based on these categories we derive seven hypotheses and present an integrated and extended model for factors enabling the development of AI in municipalities (c.f. Figure 19.1). The choice of relevant factors within each of the three categories was done based on the current accumulated knowledge in past research. The hypotheses examine the role of each underlying factor regarding its effect on an AI capability in municipalities. While these factors may not be exclusive, they represent some of the most noted aspects that shape municipal capacities to leverage AI towards organizational goals. We therefore develop an argumentation about the effect of each on the overall levels of AI capabilities for municipalities.

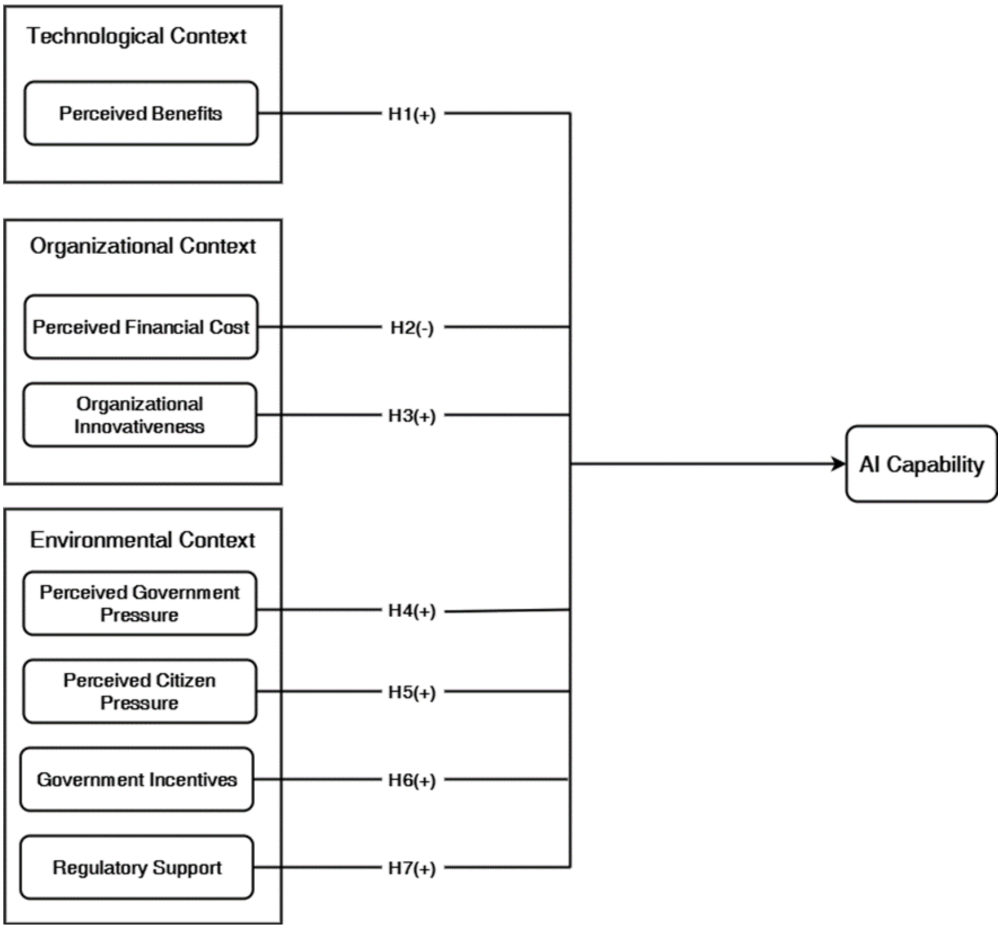

Figure 19.1 Research Model and Hypotheses

19.3.1. Technology

The dimension of "perceived benefits" can be found in the existing literature by Kuan and Chau (2001) who also employed the TOE-framework. For example, in their study on the adoption of electronic data interchange (EDI) in small businesses, they presented a perception-based model in which they distinguish between perceived direct and indirect benefits. In our study we define perceived benefits, aligned to Kuan and Chau (2001), as the benefits that are perceived rather than the benefits that are delivered or enabled by technology. The term "direct" relies to operational advantages. Therefore, perceived direct benefits lead to an increase in performance of daily internal processes of an organization. However, perceived indirect benefits describe "perceived benefits rather than benefits that are actually provided" (Kuan & Chau, 2001) by technology. The term "indirect" refers to the benefit's strategic characteristics, meaning that benefits are caused by external relationships with diverse stakeholders.

Previous literature provided information about how perceived benefits formed an incentive for the adoption or use of technology (Cruz-Jesus, Pinheiro, & Oliveira, 2019). The main rationale in the context of municipalities is that IT managers have a strong impact on the decision of municipalities to adopt AI and eventually to develop a strong AI capability. This decision, is largely shaped by their perceptions of the value that can be extracted from such investments, and their overall impression of the potential changes that AI technologies can introduce to their organizations (Mikalef et al., 2019; Schaefer et al., 2021). This leads us to hypothesize the following:

H1: Perceived benefits will positively affect the development of AI capabilities.

19.3.2.Organization

Perceived financial costs is a commonly used construct which can be found in past literature regarding the adoption of diverse technologies (Baker, 2012). Taking a manager´s or employee's perspective demonstrates that costs can be perceived from a different point of view. Financial costs can be perceived from key decision-makers are barriers of adoption, especially when it is difficult to assess the degree to which new digital solutions will be able to generate measurable value (Kuan & Chau, 2001).

Because the public sector is financed by governmental funding and taxation, the average European government agency has restricted budgets which do not allow for complete liberty in planning novel technology deployments (Misuraca, van Noordt, & Boukli, 2020). To implement new technologies in the public sector, supporting services and working processes for managers, employees and citizens are often calculated with a high amount of costs. Investing in the developing and implementing does not only cause direct financial costs but also overhead and personnel costs. As many European government agencies struggle to implement new technologies, due to the perceived financial expenses, we hypothesize the following:

H2: Perceived financial costs will negatively affect the development of AI capabilities.

Transferring organizational innovativeness back to theory shows that openness is an important adoption decision factor which is described as "the degree to which an organization is willing to infuse innovation" (Lai & Guynes, 1994; Oliveira & Martins, 2010). The notion of organizational innovativeness has been used to understand the proclivity and cultural norms linked to specific organizations, and how it influences their decision to embrace technological innovations (Aboelmaged, 2014). Recent literature also describes organizational innovativeness as an enabler of adoption processes of new technologies, and especially AI technologies (Misuraca et al., 2020; Smit et al., 2020). Organizations that embrace a culture of innovativeness have been suggested to be more open to experiment with new ideas and technologies, and to provide more time and resources for trialing new solutions using novel tools (J. Lin, Luo, & Luo, 2020). From the foregoing argumentation we hypothesize the following:

H3: Organizational innovativeness will positively affect the development of AI capabilities.

19.3.3. Environment

The dimension of "perceived government pressure" is argued by Kuan and Chau (2001) to be an important environmental factor that prompts the adoption of technology. Top government bodies such as ministries tend to publish strategic goals in terms of digitalization goals, which is likely to result in perceptions of pressure to IT managers at the municipal level. The logic argues that IT managers will perceive a need to align their activities with those of national strategies, and that specific key indicators will need to be attained to satisfy goals (Mikalef et al., 2019). Decisions undertaken by governments can put municipalities under pressure regarding the organization of timeframes, financial costs, personnel issues, and process optimization (Wirtz & Müller, 2018). In addition, municipalities often follow such governmental pressure with undertaking different forms of resource configurations in order to meet governmental requirements. In the case of AI capabilities this can mean starting to develop the appropriate organizational structure, making data available and accessible, and developing pilot infrastructure to execute AI projects (Andreasson & Stende, 2019). Thus, we propose:

H4: Perceived government pressure will positively affect the development of AI capabilities.

In their study on the adoption of electronic government services, Tung and Rieck (2005) used the effect of "social influence" as an important factor in adoption decisions. The term defines the importance of the public's view of a company as it tries to influence the decisions undertaken by the organization. Since opinions of citizens and their needs are important to the municipalities they belong, the perceived pressure from society results in citizens providing pressure on municipalities in order to adopt novel technologies and provide better and more efficient services (Schaefer et al., 2021). Municipalities in particular have an important role in providing services to citizens, so it is highly probable that perceptions of pressure from the public is likely to nudge IT managers to accelerate their deployments (Bullock, Luccioni, Pham, Lam, & Luengo-Oroz, 2020). Thus, we propose that municipalities need to adapt to their citizen's needs, leading to perceived citizen pressure influencing municipalities deployment of AI capabilities. Thus, we hypothesize the following:

H5: Perceived citizen pressure will positively affect the development of AI capabilities.

Governmental incentives can be described as instigators for municipalities to deploy AI solutions as they provide the necessary resources to develop and deploy new technologies into operations (Komninos, 2006). As municipalities are dependent upon governmental support in developing new directions in terms of technological diffusion, the level of support that they receive is likely to have an important impact on the degree to which they foster AI (Misuraca et al., 2020). Apart from providing the relevant resource, governments oftentimes also offer incentives to continue the pursuit of important objectives. Such incentives are predominantly associated with financial benefits enabling the implementation of new technologies or the hiring of qualified personnel managers and employees to the public sector (Misuraca et al., 2020). Regarding the implementation of new technologies, both financial support and qualified managers and employees are important for municipalities during digital transformation processes (Niehaves, Röding, & Oschinsky, 2019; Schaefer et al., 2021). This leads us to hypothesize the following:

H6: Government incentives will positively affect the development of AI capabilities.

Prior literature argues that regulatory supports for municipalities has important effects on their decision to adopt and rollout digital solutions to the public (Androutsopoulou, Karacapilidis, Loukis, & Charalabidis, 2019; Pedersen, 2018). Regulatory support can be achieved for example through the regulations, strategies, and standards provided by higher hierarchical public sector organizations on different municipal levels. As municipalities aim to formulate regulations governance schemes in the absence of clear regulations for themselves on their own (Niehaves et al., 2019), regulatory supports from higher municipal levels can provide the needed support for municipalities to guide their actions in terms of digital transformation (Kane, Palmer, Phillips, Kiron, & Buckley, 2015). For example, recent literature in theory and practice refer to regulatory supports such as digital transformation strategies and AI strategies (Misuraca et al., 2020). Such initiatives are supposed to support municipalities regarding their own regulations and strategies by helping them to align to higher hierarchical supposed goals.

We suggest that the presence of strong regulatory support will facilitate municipalities to foster their AI capabilities. We therefore hypothesize the following:

H7: Regulatory support will positively affect the development of AI capabilities.

19.4. Method

19.4.1. Survey administration and data

In this study we used a survey-based method to collect data from multiple municipalities in different European government agencies. The choice of the method was based on the fact that survey-based studies allow for generalizability of outcomes and easy replication, and they enable the concurrent inclusion of several factors (Pinsonneault & Kraemer, 1993). In addition, survey-based studies are able to capture general tendencies and identify complex associations between variables in a sample. According to Straub, Boudreau, and Gefen (2004) survey-based research is also of importance for exploratory settings and for predictive theory to be able to generalize results. In this study, we use constructs and corresponding survey items that are largely based on previously published studies, so there is additional support for their psychometric properties. In terms of their operationalization, all constructs and respective items were measured on a 7-point Likert scale. This was done because the Likert scale is a well-accepted practice in large-scale empirical research where there are no objective measures of hard-to-measure concepts like beliefs, attitudes, and capabilities (Kumar, Stern, & Anderson, 1993). Before the survey was deployed, a group of experienced researchers filled out the survey in order to verify that there were no errors and that all questions were clear and understandable. Due to the fact that we allocated data from different European countries (e.g., Finland, Germany, and Norway), the survey was available in four languages (English, German, Norwegian, and Finish). The group of respondents of the pre-test noted sentences that were not clear so that translations could be refined. To achieve comparable insights, we collected data in three European countries that feature similarities with regards to their AI strategies and their AI progress Furthermore, all countries have in common a similarly revealed technology advantage (Ubaldi, 2020). Against this background, we expect the results to represent AI capabilities of government agencies in eGoverment ready countries. A cross-country comparison did not reveal any significant differences regarding the core elements of our research model. For this reason, we concentrate on the sample to represent eGovernment ready European government agencies.

To examine the hypothesized relationship of our research model, email invitations were sent out with a link to the electronic survey to key respondents in municipalities of European government agencies. The target respondents mainly comprised of chief digital officers and higher-level technology managers in municipalities. For all three countries, a mailing list directory was created for the municipalities of the country, and information about the best suited respondent was obtained through the publicly available data on their respective websites. If information on relevant respondents was not available on these websites, a request was sent to the general email address of each municipality asking for the contact details of respondents that fit the profile. From the initial invitation towards key respondents, three subsequent reminders were sent out to increase response rates. The data collection processes started in October 2020 and was concluded in early January 2021. The final sample consisted of 132 responses of which 93 were complete and usable for further analysis.

The responses came from a diverse set of governmental agencies that ranged from some that were rather small in terms of population, to other that were quite large (over 300.000 citizens). The largest proportion of responses came from Norwegian municipalities that accounted for 71% of the sample, while Germany accounted for 22%, and Finland 7% respectively. In terms of the respondents' position, we were able to collect responses for employees holding key positions related to IT, such as chief digital officers, IT directors, and IT managers. Furthermore, most government agencies had relatively well-staffed IT departments, with most having more than 10 dedicated employees working on IT projects. In addition, a considerable subset of municipalities had a large number of employees in their IT departments (50+ employees). With regards to their use of AI, the largest proportion of companies had been using AI for approximately 2 years (35%), with a smaller percentage having experience with AI for over 3 years (Table 19.2).

Factors	**Sample (N = 93)**	**Proportion (%)**
Country		
Germany	21	22%
Norway	66	71%
Finland	6	7%
Respondents position		
Chief Digital Officer (CDO)	61	65%
IT director	20	22%
IT manager	9	10%
Operations manager	3	3%

Municipality size (Number of citizens)		
1.000 – 9.999	16	17%
10.000 – 24.999	12	13%
25.000 – 49.999	27	29%
50.000 – 99.9999	22	24%
100.000 – 299.999	12	13%
300.000 +	4	4%
Department size (Number of employees)		
1 - 9	21	23%
10 - 49	44	47%
50 - 249	25	27%
250 +	3	3%
Length of AI use in municipality (Number of years)		
< 1 year	11	12%
1 year	18	19%
2 years	33	35%
3 years	23	25%
4 + years	8	9%

Table 19.2 Descriptive statistics of the sample and respondents

Since the data we used for this study were collected from a single respondent at a single point in time, there is a possibility that it may be subject to bias. To account for such bias, we followed the guidelines of Podsakoff, MacKenzie, Lee, and Podsakoff (2003) and run several analyses to determine if there was cause for concern regarding common method bias. We first conducted a Harmon one-factor tests on the eight main variables used in the study. The outcomes did not produce a unifactorial solution, with the maximum variance explained by any one factor being 21.9%. This outcome is a good indication that common method bias is not a major concern. In addition, we tested for goodness-of-fit, based on the suggestions of Tenenhaus, Vinzi, Chatelin, and Lauro (2005) through PLS path modeling. In our empirical analysis, the outcomes suggest that the model has an acceptable goodness-of-fit since it surpasses the lower limit of 0.36 as suggested by Wetzels, Odekerken-Schröder, and Van Oppen (2009). As a result, these tests confirm that our research model and the way we operationalized it are not subject to common method biases. As a further method of determining if biases exist in our sampling procedure, we performed some analyses to examine for the presence of nonresponse bias. Specifically, the profile of municipalities that participated in the study was compared with those of which we did not receive a response or incomplete responses were delivered (e.g., size, country). Through a chi-square analysis we found that there was no significant systematic response bias. Finally, we also compared early with late respondents in terms of different sample demographic characteristics and found no indication of differences that could signal the presence of biased data.

19.4.2.Measurements

The scales for the constructs used in this study were primarily adopted or adapted from prior studies and have therefore been tested on their psychometric properties. In Appendix A we provide a summary of the items used form the constructs of the study.

Perceived direct benefits was developed as a first-order reflective construct, according to the study of Kuan & Chau (2001). Respondents were asked to rate how much they agree or disagree regarding the potential direct benefits of adopting AI for municipality-related operations on a 7-point Likert scale, from 1 (strongly disagree) to 7 (strongly agree). Five items were used to capture the construct.

Perceived financial cost was developed as a first-order reflective construct, and asked respondents to evaluate their beliefs about the associated costs of adopting AI in their organizations. The items were based on the study of Kuan & Chau (2001) and included questions on set-up, training, and running AI. In like with the other measurements, the items measured respondents' perceptions of a 7-point Likert scale.

Organizational innovativeness measured the degree to which respondents perceive their organization to have a culture that encourages and pursues continuous innovation. The construct was developed based on adapted items from the studies of Venkatesh and Bala (2012) and Salleh and Janczewski (2016) and was operationalized using a 7-point Likert scale through a first-order reflective construct.

Perceived government pressure captured the degree to which respondents experienced that top government was prompting municipalities to adopt AI. Respondents were asked to evaluate on a 7-point Likert scale the level to which they perceived that the government was introducing measures and regulations to accelerate AI deployment. The items used were adapted from the study of Kuan & Chau (2001).

Perceived citizen pressure measured the level to which municipalities experienced a push from the citizens to deploy AI-based services. The construct was developed as first-order reflective based on adapted items from several studies (Salleh & Janczewski, 2016; Venkatesh & Bala, 2012). Respondents were asked to evaluate on a 7-point Likert scale the degree to which they perceived that citizens wanted municipalities to provide more AI services.

Government incentives captured the degree to which respondents believed there were adequate measures and initiatives launched by top government to facilitate adoption and use of AI in municipalities. The construct was developed as a first-order reflective construct based on three indicators that were adapted from prior studies and measured on a 7-point Likert scale (Kuan & Chau, 2001; Salleh & Janczewski, 2016).

Regulatory guidelines measured the degree to which respondents believed there were clear regulations and directives about how to handle different relevant facets of AI projects, such as data security and protections schemes, ethical frameworks, and clear legal frameworks on data protection and use. The construct was self-developed based on prior work that included interviews with key respondents in municipalities and operationalized as a first-order reflective construct measured on a 7-point Likert scale.

AI capability was adopted from the study of Mikalef & Gupta (2021) with minor adaptation to fit the case of municipalities. The construct captures the degree to which municipalities are able to leverage their AI-related resources. It is a third-order formative construct, comprised of eight first-order constructs. All items of the respective dimensions are captured on a 7-point Likert scale.

19.5. Analysis

To actualize the study's objective and to determine the research model's validity and reliability, we built on partial least squares-based structural equation modeling (PLS-SEM) analysis. To run the analysis, we used the software package SmartPLS 3 (Ringle, Wende, & Becker, 2015) The choice of PLS-SEM is considered appropriate for this study since it allows the simultaneous estimation of multiple relationships between one or more independent variables, and one or more dependent variables (Hair Jr & Hult, 2016). In contrast with other structural equation methods, PLS-SEM provides the advantage of (i) flexibility with respect to the assumptions on multivariate normality, (ii) use of both reflective and formative constructs, (iii) being able to compute complex models with smaller samples, (iv) allowing for robust estimation of formative constructs, and (v) allowing functionality as a predictive tool for theory building (Nair, Demirbag, Mellahi, & Pillai, 2018).

The use of PLS-SEM is widespread in the domain of information systems (IS) research, and specifically with regards to the estimation of complex relationships between constructs (Ahammad, Tarba, Frynas, & Scola, 2017; West, Hillenbrand, Money, Ghobadian, & Ireland, 2016). Furthermore, one of the advantages of PLS-SEM is that it allows for a calculation of indirect and total effects, which permits the simultaneous assessment of the relationships between multi-item constructs while reducing the overall error (Astrachan, Patel, & Wanzenried, 2014). In addition, the 93 responses analyzed as part of this study exceed both the requirements of: (1) ten times the largest number of formative indicators used to measure one construct, and (2) ten times the largest number of structural paths directed at a particular latent construct in the structural model (Hair et al., 2011). Lastly, since the research model is based on an exploratory study rather than a theory exploration, PLS-SEM is deemed as a more suitable alternative than covariance-based SEM.

19.5.1.Measurement model

Since our suggested research model includes reflective and formative constructs, we employed different assessment criteria to evaluate each. Furthermore, we included additional analyses for the higher-order construct used in the study (i.e., AI capabilities). The first step on the assessment of the measurement model was to assess the statistical properties of first-order reflective latent constructs. For these constructs we examined their reliability, convergent validity, and discriminant validity. We assessed reliability at the construct and item levels. For the former, we looked at the values of Composite Reliability (CR) and Cronbach Alpha (CA) and ensured that they were above the lower threshold of 0.70 (Nunnally, 1978). For the latter, we examined construct-to-item loadings, making sure that all were above the lower limit of 0.70 on their assigned construct (Appendix B). In gauging convergent validity, we used the Average Variance Extracted (AVE) values computed by SmartPLS to determine if all constructs surpassed the threshold of 0.50. The lowest observed value for first-order reflective constructs was 0.54, thus verifying that convergent validity was established. We examined discriminant validity by examining if each indicator loading was greater than its cross-loadings with other constructs (Appendix B), and by performing a Heterotrait–Monotrait ratio (HTMT) analysis (Henseler, Hubona, & Ray, 2016). All values in the HTMT ratio were lower than 0.85 which indicates that discriminant validity has been established (Appendix C). The detailed results are presented in Table 19.3, suggesting that the first-order reflective variables are valid to work with and are good indicators of their respective constructs.

	Construct	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Perceived Benefits	**0.90**														
2	Perceived Financial Cost	0.64	**0.96**													
3	Organizational Innovativeness	0.51	0.36	**0.89**												
4	Perceived Government Pressure	-0.05	-0.17	0.38	**0.87**											
5	Perceived Citizen Pressure	0.18	-0.16	0.32	0.41	**0.81**										
6	Government Incentives	0.40	0.35	0.26	-0.06	0.23	**0.92**									
7	Regulatory Guidelines	0.12	0.18	-0.13	-0.16	0.06	0.43	**0.93**								
8	Data	0.22	0.28	0.43	0.12	0.25	0.38	-0.36	**n/a**							
9	Technology	0.56	0.55	0.56	0.05	0.14	0.39	-0.30	0.83	**n/a**						
10	Basic Resources	0.49	0.49	0.46	-0.18	0.10	0.51	-0.32	0.82	0.87	**n/a**					
11	Technical Skills	0.56	0.52	0.38	0.13	0.11	0.46	-0.19	0.68	0.88	0.69	**0.88**				
12	Business skills	0.53	0.50	0.74	0.32	0.14	0.26	-0.19	0.63	0.83	0.66	0.71	**0.86**			
13	Inter-departmental Coordination	0.17	-0.08	0.64	0.64	0.45	0.08	-0.19	0.43	0.27	0.21	0.18	0.51	**0.88**		
14	Organizational Change Capacity	0.34	-0.02	0.66	0.52	0.57	0.09	0.02	0.27	0.25	0.21	0.10	0.53	0.75	**0.79**	
15	Risk Proclivity	0.42	0.36	0.71	0.33	0.27	0.16	-0.16	0.58	0.69	0.52	0.58	0.80	0.54	0.56	**0.90**
	Mean	4.65	4.50	3.83	3.99	4.72	2.54	3.14	2.85	3.36	2.41	2.43	3.10	4.63	4.75	3.61
	Standard Deviation	1.86	1.74	1.44	1.44	1.43	1.40	1.42	1.40	1.81	1.38	1.54	1.61	1.29	1.27	1.56
	AVE	0.80	0.92	0.76	0.75	0.66	0.84	0.86	n/a	n/a	n/a	0.77	0.73	0.78	0.63	0.82
	Cronbach's Alpha	0.94	0.96	0.87	0.71	0.80	0.91	0.95	n/a	n/a	n/a	0.96	0.95	0.95	0.88	0.89
	Composite Reliability	0.95	0.97	0.92	0.86	0.85	0.94	0.96	n/a	n/a	n/a	0.97	0.96	0.96	0.91	0.93

Table 19.3 Assessment of reliability, convergent, and discriminant validity of reflective constructs

For first-order formative constructs (Table 19.3) we started by assessing the weights and significance of items onto their respective constructs. Based on the suggestions of Cenfetelli and Bassellier (2009), even though formative constructs are likely to have some indicators with nonsignificant weights, they should not be removed as long as there is strong theoretical justification for their inclusion in the measurement model. We find that two items related to the Data first-order construct are nonsignificant (i.e., DT1 and DT3). Yet, since each of the items of the Data constructs captures important complementary aspects of the overall concept, we retain the two indicators with nonsignificant weights. Next, we examine the extent to which indicators of formative constructs may be subject to multicollinearity. For assessing potential multicollinearity issues, we examine variance inflation factor (VIF) values, making sure they were below the more conservative cut-off point of 3.3 (Petter, Straub, & Rai, 2007).

Construct	Measures	Weight	Significance	VIF
Data	DT1	0.072	$p > 0.05$	1.965
	DT2	0.214	$p < 0.001$	2.980
	DT3	0.119	$p > 0.05$	3.265
	DT4	0.568	$p < 0.001$	2.149
	DT5	0.260	$p < 0.001$	2.561
	DT6	0.191	$p < 0.001$	2.189
Technology	TC1	0.512	$p < 0.001$	2.533
	TC2	0.121	$p < 0.001$	3.067
	TC3	0.244	$p < 0.001$	2.682
	TC4	0.158	$p < 0.001$	1.370
	TC5	0.314	$p < 0.001$	1.207
	TC6	0.152	$p < 0.001$	2.633
	TC7	0.197	$p < 0.001$	2.579
Basic Resources	BR1	0.241	$p < 0.001$	3.201
	BR2	0.503	$p < 0.001$	2.536
	BR3	0.243	$p < 0.001$	2.963

Table 19.4 First-order formative construct validation

In sequence, and after having established that the lower-order items are good representations of the constructs they capture, we proceeded to ensure that second order and third order formative constructs were valid. We followed the same procedure, ensuring that the corresponding dimensions were statistically significant on their corresponding higher order construct, and that multicollinearity was not an issue by examining VIF values (Table 19.5).

Construct	Measures	Weight	Significance	VIF
Tangible	Data	0.402	$p<0.001$	2.767
	Technology	0.557	$p<0.001$	3.167
	Basic Resources	0.180	$p<0.001$	2.863
Human	Managerial Skills	0.507	$p<0.001$	2.039
	Technical Skills	0.573	$p<0.001$	2.039
Intangible	Inter-Departmental Coordination	0.546	$p<0.001$	2.382
	Organizational Change Capacity	0.342	$p<0.001$	2.470
	Risk Proclivity	0.250	$p<0.001$	1.527
BDAC	Tangible	0.370	$p<0.001$	3.012
	Human	0.508	$p<0.001$	3.133
	Intangible	0.261	$p<0.001$	3.088

Table 19.5 Higher-order formative construct validation

19.5.2. Structural model

The results of our structural model from the PLS analysis are depicted in Figure 19.1. In the figure, we present the explained variance of endogenous variables (R2), the standardized path coefficients (β), as well as representation of significance levels of the hypothesized associations. The outcomes of the analysis are gauged by examining the examining coefficient of determination (R2) values, predictive relevance (Stone-Geisser Q2), and the effect size of path coefficients. We obtain the significance of estimates (t-statistics) through the bootstrapping algorithm of SmartPLS running an analysis with 500 resamples. As shown in Figure 19.2, five of the seven hypotheses were found to be statistically significant. Specifically, we observe that the perceived benefits of AI do not have a significant impact on a firms AI capability (β=0.134, t=1.399, $p > 0.05$). On the other hand, organizational factors have an influence on the extent to which municipalities are able to foster their AI capabilities, with perceived financial costs (β=0.263, t=2.359, $p < 0.05$), and organizational innovativeness (β=0.323, t=2.991, $p < 0.01$) exhibiting positive and significant impacts. When looking at the impact of the environmental context, we find that perceived citizen pressure is the only factor not having a significant effect (β=0.078, t=0.674, $p > 0.05$). We do find, however, that perceived government pressure (β=0.188, t=2.358, $p < 0.05$), and government incentives (β=0.299, t=3.016, $p < 0.01$) both positively impact municipalities AI capabilities. Surprisingly, we find a significant negative effect of regulatory guidelines on an AI capability which goes against our hypothesis (β=-0.398, t=3.545, $p < 0.01$).

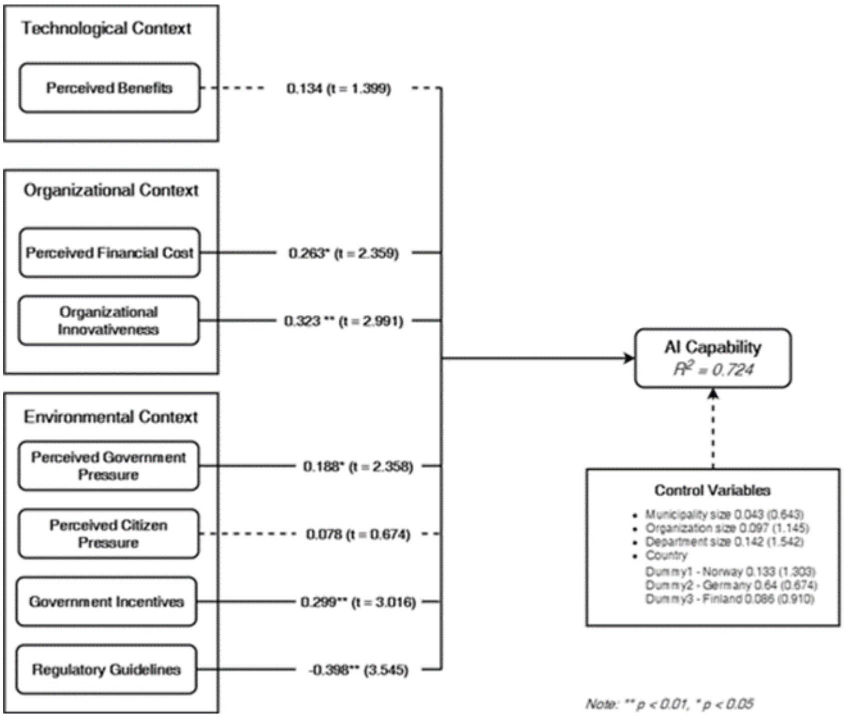

Figure 19.2 Results of the PLS-PM estimation (β* significant p<.01, β** significant p<.05, β* significant p<.1, n.s. = non-significant)**

The structural model explains 72.4% of variance for AI capabilities (R2 = 0.724). The coefficient of determination is extremely high, showcasing that the factors we have included in our analysis are important aspects in affecting the degree to which municipalities are able to foster their AI capabilities (Hair Jr, Hult, Ringle, & Sarstedt, 2016). Furthermore, to further verify our results we assess the model in terms of the effect size f2. In looking at the effect size f2 values, we are able to determine the contribution of each of the exogenous construct's contribution to the outcome variables (AI capabilities) R2. We find that five out of seven variables direct values being above the thresholds of either 0.15 or 0.35. These results enable us to conclude that the exogenous variables have moderate to high effect sizes. To verify the effect of confounding, we also assessed the impact that control variables have on the AI capability of municipalities. As shown in Figure 19.2, the influence of the control variables we included is found to be non-significant.

While the outcomes provide empirical support for some of our proposed relationships, we find that two are non-significant, and another two go against our theorizing. Specifically, we find that perceptions of the benefits of AI have no impact on whether a municipality will develop an AI capability. This outcome can be understood by the fact that there are likely other aspects that exert a stronger impact on ability of municipalities to develop an AI capability, such as a culture for innovativeness and the right mix of incentives and push from higher government, which likely render perceptions of value as less important. Similarly, we find that perceived citizen pressure does not play a role in the degree to which municipalities develop their AI capabilities, indicating that the push from citizens is either not present yet, or is not an influential factor that can prompt municipalities to foster AI in their operations. Our results also indicate two surprising findings. First, we find that the perceived financial cost of AI is positively associated with the development of an AI capability. This finding indicates that an understanding of the associated costs involved with adopting AI does not act as a hindrance for adoption, but rather, indicates that technology managers are aware of the associated investments and are able to plan for them. Second, we find that governmental guidelines in terms of AI-related processes act negatively in the formation of an AI capability. This surprising finding can be attributed to the fact that AI guidelines operate in a restricting manner, imposing constraints in rolling out AI applications instead of providing a coherent framework that can aid AI maturation in municipalities. In the next section we discuss in detail the theoretical and practical implications of our findings.

19.5.3. Predictive validity

Further to assessing R2 values, we also look at the Q2 predictive relevance of exogenous variables (Woodside, 2013). The predictive relevance score is a measure of how well values are reproduced by the model and its parameter estimates using sample re-use (Chin, 1998). This method is a combination of cross-validation and function fitting and calculates each construct predictive relevance by removing inner model associations and computing changes in the criterion estimates (q2) (Hair, Sarstedt, Ringle, & Mena, 2012). Values of Q2 that are larger than 0 are an indication that the structural model has strong predictive relevance. In contrast, values below 0 are a sign of low predictive relevance (Hair Jr et al., 2016). Our analysis shows that the only dependent variable that we have, AI capability, has a satisfactory predictive relevance (Q2 = 0.411). As the rest of the constructs of the TOE-framework are exogenous constructs, they do not have Q2 predictive relevance scores. Further on this analysis, q2 value are above the value of 0.35, indicating that the effect size of predictive relevance is high.

19.6. Discussion

In this study we have sought to understand the aspects that either enable or hinder the ability of municipalities to foster an AI capability. As an increasing number of municipal processes can now be replaced and improved using AI, understanding how to facilitate structured adoption and use is of great importance for being able to deploy such solutions and provide better services to citizens and businesses. To expand our understanding of this topic, we developed a research model that attempted to explore the impact that different technological, organizational, and environmental aspects have on government agencies AI capability levels. We selected an AI capability as the outcome of interest, as it more accurately captures the ability of municipalities to leverage the relevant AI resources towards organizational goals. In contrast, simply examining AI infrastructure investments would not be a good measure of how ready municipalities are to implement AI applications. We therefore built on prior empirical work and used an adapted measure of an AI capability to determine what factors have an important bearing on a municipality's ability to leverage relevant AI resources towards key objectives. Using primary survey-based data from key respondents in 93 municipalities of three

European nations, our results pinpoint to some interesting outcomes. In the next subsections we expand on the theoretical and practical relevance of these findings.

19.6.1. Implications for research

While the study of AI in organizations, particularly public ones, is still at a nascent level, research has started to examine applications of AI for public administration, as well as the supporting technologies required to deploy these (Wirtz et al., 2019). This study contributes to this direction by providing a more holistic perspective regarding AI leveragability. By introducing the notion of an AI capability for public bodies, and specifically municipalities, this work centers the importance not solely on the technological artifact, but on the ability of the organization to make effective use of it. In other words, the used notion of an AI capability more closely aligns with the concept of organizational readiness to deploy AI solutions to relevant stakeholders. Expanding the perspective of AI beyond just data, infrastructure, and algorithms, our outcome variable encapsulates the necessary complementary resources that enable government agencies to generate AI applications that can be readily rolled out. We therefore add to the existing body of knowledge by studying how key organizational digital capabilities (i.e., an AI capability) are shaped and formed in their relevant context.

Second, while there have been some studies examining how internal, organizational aspects related to municipalities influence their levels of AI adoption and use, few studies so far have examined the concurrent effect of external pressures and influences. Drawing on the TOE-framework, our study adds to the current body of research by investigating the competing enablers and inhibitors that influence AI capability levels in municipalities. By doing so, we consider internal characteristics such as perceptions of value and organizational innovativeness, as well as important aspects of the external environment. As top-government decisions have an important impact on actions of lower-level administration, it is important to understand how these forces coalesce to shape the AI capabilities of municipalities. In our study we also incorporate aspects relating to the perceived push from citizens and find some interesting results through our empirical analysis. The findings also reveal some surprising outcomes that generate further discussion about future research.

Specifically, we find that in the case of municipalities, the perceptions of senior-level IT managers on the value of AI have little impact on how much they are able to foster an AI capability. This finding can be attributed to the fact that an AI capability is not solely under the influence of the IT department and involves an organizational effort that requires synchronizations and planning from the top-down. In other words, to foster an AI capability, it is important that all departments are committed and are part of development efforts. This can be attributed to the fact that AI applications require data and input from domain experts that belong to different departments (Misuraca et al., 2020). It is therefore likely that organizational structure and decision-making appropriation play important roles in the ability of municipalities to build an AI capability. In addition, such an outcome may also mean that decentralizing decision-making and technology deployment in municipalities may not be an optimal solution when it comes to AI.

Our analysis also indicates some interesting results in relation to organizational factors that have an important role in shaping AI capabilities. We find support for the idea that innovativeness is associated with higher levels of AI capabilities, which confirms the understanding that the ability to make use of AI in municipalities is more associated with a general culture of adopting and embracing new ideas at an organizational level rather than at the individual level. This finding also shows that being able to prepare for leveraging AI is dependent on a prior developed capacity to innovate, which permeates the structure of the organization and sets some common values and targets. Furthermore, we find that perceptions of IT managers regarding the financial cost of AI to be associated with higher maturity of AI capabilities. This outcome can be explained by the fact that IT managers that have devoted the most time into planning their AI deployments are better aware of the incurred financial costs associated with such initiatives. As a result, IT managers that are able to develop a detailed plan for all costs before and during AI implementation, are also the most likely to have set in action the relevant resources to utilize such investments.

Finally, our analysis indicated some striking findings regarding the role of the external factors in shaping the levels of AI capabilities in municipalities. Specifically, we found that perceptions of citizen pressure do not have an impact on the level of AI capabilities developed internally. This can be explained in two different ways. First, that IT managers are not aware of opinions and attitudes of citizens regarding AI use for services that concern them, or do not have appropriate channels to communicate such opinions. Second, that the role of citizen-oriented AI applications is not on the primary list of objectives for many municipalities, that might seek more relevant and critical applications related to internal processes or interactions with other stakeholders. However, the other significant effect that we find points out to important facilitating and inhibiting forces. In detail, we find that perceptions of governmental pressure play a positive role in the development of an AI capability. This finding highlights that municipalities perceive that it is important to align with national strategies and directives regarding digital strategies, and particularly AI deployment (Niehaves et al., 2019). Furthermore, it suggests an important difference compared to private organizations where technology adoption is largely propelled by competition and costumer push (Dubey, Gunasekaran, Childe, Blome, & Papadopoulos, 2019).

In line with our argument, we also find that government incentives play an important role in developing AI capabilities. This outcome showcases the importance of not only providing some national strategies regarding AI deployment targets, but also following up with supportive measures to accelerate deployment and use of AI (Misuraca et al., 2020). In the case of municipalities that are public bodies, such incentives are very important, since they likely involve the required provision of cash flows and other resources needed to create strong AI capabilities. On the other hand, we find that regulatory guidelines have an impeding impact on the ability of municipalities to develop their AI capabilities. A potential explanation for this surprising finding can be that rules and regulations establish a strict operating framework which does not allow for the necessary flexibility and maneuvering to foster a municipal-wide AI capability. Such tight operating parameters can hinder the ability to access and use important data resources, for instance, or limit the transferability and re-use of existing important data sources.

19.6.2.Implications for practice

Apart from the contributions to the existing body of research, our study also points to some important practical implications that are of relevance for stakeholders at different levels. First, for IT managers in municipalities our findings suggest that they should consider the need to develop an organization-wide readiness perspective when deploying AI applications. Simply focusing on technology adoption through infrastructure investments and pools of data is unlikely to contribute towards value realization in AI-driven deployments. Furthermore, the findings underscore the importance of closely aligning organizational goals with managers of other domains in municipalities and fostering close ties of collaboration. Since AI applications require data and domain knowledge from different departments, it is important that there is a common understanding of the aims and goals of AI projects, and appropriate structures and processes have been put in action to accommodate these.

Furthermore, for senior administrative staff in municipalities the results show that it is important to balance both organizational aspects, such as a culture of innovativeness, with external relationships, such as negotiations with higher government bodies to ensure appropriate funding streams and regulatory frameworks that do not impede AI capability development. The issue of having access to sufficient governmental incentives for fostering AI capabilities is particularly heightened for smaller municipalities that most likely do not have the necessary additional resources required to foster AI alone. Furthermore, for such smaller municipalities having access to a sufficient quantity of data required to train AI applications is a major obstacle. Managers in such circumstances could opt for forming alliances or synergizing with other municipalities to co-create value and be able to enhance their AI capabilities.

From a policy-making point of view, it is important that strategic directions at a national level provide a sense of directions with specific goals that are relevant and attainable by municipalities when it comes to AI deployment. Furthermore, such directions need to be coupled with incentives that are aligned with the requirements of municipalities. Specifically, this means that the idiosyncratic requirements of different municipalities need to be considered, and appropriate aiding frameworks must be established to aid them in maturing their AI capabilities. Furthermore, in doing so it is important to have a clear understanding about what the main priorities and needs of citizens and relevant stakeholders in terms of AI-driven services are. Doing so will facilitate an alignment between the consumers and the providers of AI solutions, while ensuring that there are sufficient resources to foster required levels of AI capability within municipalities.

19.6.3. Limitations and future research

While our study contributes to the current body of research, it is not without limitations. First, the sample used in this study included only three countries in northern Europe, thus not being representative of the contingencies and contextual factors that may have an impact on governmental agencies in other countries. It is highly probable that in other countries, even within Europe, a completely different set of aspects may have an important influence on maturation of AI capabilities in municipalities. The three countries we collected data from in this study are largely homogenous in terms of availability of resources and socio-economic conditions. In countries characterized by economic austerity policies availability of incentives may not be present, and other forces may have an important impact on how municipalities develop their AI capabilities. Second, in this study we collected data that correspond to a snapshot in time. This has the limitation that we cannot examine a process-perspective of AI capability maturation, and the dynamics that shape and form them over time. Several additional internal and external aspects are therefore likely to emerge as inertial forces or key conditions in a municipalities ability to leverage AI effectively. Future studies can therefore focus on longitudinal studies to identify the evolution of such patterns of activity. Third, our analysis may likely not include other important factors that influence a national or regional level. For instance, distribution of authority between hierarchical levels of public administration may mean that in some countries there is greater liberty in crafting an AI strategy and implementing it in terms of an AI capability compared to others. An interesting future direction would therefore be to understand how the responsibilities assigned to municipalities play a role in their propensity to develop an AI competence.

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19.8. Appendix

19.8.1. Appendix A. Survey Instrument

Measure	Item
Perceived Direct Benefits	PB1. We expect that the use of AI will help us to improve data accuracy
	PB2. We expect that the use of AI will help us to improve security of data
	PB3. We expect that the use of AI will help us to improve operation efficiency
	PB4. We expect that the use of AI will help us to speed up processing applications
	PB5. We expect that the use of AI will help to reduce clerical errors (e.g. duplicate data sets).
Perceived Financial Costs	PF1. The use of AI requires high set-up costs.
	PF2. The use of AI requires high running costs.
	PF3. The use of AI requires high training costs.
Organizational Innovativeness	OI1. My organization readily accepts innovations based on research results.
	OI2. Management in my organization actively seeks innovative ideas.
	OI3. Innovation is readily accepted in this organization.
	OI4. People are penalized for new ideas that do not work. (*dropped*)
Perceived Government Pressure	PG1. Progressive mandatory measures are introduced by the government (e.g. indexes to measure the number of digital services).
	PG2. Regulations regarding online services for citizens are established.
Perceived Citizen Pressure	PC1. Our citizens want us to provide our services digital.
	PC2. Our citizens ask for digital services on a regular basis.
	PC3. Our citizens prefer municipalities who provide digital services.
Government Incentives	GI1. There are enough motives available from top government and policy makers to ensure that AI initiatives can be implemented.
	GI2. There are enough financial resources available from top government and policy makers to ensure that AI initiatives can be implemented.
	GI3. There are enough governmental initiatives available to ensure that AI initiatives can be implemented.

Regulatory Guidelines	RG1. Government provides us an official ethical framework for the use of AI in municipalities.
	RG2. Government provides us official policies on the use of AI in municipalities.
	RG3. Government provides us official AI-policies on data security and protection in municipalities.
	RG4. Government provides us clarification of legal issues for the widespread and long-term use of AI in municipalities.
AI Capability	
Tangible	
– Data	D1. We have access to very large, unstructured, or fast-moving data for analysis
	D2. We integrate data from multiple internal sources into a data warehouse or mart for easy access
	D3. We integrate external data with internal to facilitate high-value analysis of our business environment
	D4. We have the capacity to share our data across organizational units and organizational boundaries.
	D5. We are able to prepare and cleanse AI data efficiently and assess data for errors
	D6. We are able to obtain data at the right level of granularity to produce meaningful insights
– Technology	T1. We have explored or adopted cloud-based services for processing data and performing AI and machine learning
	T2. We have the necessary processing power to support AI applications (e.g. CPUs, GPUs)
	T3. We have invested in networking infrastructure (e.g. enterprise networks) that supports efficiency and scale of applications (scalability, high bandwidth, and low-latency)
	T4. We have explored or adopted parallel computing approaches for AI data processing
	T5. We have invested in advanced cloud services to allow complex AI abilities on simple API calls (e.g. Microsoft Cognitive Services, Google Cloud Vision)
	T6. We have invested in scalable data storage infrastructures
	T7. We have explored AI infrastructure to ensure that data is secured from to end to end with state-of-the-art technology
– Basic Resources	BR1. The AI initiatives are adequately funded
	BR2. The AI project has enough team members to get the work done
	BR3. The AI project is given enough time for completion
Human Skills	
– Technical Skills	TS1. Our organization has access to internal talent with the right technical skills to support AI work
	TS2. Our organization has access to external talent with the right technical skills to support AI work
	TS3. Our data scientists are very capable of using AI technologies (e.g. machine learning, natural language processing, deep learning)
	TS4. Our data scientists have the right skills to accomplish their jobs successfully
	TS5. Our data scientists are effective in data analysis, processing, and security
	TS6. Our data scientists are provided with the required training to deal with AI applications
	TS7. We hire data scientists that have the AI skills we are looking for
	TS8. Our data scientists have suitable work experience to fulfill their jobs
– Business skills	BS1. Our managers are able to understand business problems and to direct AI initiatives to solve them
	BS2. Our managers are able to work with data scientists, other employees and customers to determine opportunities that AI might bring to our organization
	BS3. Our managers have a good sense of where to apply AI
	BS4. The executive manager of our AI function has strong leadership skills
	BS5. Our managers are able to anticipate future business needs of functional managers, suppliers and customers and proactively design AI solutions to support these needs
	BS6. Our managers are capable of coordinating AI-related activities in ways that support the organization, suppliers and citizens
	BS7. We have strong leadership to support AI initiatives.
	BS8. Our managers demonstrate ownership of and commitment to AI projects.
	BS9. Our managers demonstrate an exemplary attitude to the use of AI.
Intangible	

– Inter-Departmental Coordination	*Please indicate to what extent do departments within your organization engage in the following activities:*
	IC1. Collaboration
	IC2. Collective goals
	IC3. Teamwork
	IC4. Same vision
	IC5. Mutual understanding
	IC6. Shared information
	IC7. Shared resources
– Organizational Change Capacity	OC1. Our organization is able to anticipate and plan for the organizational resistance to change.
	OC2. Our organization follows appropriate regulations when reengineering processes.
	OC3. Our organization acknowledges the need for managing change.
	OC4. Our organization is capable of communicating the reasons for change to the members of our organization.
	OC5. Our organization is able to make the necessary changes in human resource policies for process re-engineering.
	OC6. Our management commits to new values in our organization.
– Risk Proclivity	RP1. In our organization we have a strong proclivity for high risk projects (with chances of very high returns)
	RP2. In our organization we take bold and wide-ranging acts to achieve firm objectives
	RP3. We typically adopt a bold aggressive posture in order to maximize the probability of exploiting potential opportunities

19.8.2. Appendix B. Cross loadings

	PB	PF	OI	PG	PC	GI	RG	D	T	BR	TS	BS	IC	OC	RP
PB1	**0.918**	0.563	0.381	-0.066	0.230	0.435	0.263	0.222	0.523	0.426	0.502	0.488	0.171	0.360	0.310
PB2	**0.914**	0.549	0.478	-0.115	0.167	0.324	0.078	0.216	0.536	0.448	0.485	0.403	0.123	0.272	0.386
PB3	**0.925**	0.615	0.490	-0.103	0.255	0.385	0.157	0.214	0.479	0.443	0.516	0.490	0.170	0.348	0.459
PB4	**0.939**	0.746	0.410	-0.162	0.088	0.484	0.092	0.263	0.596	0.586	0.629	0.503	0.021	0.223	0.346
PB5	**0.766**	0.330	0.530	0.256	0.028	0.135	-0.089	0.038	0.350	0.245	0.353	0.494	0.279	0.330	0.386
PF1	0.700	**0.953**	0.449	-0.157	-0.100	0.337	0.143	0.291	0.563	0.535	0.488	0.532	-0.043	0.134	0.471
PF2	0.564	**0.956**	0.263	-0.193	-0.095	0.329	0.182	0.299	0.547	0.473	0.530	0.452	-0.105	-0.123	0.268
PF3	0.543	**0.967**	0.288	-0.141	-0.288	0.330	0.207	0.206	0.465	0.394	0.460	0.437	-0.088	-0.102	0.268
OI1	0.579	0.446	**0.917**	0.203	0.328	0.291	-0.070	0.391	0.593	0.468	0.445	0.696	0.488	0.510	0.652
OI2	0.351	0.307	**0.867**	0.438	0.099	0.207	-0.121	0.404	0.462	0.416	0.239	0.717	0.601	0.651	0.668
OI3	0.414	0.178	**0.889**	0.399	0.422	0.195	-0.169	0.340	0.435	0.329	0.319	0.558	0.626	0.625	0.581
PG1	-0.074	-0.383	0.351	**0.839**	0.481	-0.031	-0.238	0.094	0.031	-0.153	0.092	0.184	0.589	0.435	0.238
PG2	-0.024	0.040	0.319	**0.897**	0.261	-0.072	-0.051	0.106	0.058	-0.160	0.129	0.361	0.530	0.474	0.322
PC1	0.147	-0.118	0.108	0.331	**0.774**	0.210	0.265	0.128	0.041	-0.045	0.003	0.055	0.356	0.487	0.039
PC2	0.195	-0.026	0.050	0.256	**0.763**	0.287	0.374	0.060	0.028	-0.026	0.016	0.011	0.201	0.390	-0.023
PC3	0.132	-0.175	0.401	0.381	**0.894**	0.150	-0.150	0.299	0.180	0.182	0.152	0.184	0.433	0.496	0.386
GI1	0.419	0.371	0.282	-0.142	0.116	**0.953**	0.308	0.455	0.489	0.623	0.552	0.316	0.053	0.096	0.206
GI2	0.358	0.236	0.251	-0.003	0.373	**0.949**	0.436	0.342	0.290	0.409	0.340	0.164	0.109	0.111	0.140
GI3	0.293	0.343	0.135	0.066	0.176	**0.845**	0.559	0.120	0.180	0.205	0.259	0.163	0.046	-0.003	0.000
RG1	0.133	0.302	-0.026	-0.082	0.011	0.320	**0.843**	-0.267	-0.124	-0.226	-0.022	-0.023	-0.147	-0.046	0.037
RG2	0.159	0.139	-0.131	-0.052	0.084	0.315	**0.949**	-0.418	-0.345	-0.400	-0.233	-0.200	-0.154	0.088	-0.162
RG3	0.095	0.218	-0.135	-0.211	0.006	0.482	**0.942**	-0.318	-0.256	-0.241	-0.166	-0.190	-0.203	-0.024	-0.174
RG4	0.067	0.115	-0.145	-0.214	0.084	0.456	**0.973**	-0.308	-0.297	-0.266	-0.201	-0.208	-0.201	-0.002	-0.193
D1	0.240	-0.021	0.354	0.373	0.302	0.051	-0.161	**0.712**	0.486	0.292	0.427	0.442	0.481	0.468	0.496
D2	-0.071	0.141	0.128	0.073	0.060	0.222	-0.295	**0.792**	0.577	0.551	0.444	0.269	0.206	-0.009	0.316
D3	0.218	0.104	0.291	0.135	0.308	0.148	-0.470	**0.775**	0.573	0.595	0.443	0.329	0.451	0.256	0.510

D4	0.297	0.270	0.480	0.135	0.244	0.346	-0.405	**0.918**	0.803	0.793	0.693	0.702	0.445	0.307	0.651
D5	0.013	0.134	0.287	0.100	0.269	0.303	-0.315	**0.812**	0.643	0.618	0.536	0.384	0.316	0.117	0.341
D6	0.369	0.399	0.315	-0.070	0.251	0.375	-0.164	**0.768**	0.590	0.745	0.394	0.421	0.344	0.324	0.388
T1	0.679	0.416	0.476	-0.038	0.237	0.402	-0.196	0.690	**0.852**	0.800	0.692	0.711	0.308	0.315	0.521
T2	0.289	0.340	0.458	0.181	0.276	0.140	-0.279	0.600	**0.728**	0.537	0.596	0.647	0.278	0.311	0.565
T3	0.181	0.456	0.427	0.056	-0.055	0.157	-0.271	0.589	**0.721**	0.604	0.510	0.638	0.079	0.178	0.551
T4	0.406	0.391	0.199	0.228	-0.032	0.268	-0.123	0.498	**0.724**	0.455	0.816	0.599	0.152	0.030	0.456
T5	0.360	0.433	0.301	0.199	0.013	0.211	-0.193	0.605	**0.779**	0.519	0.855	0.643	0.195	0.014	0.611
T6	0.137	0.240	0.404	0.111	0.105	0.253	-0.447	0.530	**0.750**	0.546	0.609	0.447	0.023	0.076	0.397
T7	0.481	0.574	0.422	0.067	0.019	0.429	-0.098	0.656	**0.796**	0.679	0.820	0.647	0.247	0.154	0.496
BR1	0.411	0.484	0.441	-0.095	-0.096	0.396	-0.344	0.698	0.795	**0.904**	0.592	0.648	0.158	0.158	0.489
BR2	0.384	0.373	0.244	-0.104	0.206	0.583	-0.175	0.634	0.716	**0.837**	0.641	0.505	-0.007	0.087	0.325
BR3	0.467	0.455	0.381	-0.169	0.185	0.568	-0.258	0.781	0.837	**0.968**	0.697	0.606	0.132	0.172	0.456
TS1	0.578	0.425	0.318	0.231	0.051	0.122	-0.296	0.368	0.628	0.383	**0.803**	0.520	0.174	0.118	0.351
TS2	0.477	0.719	0.328	-0.058	-0.045	0.461	-0.019	0.528	0.742	0.629	**0.791**	0.626	0.037	0.013	0.369
TS3	0.445	0.441	0.304	0.181	0.061	0.383	-0.230	0.644	0.816	0.618	**0.967**	0.664	0.185	0.014	0.578
TS4	0.404	0.370	0.233	0.198	-0.030	0.339	-0.328	0.544	0.714	0.545	**0.928**	0.544	0.112	-0.049	0.433
TS5	0.470	0.495	0.401	0.070	0.112	0.522	-0.181	0.799	0.899	0.777	**0.952**	0.712	0.204	0.098	0.643
TS6	0.431	0.390	0.322	-0.044	0.100	0.585	-0.017	0.701	0.812	0.752	**0.819**	0.677	0.214	0.170	0.548
TS7	0.614	0.388	0.340	0.190	0.291	0.460	-0.131	0.578	0.755	0.562	**0.861**	0.576	0.194	0.209	0.518
TS8	0.559	0.418	0.409	0.151	0.200	0.337	-0.160	0.583	0.808	0.540	**0.911**	0.687	0.125	0.147	0.611
BS1	0.210	0.166	0.716	0.588	0.279	-0.039	-0.321	0.512	0.576	0.340	0.484	**0.822**	0.639	0.556	0.793
BS2	0.243	0.127	0.698	0.554	0.396	0.100	-0.194	0.463	0.586	0.388	0.444	**0.845**	0.628	0.634	0.705
BS3	0.492	0.435	0.592	0.350	0.135	0.201	0.053	0.339	0.563	0.385	0.475	**0.825**	0.353	0.482	0.770
BS4	0.454	0.593	0.567	0.246	0.134	0.188	-0.129	0.540	0.731	0.562	0.641	**0.895**	0.268	0.361	0.647
BS5	0.495	0.390	0.692	0.232	0.343	0.314	-0.042	0.621	0.719	0.618	0.538	**0.890**	0.527	0.638	0.781
BS6	0.562	0.586	0.616	0.180	0.144	0.301	0.059	0.572	0.748	0.594	0.558	**0.859**	0.389	0.485	0.648
BS7	0.547	0.513	0.691	0.217	-0.093	0.288	-0.176	0.545	0.784	0.648	0.696	**0.917**	0.465	0.409	0.644
BS8	0.463	0.540	0.606	0.053	-0.157	0.339	-0.283	0.636	0.830	0.771	0.744	**0.861**	0.325	0.256	0.577
BS9	0.568	0.411	0.545	0.173	0.034	0.223	-0.389	0.574	0.795	0.647	0.831	**0.782**	0.400	0.326	0.650
IC1	0.221	0.042	0.547	0.549	0.457	0.205	0.015	0.399	0.309	0.205	0.217	0.470	**0.888**	0.656	0.417
IC2	0.198	-0.169	0.614	0.565	0.489	0.037	-0.207	0.401	0.241	0.173	0.122	0.431	**0.934**	0.687	0.482
IC3	0.152	-0.092	0.621	0.525	0.383	0.069	-0.218	0.436	0.248	0.246	0.125	0.480	**0.953**	0.716	0.489
IC4	0.273	-0.030	0.647	0.515	0.469	0.264	-0.157	0.431	0.356	0.330	0.320	0.551	**0.850**	0.724	0.522
IC5	0.092	-0.098	0.569	0.587	0.393	-0.103	-0.253	0.332	0.154	0.104	0.103	0.393	**0.853**	0.652	0.618
IC6	0.093	-0.002	0.566	0.644	0.295	0.019	-0.232	0.397	0.249	0.176	0.182	0.515	**0.921**	0.658	0.462
IC7	-0.056	-0.159	0.319	0.575	0.228	-0.050	-0.108	0.190	0.080	-0.006	-0.002	0.285	**0.754**	0.493	0.285
OC1	0.101	-0.318	0.384	0.385	0.419	-0.040	-0.265	0.224	0.090	0.126	0.000	0.258	0.709	**0.729**	0.301
OC2	0.329	-0.029	0.453	0.520	0.662	0.228	0.167	0.139	0.093	0.084	0.089	0.315	0.521	**0.792**	0.369
OC3	0.320	0.054	0.522	0.354	0.318	0.050	-0.077	0.179	0.216	0.225	0.100	0.424	0.507	**0.824**	0.339
OC4	-0.014	-0.155	0.228	0.286	0.569	0.188	0.320	0.055	-0.083	0.018	-0.198	0.120	0.453	**0.756**	0.278
OC5	0.370	0.189	0.667	0.301	0.292	0.030	0.127	0.262	0.383	0.246	0.218	0.598	0.439	**0.722**	0.598
OC6	0.433	0.117	0.786	0.575	0.457	0.011	-0.085	0.343	0.390	0.246	0.200	0.678	0.818	**0.907**	0.681
RP1	0.501	0.466	0.663	0.163	0.058	0.080	-0.186	0.500	0.690	0.498	0.605	0.744	0.475	0.323	**0.853**
RP2	0.358	0.359	0.710	0.323	0.332	0.239	-0.246	0.636	0.690	0.594	0.546	0.775	0.479	0.502	**0.939**
RP3	0.303	0.183	0.571	0.378	0.310	0.099	-0.021	0.431	0.504	0.338	0.446	0.665	0.502	0.660	**0.917**

19.8.3. Appendix C. Heterotrait-Monotrait ratio (HTMT)

	Construct	1	2	3	4	5	6	7	8	9	10	11	12
1	Perceived Benefits												
2	Perceived Financial Cost	0.656											
3	Organizational Innovativeness	0.563	0.373										
4	Perceived Government Pressure	0.215	0.304	0.510									
5	Perceived Citizen Pressure	0.236	0.175	0.335	0.530								
6	Government Incentives	0.410	0.368	0.267	0.138	0.352							
7	Regulatory Guidelines	0.161	0.222	0.144	0.234	0.342	0.502						
8	Technical Skills	0.593	0.540	0.410	0.197	0.170	0.448	0.200					
9	Business skills	0.556	0.506	0.812	0.413	0.247	0.258	0.210	0.733				
10	Inter-departmental Coordination	0.204	0.117	0.698	0.807	0.454	0.149	0.209	0.198	0.541			

11	Organizational Change Capacity	0.387	0.227	0.738	0.660	0.657	0.157	0.254	0.218	0.576	0.793	
12	Risk Proclivity	0.474	0.393	0.814	0.406	0.276	0.173	0.184	0.633	0.781	0.579	0.608

20. Smart Cities as Hubs

Paper Number	**P13**
Title	**Smart Cities as hubs: can this be their "ultimate" mission?**
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Table 20.1 Fact Sheet Publication

Smart Cities as hubs: can this be their "ultimate" mission?

Abstract. It has been more than 20 years since the initial appearance of the term smart city (SC) in the literature. The SC scope ranges, and it is being seen from different perspectives by alternative actors with quite competitive interests. In contextual terms, the SC is being transformed to a service-oriented ecosystem. In terms of policy and objectives the SC mostly deals with sustainable challenges and urban growth. However, in terms of artefacts, all the emerging technologies are being combined or struggle to play an extensive role in SC; while in terms of people, skills and social engagement are being encouraged. However, practice shows that the SC scope has a limited application, since it is mostly being capitalized for utility upgrades or for urban renovation, while Internet-of-Things (IoT)-readiness enables real-time city monitoring. The aim of this theoretical paper is to discuss the fact that the mission of SC seems to have been accomplished: SC are being transformed to hubs that collect, process, and transmit data and services; bring together people to co-design; or control material flows. Aligning to the smart city of Lohmar, which gets funded by the Federal Ministry of the Interior, Building and Community of Germany and their project "Smart Cities made in Germany" since 2020, this paper attempts to define the role and the architecture of this "SC-as-a-hub operation", which can standardize and control all flows across smart cities.

Keywords: smart city, hub, IoT, data, smart services, architectures

20.1. Introduction

Lohmar is a rural municipality in the exurbs of Cologne and Bonn in North Rhine-Westphalia, Germany. It is located on the Agger between the "Wahner" heather in the west and the "Naafbachtal" nature reserve in the east. "Loh" stands for forest (nature reserve) and "mar" for waters (Agger). For its approximately 30,000 inhabitants the city of Lohmar wants to be and remain attractive and worth living in (City of Lohmar, 2013). For Lohmar, this can only be achieved in combination with digital transformation processes. That is why Lohmar has set itself an overriding objective: "Lohmar | Digital | For everyone" (City of Lohmar 2020).

In 2020, Lohmar submitted an application for the call "Smart Cities made in Germany" from the Federal Ministry of the Interior, Bulding and Community (BMI), namely "Rhenish.Bergish.Smart.Mobil" (RBS.Mobil). Approved at the end of 2020, the realization of RBS.Mobil is starting in 2021. RBS.mobil contains seven projects. The first project to be implemented contains Lomar's idea to let the smart city's digital self be represented as a hub, where stakeholders can easily connect to using their technologies.

Considering the term *smart city* (SC) in general, its evolution has followed specific patterns in the last 20-years (Anthopoulos, 2017). This evolution can be translated to norms that dealt with emerging political challenges: they started with Internet connectivity requirements in the early 1990s; followed by taking advantage of the Information and Communications Technologies (ICT) for urban growth in the early 2000s; and turned to innovation that can ensure urban sustainability –in environmental, economic and social terms- in the early 2010s. Today, it is more likely to consider SC as a "necessary advancement" for cities' evolution to sustainable, friendly and resilient cities and all cities perform planning to adopt ICT solutions for their future.

Cities around the world changed their missions during this SC evolution. The most agile cases that attempted to utilize these SC evolution patterns for their own good are e.g., Amsterdam and Barcelona defining a roadmap for their development. Moreover SCs around the world can be classified in specific clusters, according their evolving SC story: cities focusing on people and innovation, and utilize their fame, cohesion and size to co-define their future (e.g., Melbourne and Washington DC); cities attempting to embed ICT to provide smart services to their communities (numerous cities offering advanced parking; lighting etc. services); cities renovating or developing brand-new districts with fully-automated smart services (i.e., waste collection and process, remote contro,; interactivity with utilities in Songdo, Aspern, Kista, Sidewalk Toronto); and cities from-scratch that provide large-scale smart services (e.g., Dubai, Masdar, Tianjin).

Moreover, the SC evolution is based on big vendors' support, which try to define common SC values gaining most of their proportions. However, other stakeholders try to take advantage of the SC development, regardless the class that the SC belongs to. Governments for instance try to open their data and other facilities to co-design with citizens gaining trust, citizens try to simplify their daily procedures (i.e., locate the appropriate transportation means according to weather or traffic conditions), and start-uppers try to take advantage of data and of new market opportunities.

On the other hand, standardization tries to clarify the SC regarding their definition and conceptualization and via homogenizing the emerging technologies (i.e., smart lighting, smart parking, blockchain etc.). The International Standards Organization (ISO) have released several standards for the SC, while quite recently they have published indexes for SC in the

ISO 37122 document (ISO, 2019) and benefit maps from SC investments (ISO, 2015), while the ITU has defined specifications the circular economy (ITU, 2019c).

A huge variety of fixed or portable devices (i.e., sensors, cameras, meters, actuators, RFIDs), the so-called Internet of Things (IoT), and applications (i.e., online social networks (OSNs), web platforms, mobile applications, etc.) enable data generation and collection (Moustaka et al., 2018a), together with new business models and market opportunities. These amounts of heterogeneous urban data streams, generated from numerous data sources in the urban space, result in the transition from "data-informed urbanism" to "data-driven urbanism" (Kitchin, 2016). These sources enable the deployment of several innovative smart services (i.e., waste bin capacity monitoring; water loses; energy demands etc.) as well as behavior analysis (i.e., complaints registration; public Wi-Fi use; transportation routes' change etc.). Nevertheless, the primary role is still played by the big vendors, which attempt to lead this campaign with city management platforms: CISCO Kinetic (CISCO, 2017); Intel City Manager (Intel, 2016); and ESRI Geovent Server (ESRI, 2018), are only some of the platforms, which have been developed by big SC vendors, while products like Invipo (Incinity, 2017) is produced by a new entrant. They all depict visualize real time data and they are accompanied by cloud-based (e.g., Amazon Cloud□ for Intel and Microsoft Azure□ for Invipo accordingly) and by geolocation services.

This SC progress transforms the city to a "connected space", where information, services, materials, and people flow and utilize innovation and technology to monitor, manage and enhance this flow. It looks like the SC plays the role of "hub", where anyone could connect and gain access to the above flows. This paper observed this phenomenon, providing a foundation for the city of Lohmar, and aims to answer the following research questions:

RQ1: How SC is being transformed to a hub?

RQ2: What could be this SC Hub's role and architecture?

Both these questions are important to be answered since, first this "SC hubness" must be confirmed (RQ1), while this "SC hubness" determination (RQ2) will help the cities and communities to host "an umbrella system" (the so-called "SC Hub"), which will be scalable, open and cross-SC-platform enabled. Additionally, when this hub will be clarified in technological terms, it can show how it can be "parameterized" to serve any type of city, in our case first the smart city of Lohmar, and the flows that it serves can be standardized. As such, the contribution of this study is twofold: it (i) determines that the SC conceptualization is accomplished: several city management platforms integrate numerous smart services and transform cities to ICT-based hubs, and (ii) provides with the architecture this SC Hub approach building a foundation for the smart city of Lohmar.

The rest of this paper is structured as follows: *Section 2* uses facts and theoretical evidence to prove this SC Hub transformation. *Section 3* defines the architecture of this SC Hub approach. *Section 4* shows how this approach can be measured. The paper ends with *Section 5*, which contains some conclusions and future perspectives.

20.2. Background

SC has been defined and conceptualized by the international standards, under a typical process for innovation clarification (Anthopoulos, 2017). However, even the international standards differentiate and they define the SC as *a city model that uses state-of-the art ICT to a) improve living, efficiency and competitiveness with respect to future generations* (ITU, 2014) *or to b) facilitate the planning, construction, management and smart services* (ISO, 2015); while the "smartness" of a city describes *its ability to bring together all its resources, to effectively and seamlessly achieve the goals and fulfil the purposes it has set itself* (ISO, 2015).

The above definitions place some features for the SC: a) the incorporation of cutting-edge ICT and of ICT innovation; b) the use of this technology for connecting the city resources, for delivering enhanced services and for meeting specific targets (i.e., city efficiency and effectiveness; livability). Today, cutting-edge ICT concern different existing or emerging technologies (i.e., cloud; edge computing; data analytics; IoT; Artificial Intelligence (AI); 5G and 6G connectivity; blockchain; FinTech services etc.), which are being evolved and enable city's digital transformation (ITU, 2019; ITU, 2020). The combination of these technologies is a complex process that relies on open technologies and follows a specific architecture (Anthopoulos et al., 2015), which is being adopted by a city. Numerous cases around the world try to implement SC strategies (Anthopoulos, 2019). Cities define their missions, embed technology in city facilities (IoT), collect and analyze data to improve their efficiency, deliver different types of smart services around the SC dimensions (people, mobility, economy, governance, environment, living) (Giffinger and Gudrun, 2010), engage their communities around designing and improving these services, work on attracting visitors, citizens and businesses, and design means with the ICT to deal with recent and future challenges (i.e., resilience, climate change, poverty etc.) that have been labeled by the United Nations (UN) as strategic development goals (SDGs) (United Nations, 2014).

Existing implementations show that the SC development today is based primarily on the above achievements, and in terms of technology on *IoT* embedded facilities, *telecommunication networks* that collect data from them (i.e., Bluetooth Low Energy, LoRA, ZigBee, Insteon, 3G, 4G, 5G etc.) (Ray, 2016), *city dashboards* (Kitchin, 2014) - also labeled "IoT platforms" or "city platforms" (Fahmideh and Zowgi, 2020)- that visualize them; and *applications* that transact with the dashboards. A *city platform* is defined as *a computer system or integration of computer systems that, under control of the city, uses information and ICT to access data sources and process them to offer urban operation and services to the city* (ITU, 2018). Similarly, a *SC platform* is a *city platform that offers direct integration of city platforms and systems, or through open interfaces between city platforms and third parties, to offer the urban operation and services supporting the functioning of city services, as well as efficiency, performance, security, and scalability* (ITU, 2018). This approach aligns to the overall "city as platform" approach that has also been discussed (IBM, 2012).
These implementations show that "IoT" and "platform" are crucial for SC development and indeed, their combination returned numerous articles in late January 2020 and late January 2021 from known scientific resources (Table 20.2). Only a few of the results appear to be relative to the context of a software dashboard with city data. This evidence shows that the term "smart city platform" (Teslya et al., 2019) emerges, while it is also seen as "smart city control system" (Sanchez et al., 2019).

SOURCE	***"smart city" AND "platform" AND "IoT"***		***"smart city platform"***	
	Jan. 2020	Jan. 2021	Jan. 2020	Jan. 2021
SCOPUS®	690	955	94	118
Google SCHOLAR®	26,400	37,600	1,170	1,540
Science Direct®	1,736	2,736	77	107

Table 20.2 Results from scientific resources

A brief look on the extracted review articles show that several platform installations exist around the world. Some cities use open platforms (i.e., FIWARE (2020) in Takamatsu city, Japan (Ishii and Yamanaka, 2018) and ThingSpeak in Cape Cod, Massachusetts), while others have installed commercial products that serve the demand for city's data collection, analysis and visualization, for its application development, and for remote utility monitoring, management and integration (Nakhuva and Champaneria, 2015; Mineraud et al., 2016; Ray, 2016; Zdraveski et al., 2017; Anthopoulos, 2019) (Table 20.3).

City platform product	Source
Cisco Kinetic	Cisco (2020; 2017)
Siemens Mindsphere	Siemens (2018)
Microsoft Citynext; Microsoft Azure Digital Twin	Microsoft (2020;2019;2013)
IBM Intelligent Operations Center	IBM (2020), Bhowmick et al. (2012)
Intel City Manager	Intel (2016)
SAP Future Cities Software	SAP (2020)
HUAWEI Intelligent Operation Center Solution	Huawei (2020; 2018; 2013)
Hitachi Visualization Suite	Hitachi (2020; 2019)
CA	CA Technologies (2019)
Invipo Smart City Platform	Invipo (2020)
Telenavis	Telenavis (2020)
other IoT platforms: KAA, Temboo, SeeControl IoT, SensorCloud, Etherios, Xively, Ayla's IoT cloud fabric, thethings.io, Exosite, Arrayent, OpenRemote, Arkessa, Axeda, Oracle IoT cloud, Nimbits, ThingWorx, InfoBright, Jasper Control Center, Echelon, AerCloud, Plotly, ThingWorx, GroveStreams, Zetta etc.	Nakhuva and Champaneria (2015); Mineraud et al. (2016); Ray (2016)

Table 20.3 Representative products for SC platform (January 2020)

Figure 20.1 A generic SC platform architecture

The analysis of the above products shows that all these platforms are cloud-based and are being offered with the Software-as-a-Service (SaaS) model. A generic architecture that is being followed can be depicted in the following (Figure 20.1) and shows that the SC software platform is accompanied by Application Programming Interfaces (APIs) that enable connections with IoT in the city, local systems, and other software applications. Additionally, the SC platform offers secure identities (IDs) for these connections and software utilities (SDKs) to the developers, who want to visualize the data that their applications share with the platform. The platform can visualize the data that it collects from its API connections by validated connected contributors. Due to the increasing number of SC platforms, standardization processes have been performed (i.e., ITU (2018); ISO (2020)) to define corresponding specifications and interoperability features, while others are on the go (ITU, 2021).

20.3. The concept of "smart city as hub"

According to the definitions that were previously discussed, the purpose of the SC, and in our case the smart city of Lohmar, is to utilize cutting- edge information communication technologies (ICT) to deal with significant challenges like, improving the quality of local life and sustainable local growth. SCs are not only based on ICT but, several drivers (e.g., efficient services, appropriate connections between various systems in the cities, shared city infrastructure, operations' monitoring) affect their development (Hollands, 2008; Komninos, 2008; Wenge et al., 2014). Additionally, Pourzolfaghar and Helfert (2017a) emphasized integration, information sharing and communication between many systems for making a city smart. This implies that contrary to the traditional cities, the SC requires innovation and infrastructure connection and cross-border transactions with data from different systems and formats (Bischof et al., Anthopoulos and Fitsilis, 2010). Consequently, the effective information exchange between different systems and smart services, together with and the provision of high-quality information are two important issues for a SC. Cross- border transactions in SC is hard to be performed in an efficient and effective way, while smart services and in general city performance must be measured and monitored with the use of key performance indicators (KPIs). Many KPIs are not simple and they require data from several sources for their calculation. Indicatively, the ISO (2015) and the ITU (ITU, 2017; 2014) defined several KPIs to measure how smart and sustainable a city is and recently they concluded on a global index entitled "United for Smart Sustainable City Index (SSC-Index)" (ITU, 2019b). The dynamic collection and combination of data requires the appropriate APIs to connect the corresponding sources.

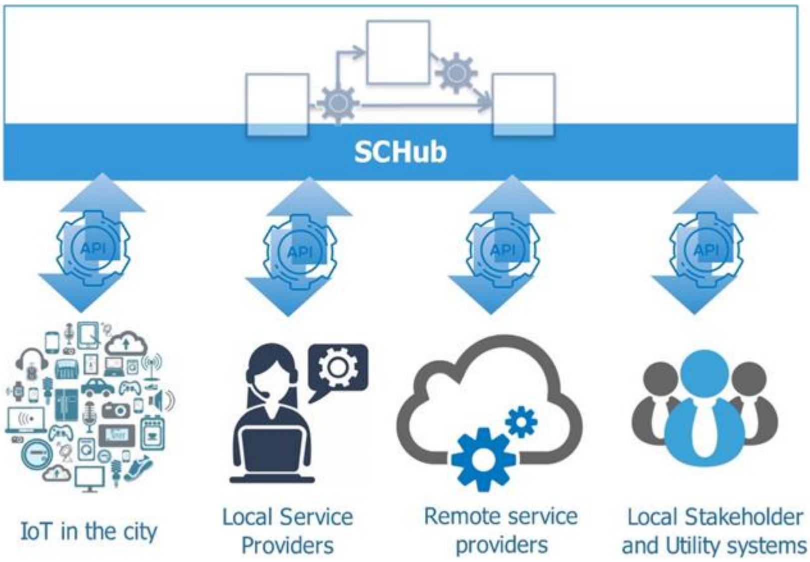

Figure 20.2 The concept of the SC Hub

The existing role of the SC platforms (Figure 20.1), together with this requirement for KPI measurement, introduces the idea of the SC as a hub (or SC Hub), which is inspired from the typical network hub. A typical network/ethernet hub enables the alternative ICT devices to connect and exchange data according to the IEEE 802.3 standard (IEEE, 2019), regardless their purpose (e.g., printer, PC, TV etc.). In similar terms, when a partner wants to connect with the SC, or in our case the SC of Lohmar, to gain access to the available information and services or to offer information and services, the partner should be able to "connect" to the SC Hub (Figure 20.2) like it happens with the SC platform (Figure 20.1). The difference with the SC platform is that the SC Hub does not oblige data to be gathered and stored in a common repository or cloud (that normally belongs to the SC platform's vendor), nor necessarily to be visualized in a specific dashboard (but potentially numerous), while the developers should not follow specific but open SDKs (e.g., the CitySDK (CitySDK, 2012)). More specifically, the SC Hub should offer APIs (like network slots) to the IoT local owners, the local public and private service providers, the remote service providers (e.g., distant cloud-based services), and the local stakeholders and utility systems. As such, all these partners should comply with the specification rules of the SC Hub and submit data under predefined formats. They could also use specific, open SDK when it is needed to develop compatible information and service flows. The SC Hub consists of layers -like the ones defined by the Open Systems Interconnection model (OSI, model) (ISO, 1994) for the typical network hub- that will enable data flow within the SC Hub and between the APIs (Figure 20.3), which are analyzed in the following sections.

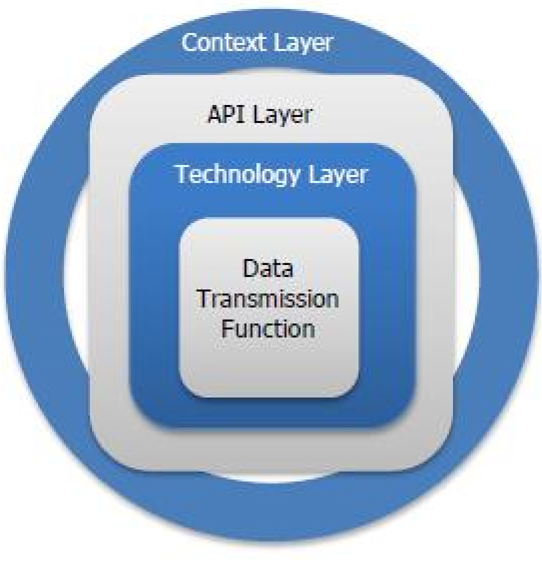

Figure 20.3 SC Hub Architecture

20.3.1.Connecting the data sources: The SC Hub´s architecture

20.3.1.1. The Context layer

As it is shown in Figure 20.3, the SC Hub architecture is analyzed in four layers: *The Context layer, the API layer, the Technology layer and the Data Transmission Function* (Figure 20.1).

Following the SC architecture that was introduced by Pour (2017), this layer includes all the standards from the SC domain for data transmission and data security. According to Wenge et al. (2014), the security standards have been established in four different levels including:

1) Basic standards: A set of standards dealing with fundamental technologies that are employed in the SC implementation. From the data handling's perspective, it should cover the range from information acquisition, transmission, storage, and vitalization, to processing and utilization. It mainly includes the standard of sensing technology, wired and wireless transmission, data storage, data processing and software resource.
2) Application standards: A set of standards from the viewpoints of information system development and deployment, middleware, platform technology, and domain services should be attained prior to the SC implementation.
3) Security standards: The standards should cover all the techniques related to security to make it resistant to external threats, attacks and information leaking (Aggarwal and Kumar, 2020; Chahal et al., 2020; Gupta et al., 2019, 2020; Miglani and Kumar, 2019; Saharan et al., 2020). Also, standards should consider the management aspects to avoid improper information usage.

20.3.1.2. The API layer

This layer includes different types of APIs that are required to enable data transmission through the SC Hub. The main functionality of this layer is API management.

We follow Gamma et al. (1995) and Johnson (2006) to define API *as a piece of software, which is provided by a software system and supports the connection to other systems at source code level*. In our study we focus on SC APIs, private network APIs (traditional APIs) as well as public or semi-public APIs (Web APIs), which are used over the public Internet.

As the API Layer includes different types of APIs, SC are confronted with managing APIs to support their citizens with information and services in a secured way. Although API management is a huge topic discussed in practice, academic research regarding this topic is sparse. To align with recent literature, we define API management aligning to Fremantle et al. (2015), Heffner (2014) and Raivio et al. (2011) *as the process of designing, publishing, documenting, and monitoring diverse APIs*.

First, the API undertake two different roles (characteristics): on the one hand the role of a *receiver*, which can collect different types of data and on the other hand the role of a *sender*, which submits data and provides with connection different devices or applications. In the process of designing, publishing, documenting, and monitoring diverse, these API roles must be determined.

Second, the SC APIs need to be designed to serve many clients. This designing process should secure that the APIs *are open and easy to use for developers* and citizens, to be able to communicate with diverse systems (Fremantle et al. 2015).

Third, aligning to Caelli et al. (1993) the three main requirements in designing APIs are completeness, consistency, and uniformity. Completeness states the degree to which basic operations, available to developers, are sufficient for all anticipated applications. In contrast, consistency and uniformity describe the transparency of the operations to represent and manipulate data in the program (Caelli et al. 1993).

After designing and developing, the SC APIs are published (Fremantle et al. 215, Heffner 2014). The fourth characteristic is that the portal in which the APIs are getting published need to be open, secure, and easy to use for developers.

At the next stage, the documentation of APIs is required (Fremantle et al. 2015). Therefore, we introduce the fifth APIs' characteristic of defining common standards. Interoperability, data format and the defining of the access gate should follow common standards, which should be documented and communicated for anyone connecting to the SC Hub. For this reason, data accuracy needs a prediction model (e.g., different hybrid clustering techniques or "heterogeneous mixture learning," which are common advanced heterogeneous mixture data analysis technology in the niche of data mining of big data (Karami and Kashef, 2020; Ryohei and Satoshi, 2012)). To measure the performance evaluation, metrics such as data quality (e.g., number of doublets, spelling mistakes,) can be used to measure data accuracy.

At this point, data security and privacy become an important characteristic recognizing the need for adoption regarding citizens and their data. As an example, we notice an increasing significance in areas of smart health and mobility and regarding machine learning and path modelling (Aggarwal and Kumar, 2020; Chahal et al., 2020; Gupta et al., 2019, 2020; Miglani and Kumar, 2019; Saharan et al., 2020).

When access controls and authentication of API clients are managed, *APIs need to be consequently monitored* to be able to manage the access and functionality for API usage (Fremantle et al. 2015, Schleicher et al. 2016). This is important to satisfy the API's role as a data *receiver* and *sender*. One important aspect that SC Hub will face with the API monitoring, will be the requirement for *low energy usage* (Fremantle et al. 2015). In the SC ecosystem everything is connected, and sensors communicate with devices and applications. Since the SC Hub APIs are supposed to be used by the entire city, they must be sparse in energy and bandwidth consumption, otherwise users will avoid them.

To manage and monitor the receiver and sender API roles, an API management strategy for the SC Hub must be defined. As research on API management strategies is still growing, this study aligns to recent literature regarding digital transformation strategies for municipalities (Niehaves et al. 2019, Röding et al. 2019) and three recommendations for API management strategy in SC are given below.

1. Align the API management to an existing digital transformation or SC strategy: Existing studies suggest a hierarchical alignment of strategies (Bharadwaj et al. 2013, Chen et al. 2010, Niehaves et al. 2019). This means to align municipal digital strategies to a regional or to a national SC strategy. Transferring this requirement to the SC Hub, the API management strategy should be aligned to a digital or SC strategy.

2. Co-design the APIs with stakeholders, around developers' and citizens' needs (Deloitte, 2018): API ease of use is important since they are designed to connect with different sensors and applications by several developers. Additionally, citizens must easily connect their mobile devices with these APIs (Fremantle et al. 2015).

3. Make the APIs open to technological changes, data strategies and security advices: with the emergence of open data, it is important that people can trust the quality and security of the data that are being offered via the SC Hub. This openness is important to support start-up companies and citizens to have an easy and secure access to open data portals via the SC Hub and to offer a transparent data collection and storage (Aggarwal and

Kumar, 2020; Chahal et al., 2020; Gupta et al., 2019, 2020; Miglani and Kumar, 2019; Saharan et al., 2020)

20.3.1.3. The Technology layer

This layer includes all the infrastructures that are required to enable the specified operation of the SC Hub and the corresponding data flows. The components of this layer have been inspired by the context of a SC platform and concern the following (Figure 20.4):

1. SC real time data engine: It collects via the API layer and processes data real time, coming from stakeholders' local systems 3rd. party applications (e.g., from local developers and local service providers, city applications, stakeholders' applications) and IoT (e.g., utility embedded sensors that measure motion, vibration, pressure, coverage; environmental sensors; user sensors).
2. Support services: They concern SC Hub's configuration and functions for user management; secure identity (ID) management; portal for city service offering.
3. API management: It contains features to configure the API layer for API management. The APIs enable data flow from and to the SC Hub and 3rd. party systems and applications, as well as with the Internet and potentially a local city cloud.

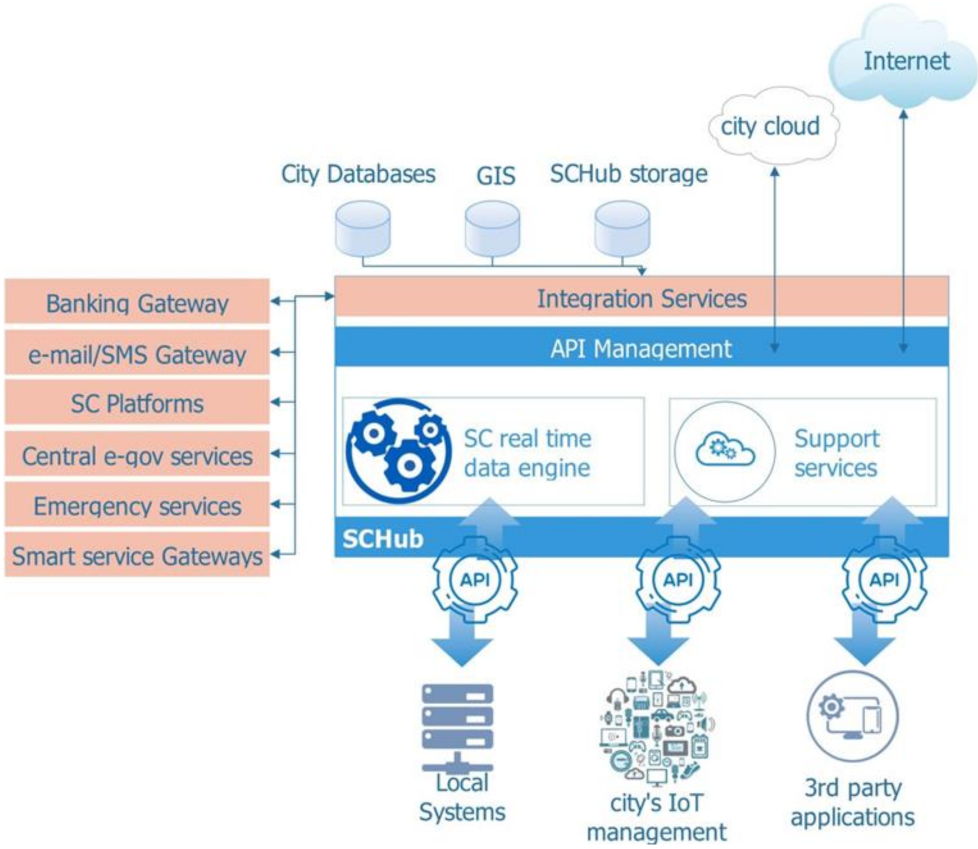

Figure 20.4 The technology layer of the SC Hub

4. Integration services: They concern typical interoperability services that can connect the SC Hub with gateways of usual 3rd. party services (e.g., banking, e-government, e-mail and SMS, SC platforms). Special attention must be paid to smart service gateways that can enable transaction and management of lighting, parking, traffic, safety etc.

5. Storage: The SC Hub has its own storage to deposit its configuration and support services and potentially it can increase its capacity to store the data flows -like a platform- and to serve as an open data repository for the SC data.

6. Standards: All the technologies should be based on open standards, including measures that calculate SC KPIs and oblige rules for the engaged systems and partners.

The above technologies require a particular operating system, that can be configured respectively, while the SC Hub could become a physical facility that will be hosted by the SC owner. The overall SC Hub operation will enable the execution of the following indicative scenarios (use cases) (Figure 20.5):

1. Data consuming:

a. Users who wants to get access to the SC available data: Users connect to the SC Hub via specific API and crawl for data. They can also get access to the open data portal of the SC owner.

b. Developers/enterprises who wants their application to retrieve data from the SC: They connect their application to the provided API. Potential but not obligatory open SDK could be provided to access the data.

2. Data provisioning: A user/application could transmit data to the SC via the SC Hub. Connection will be established via the corresponding API. Authorization for opening anonymized data will be requested prior granting transmission permission.

3. Service provisioning: A service provider could offer its functionalities via the SC Hub and a specific service portal or App that potentially be operated in the SC. A smart service catalogue will be potentially hosted at the SC portal or App, via which the service provider can launch his service. An open SDK and guidance should be available for this scenario.

4. Accessing IoT: The SC will have access to the available IoT for data collection. Registered users could also access the IoT via provided APIs (e.g., using sensors).

5. Providing IoT: Infrastructure providers could give hardware-as-a-service access to SC users via the SC Hub. In such case, the provider should use specific API and comply with SC Hub rules for granting access to his infrastructure.

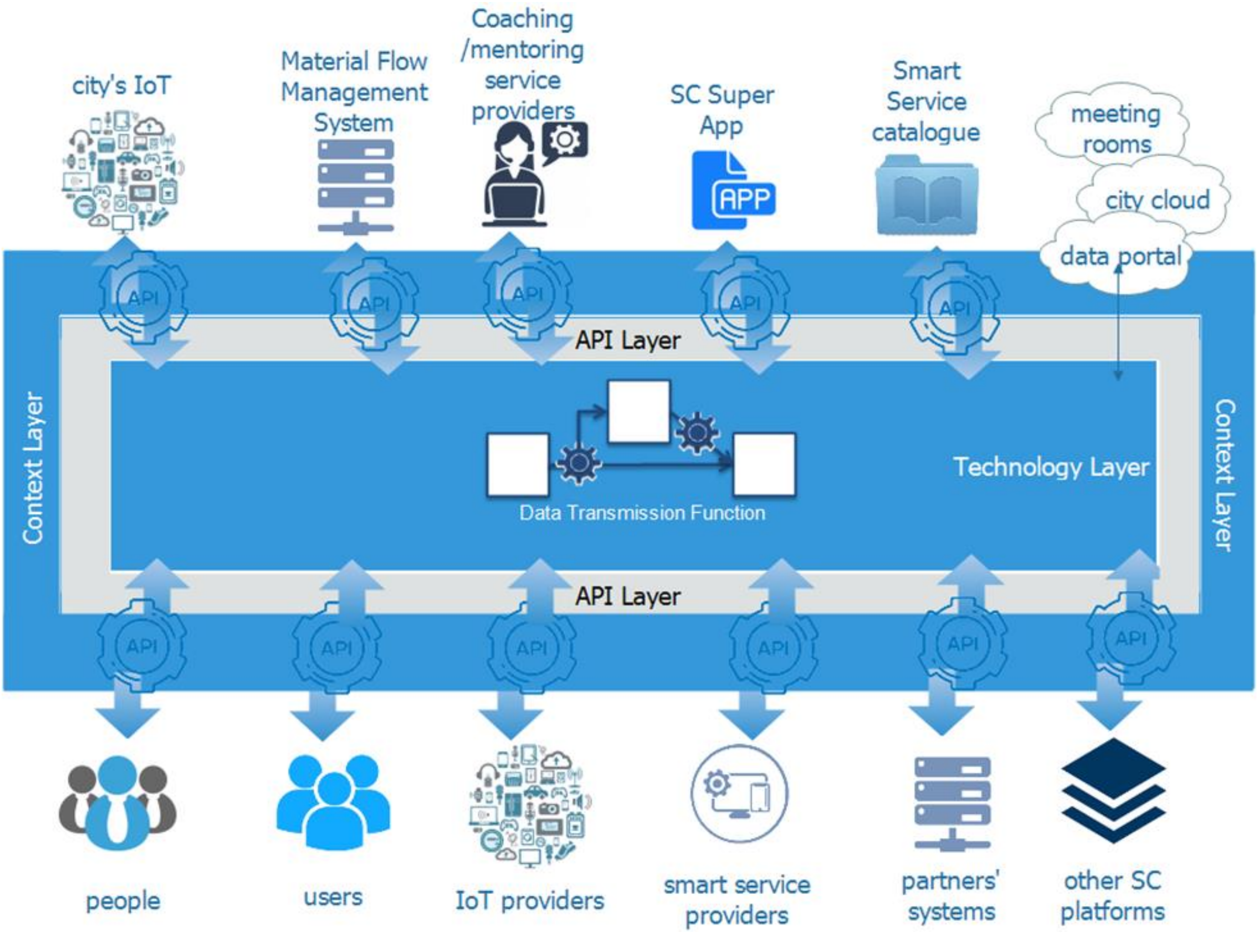

Figure 20.5 SC Hub multi-partner connections enabling several use cases

6. People connection: A city by its nature connects people. The SC Hub could provide access to registered 3rd. party specific virtual meeting places at its back office or software that provides innovation hub's services (e.g., coaching, mentoring).

7. Supply chain material flow: The SC Hub with the use of 3rd. party applications could oblige rules for material flows (e.g., scheduling, traffic jam avoidance, emergencies etc.). Partners could connect their information systems via the API to gain access to the material flow.

20.3.1.4. The Data Transmission Function

To receive the request, send the request to the existing resources, and receive the response (Pourzolfaghar and Helfert, 2017b) is introduced as the main issues of the Data Transmission Function. In cities various systems define their own standards and protocols and there is no common language between systems. Overcoming this frustration and being able to exchange huge amounts of valuable created information, an access gate to bridge the recognized gaps is necessary. By this interface, Pourzolfaghar et al. (2017c) illustrated how the information created by different smart systems will move through the defined architecture to become accessible by other smart systems.

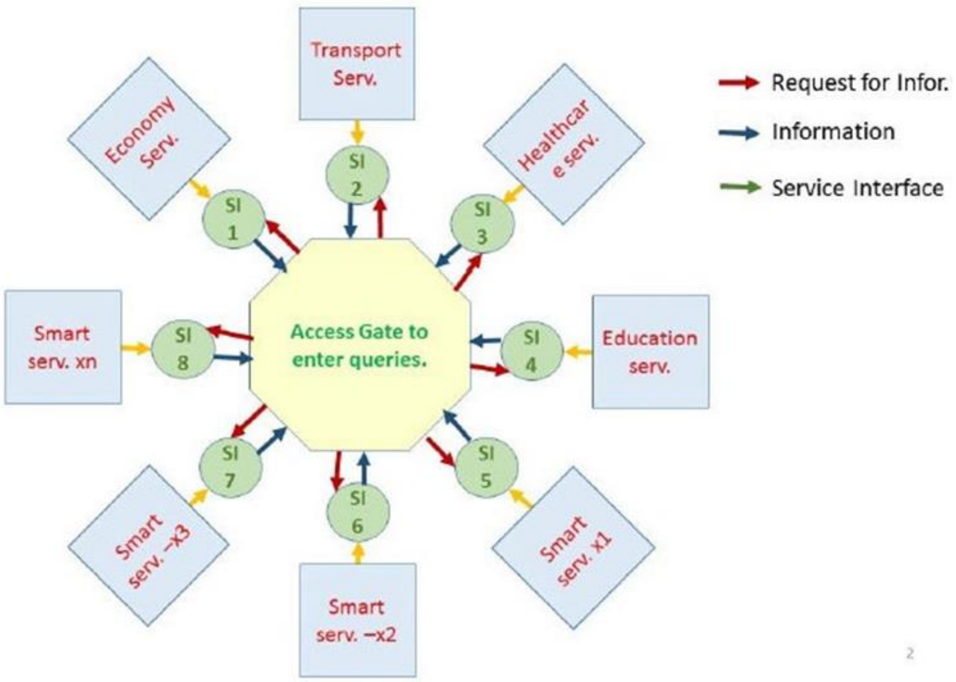

Figure 20.6 The role of the data transmission function (adopted from Pourzolfaghar et al. (2017c))

We follow Pourzolfaghar et al. (2017c) approach to define the elaborated details for the transmission layer, and to introduce the SC relevant standards for the appropriate and secure data transmission (Figure 20.6). More specifically, the data transmission function connects the data producer with the requested data consumer. Additionally, it enables the registration of a new smart services in the corresponding catalogue with the allocation of the configuration to transact with others. Data and information are produced in different systems in SC. Cross domain data transaction and utilization are complex and can be simplified with the SC Hub: the data transmission function will serve as a data transmitter between numerous smart systems -or services-, which will deliver data to and from the requested systems. The data function will be calibrated by the context layer, which keeps the SC Hub updated regarding the new established relevant standards. The function will be triggered by the API layer, which connects the end points (3rd party services) and the SC Hub. Similarly, the API can call a smart service from the corresponding catalogue. The API layer will be updated when new rules or standards appear. Finally, the technology layer supports the transmission functions, either as data generator; transmission channel; or data consumer.

20.3.2.Connecting people and materials: An innovation and supply chain hub

The existence of SC Hub can serve additional roles: a) cities are meeting spaces for people and in this regard the SC Hub could connect people that can co-create with their local governments, and people who want to innovate and launch their own startups. The SC Hub concept could play this role: it can bring together people and governments, while it can simulate a typical innovation hub via offering access to 3rd. party virtual spaces for mentoring and coaching. Additionally, the involved partners could have access to startup cloud-based services via the SC Hub, like CRM, e-mail, portal etc. b) Cities enable material flows between companies and citizens. In this regard, the SC Hub could control the entire supply chain in means that could optimize the flow process, reduce waste and emissions, and enhance recycling. Rules for material flows could be included in the SC Hub, that could work as protocol rules between devices (e.g., start a food delivery only when a condition is satisfied like, traffic downtown is less that a threshold).

Regarding service co-design, citizens can connect and design with others in virtual spaces that are accessible via the SC Hub. Services could be beyond typical eGovernment ones (Vrabie & Tirziu, 2016), but new services based on existing data and interfaces. This engagement can be established with methods like *design thinking and participatory design* (Mainka et al., 2016), under a framework that could be applied via the SC Hub.

Additionally, service and product co-creation means the implementation of the above co-designed services. Co-design and co-development interactions are not limited between citizens and the local government, but they also create the basis for start-ups, which can develop new business models and services based on the SC Hub's data. However, depending on the role of the citizens, this requires the appropriate skills including, development, design, workflows, and knowledge about processes and regulation. According to Nambisan and Nambisan (2013), citizens can play four different roles in the co- creation process: (i) identifying, discovering, or defining a problem (explorer); (ii) conceptualizing a solution (ideator); (iii) designing and developing the solution (designer); and (iv) implementing the solution (diffuser). Furthermore, people can also meet in person and return to the SC Hub. Physical places like public libraries enable open innovation processes, which changed their role towards "digital libraries, special services, and the provision of spaces" (Henkel et al., 2018). In this respect, public libraries are an indicative example of physical link between the citizens of a city, the administration, the stakeholders, and the SC Hub. At these locations, people can develop ideas, discuss, and implement novel products together, and the results can be made available as products and services via the SC Hub.

These meetings require multi-channel features from the SC Hub. Hartmann et al. (2017) describe the American citizen relationship management system 311 as a multi-channel communication system. Citizens can communicate via different technologies, like Web self-service portals, social media, a hotline, and mobile applications. Such an approach is an indicative example to address SC hub services and products.

Bringing people and materials together via a hub is also a socio-cultural task that needs to be implemented carefully. In this regard, a sustainable strategy is needed to keep these processes active in the long term and to let new results emerge in cycles. The active involvement of citizens create the motivation to get involved and to experience that the efforts also lead to concrete implementation (Jong et al., 2019).

20.3.3. Applying SC Hub: Some comparative use-cases

20.3.3.1. Connecting data producers with data consumers

We consider following roles within a city: a local data provider (x) (i.e., an IoT network owner, local social media, local service provider) wants to broadcast and offer its data to all the potential consumers (y) in the city (i.e., single users that collect data, software applications, data analyzers). The local data provider A accesses the SC Hub, follows its standards (guidelines and rules) and develops an API (APIx) according to these standards. Upon the completion, the APIx is registered to the API repository of the SC Hub and consumers (y) will be able to access it. This process is presented in UML use-case diagram of (Figure 20.7).

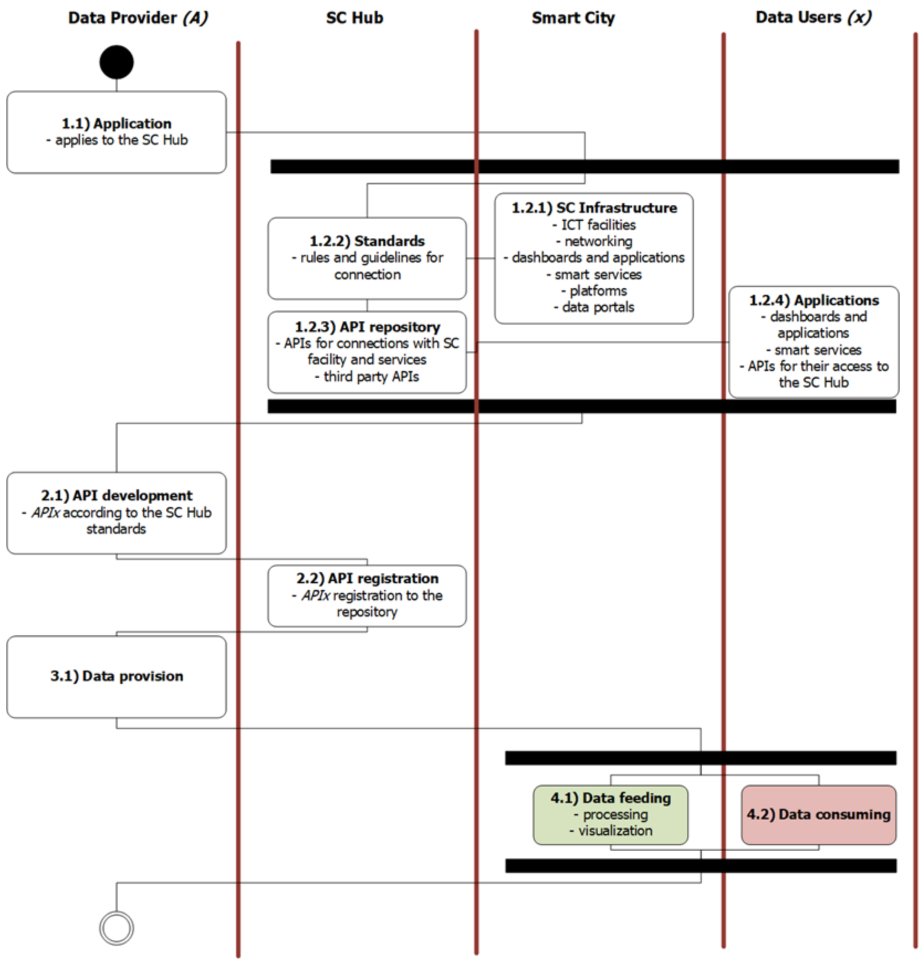

Figure 20.7 UML use-case diagram for data provisioning via the SC Hub

An example that complies with the concept of the SC Hub, besides the smart city of Lohmar, is a European lighthouse project (Acknowledgements). The required information for KPI calculation regarding energy consumption in city districts comes from numerous sources in alternative formats, while it is generated by different partners. The local partners in this project were obliged to use specific APIs to share their information amongst each other. A potential problem for this approach is that a huge number of APIs can be generated for information sharing and for specific purposes. Furthermore, the introduction of new partners in this connection should add extra APIs. Consequently, there will be an exponential growth of the generated APIs. To overcome the reported data exchange, and the observed challenges for this project, the concept of a Data Transmission Hub (DTH) was proposed. The introduction of the DTH generates some rules: specific APIs are developed and given to the information providers, while common format requirements are defined by these APIs, with which all the partners must comply.

20.3.3.2. Connecting service providers with users

Similarly, to the previous use-case scenario, a service provider (A) (i.e., an IoT-based notification service, a SC dashboard, AI-based analytics service) that wants to connect with data providers (x) and/or with users (y) via the SC Hub has to comply with the corresponding connection standards (Figure 20.8). The provider can connect his service with the corresponding API for data collection via the SC Hub from data providers (x). On the other hand, he can develop his own APIx that complies with the SC Hub standards, register to the API repository of the SC Hub and be visible to the SC Hub users. A service repository will present the available smart services and enable flows between the provider and the users. Such services could range from content retrieval to all types of government and business services.

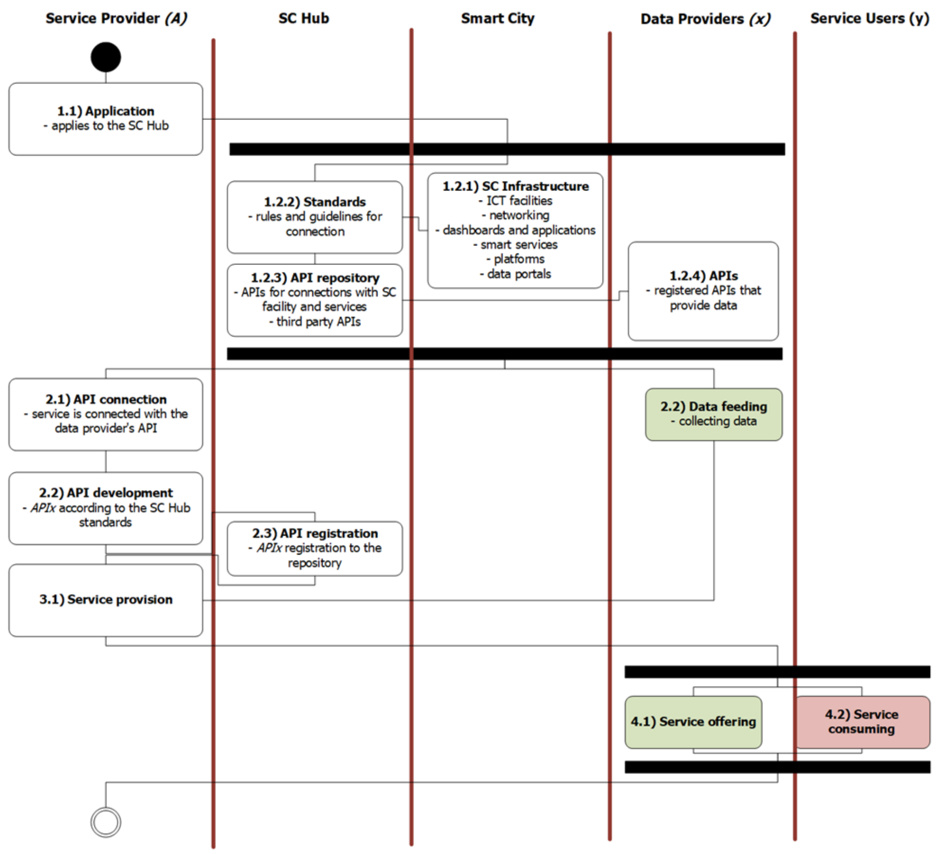

Figure 20.8 UML use-case diagram for service provisioning via the SC Hub

20.3.3.3. Controlling material flows

This futuristic scenario addresses significant urban problems, like traffic and solid waste management, water and fuel tank supplying to buildings and food supplying. Such a material flow control concerns the coordination of suppliers' fleet within the city space, material transits like waste intermediate station usage, water and fuel suppliers and smart food systems. In similar terms like the previously presented scenarios, when a supplier (A) wants to offer his products within the urban space, he must comply with the city's operational rules, which are defined in the SC Hub (Figure 20.9).

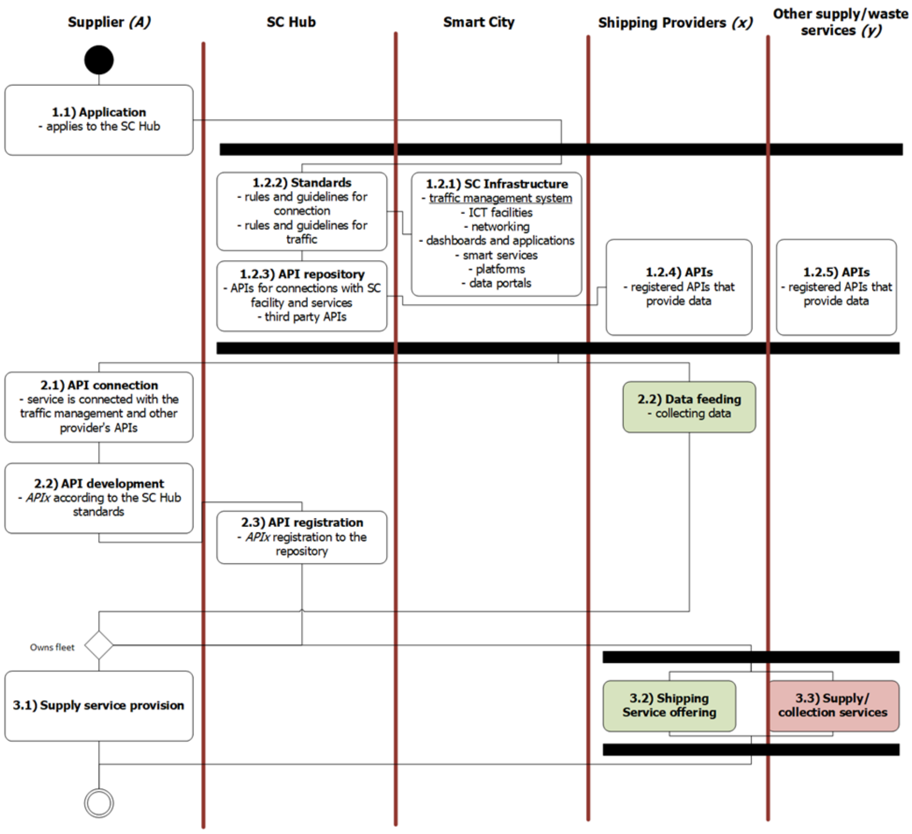

Figure 20.9 UML use-case diagram for material flow control via the SC Hub

The supplier follows the API rules of the SC Hub and connects his supply management system with the relative systems (i.e., the city's traffic management system). The supplier system collects information from the other supply/waste services (*y*) and schedules his fleet's delivery accordingly (i.e., avoid times *i* and *j*), while he submits information to the services (*y*) via the SC Hub. Moreover, the same supplier (A) in case he does not own a fleet, can connect with shipping providers (*x*) via the SC Hub and schedule according to their availability and the local traffic restrictions.

20.4. Conclusion and future research

This paper observed the evolving role of platforms within the SC context, which can be combined with the concept of city as a platform. Moreover, this paper recognized that the SC plays the role of "hub", which transforms the city to a "highly connected space", where information, services, materials, and people flow and utilize innovation and technology to monitor, manage and enhance this flow. In this regard, two research questions arose. RQ1 clarifies how the SC is being transformed to a "hub" and in this regard it analyzed literature and empirical evidence together with vendors' leaflets. This evidence showed the structure and operation of the SC platforms. Additionally, several smart service providers and consumers evolve within SC, which need management and standardization. These requirements can be met by the existence of a central point, which connects the producers and consumers within the SC and apply rules for their transactions. This central point is defined and labeled "SC Hub", while it was differentiated to the SC platform.

RQ2 on the other hand, attempted to justify this paper's claim for the SC evolution to a "hub". As such, a conceptual architecture was designed and justified this hub approach. This architecture was inspired by a typical network hub, consisting of four interconnected layers, while respecting requirements for data, service, material and people flow within a city. Additionally, some characteristics were given, such as cross-platform and open operations.

The SC Hub must be clarified, developed, and tested under a pilot case, while it should follow the standardization process for its detailed specification. Such a testing can start under the funded project "Model projects Smart Cities 2020" from the Federal Ministry of Interior, Building and Community of Germany where SC Lohmar got chosen to implement a SC Hub as one of their funded seven projects. Another case could be the proposed Lighthouse project, in case of being granted, as well as possible future projects that the authors lead. Furthermore, the SC Hub must be able to be configured appropriately to meet the requirements of every individual SC case where it would be installed.

Some futuristic scenarios have been considered for the SC Hub, especially for people and material flows. The existence of such a SC Hub could control flows and oblige specific rules to the providers/consumers to eliminate waste and mobility problems. Although someone could claim that such rules could reduce freedom in cities, today it is universally agreed that traffic and waste are phenomena that communities must reduce. Such a reduction requires an operation framework, which can be approved by stakeholders and installed in the city via the SC Hub.

20.5. Acknowldgements

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