Digital Platforms
Contextual Design Capitalizing on Location Information

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Preface

Like digital innovations that make a difference, few scientific insights come easy. Building on the rich history of the information society—some breakthrough achievements are on display in Paderborn's fabulous computer museum—the digital transformation permeates our society at all levels. Information systems, organizations, and society intertwine more profoundly than ever before. Against this backdrop, I am convinced that real progress comes at the expense of accepting and dealing with the complexity of real-world phenomena, leading to the design of innovative solutions with sufficient detail.

Among all the classes of information systems we can design, digital platforms are some of the most complex, as three reasons might illustrate. First, digital platforms must include heterogeneous groups of actors, all requiring different functionalities to create value using a platform. Second, the actors will decide on their own how they use a platform to create value and if they use it. The level of the actors' engagement will eventually render a digital platform successful or unsuccessful in achieving its purpose. In the best case, this purpose is to provide value on a societal level beyond delivering business value to platform owners alone. Third, as one reviewer pointed out, the IS discipline has proposed many different digital platforms that overlap, forming a rhizome.

In his dissertation thesis, Philipp zur Heiden provides innovative ideas on designing digital platforms to benefit the actors involved and deliver value on a societal level. In a data-driven study, he maps digital platforms as a rhizome to disentangle and define different digital platform types. Advancing design science research methods, Philipp proposes new guidelines to design platforms that fit their environment while highlighting that platforms also change their environment. He then reports on new insights into designing different types of platforms. This research includes developing in-depth knowledge of designing digital platforms as technology and performing the appropriate organizational interventions to change a platform's context in a way that aligns with the design.

The research reported in this dissertation was part of our research projects SmartMarket² (funded by the German Federal Ministry of Education and Research) and FLEMING (funded by the German Federal Ministry for Economic Affairs and Climate Action). In SmartMarket², we developed a digital actor engagement platform to innovate stationary retail. We evaluated this platform in field experiments on a real high street. In FLEMING, we designed a digital industrial platform for maintaining switchgear in a smart grid, fostering the distribution of green energy. Both platforms address pressing societal problems.

I see this dissertation thesis as an essential step towards developing new knowledge on the design of digital platforms. I wish you an insightful read, which I trust will enable you to comprehend platforms as a rhizome and provide you with hands-on advice to inform the design of your own digital platform. In the best case, you use this knowledge to promote societal value beyond implementing pure business interests. The information society depends on our willingness and ability to make a difference for the better.

Paderborn, May 2023 Prof. Dr. Daniel Beverungen

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List of Abbreviations

ADR	Action Design Research
B2B	Business-to-Business
B2C	Business-to-Consumer
C2C	Customer-to-Customer
DSR	Design Science Research
ERP	Enterprise Resource Planning
GIS	Geographic Information System
GPS	Global Positioning System
IIoT	Industrial Internet of Things
IS	Information Systems
LBA	Location-based Advertising
LBS	Location-based Service
LCS	Location-contextualizing Service
LOP	Local Online Platform
S-D logic	Service-dominant Logic of Marketing
SME	Small and Medium-sized Enterprise

Part A
Research Overview

1 Introduction

1.1 Background and Motivation

Digital platforms are a contemporary phenomenon and an emerging topic for information systems (IS) research and related domains (de Reuver et al., 2018; Hein et al., 2020). A *digital platform* is "a mediating entity operating in two- or multi-sided markets, which uses the internet to enable direct interactions between two or more distinct but interdependent groups of users (e.g., in the case of a two-sided market: buyers and sellers) to generate value for at least one of the groups (Hagiu and Wright, 2015; Rochet and Tirole, 2004; Rysman, 2009; Weyl, 2010)" (Beverungen et al., 2021, p. 513). Platforms are deemed to be digital when using data and being reprogrammable, editable, distributed, and self-referential (Yoo et al., 2010; Kallinikos et al., 2013). The flexible and stable components of a layered modular architecture (Yoo et al., 2010; Constantinides et al., 2018)—comprising a core of low variety and a periphery of highly variable components (Baldwin and Woodard, 2009)—enable digital platforms to provide control and flexibility at the same time (Tilson et al., 2010).

Being omnipresent in today's business and society (Tiwana, 2014; Parker et al., 2017), digital platforms provide different types of applications, social media, products, and digital service. Out of the ten globally most valuable brands in 2021 (Ang, 2021), the seven highest ranked brands provide digital platforms investigated, inter alia, in IS research: Amazon and Alibaba, which provide retail platforms (e.g., van der Aalst et al., 2019), Amazon and Microsoft, which dominate the market of cloud platforms (e.g., Gustavsson and Ljungberg, 2019), Apple and Google, which develop mobile hardware and software platforms to engage buyers and sellers on their app stores (e.g., Parker et al., 2017; Karhu et al., 2020), and Facebook and Tencent, which offer various social media platforms (e.g., Wade et al., 2020). Businesses utilizing digital technologies and interacting with multiple groups of users have to adapt to the trend of “platformization”, which fundamentally changes business models and relations (Pauli et al., 2021) in emergent processes (Bygstad and Hanseth, 2018).

The *contexts* digital platforms are integrated in are manifold and depend on the purpose of the platform. Social media platforms operate in business-to-consumer (B2C) environments and engage businesses and individuals, whereas industrial platforms connect businesses in business-to-business (B2B) ecosystems (Pauli et al., 2021). The context is further shaped by the highly diverse industries platforms can operate in—e.g., retail, energy, transportation, and health care. For researchers, observing interactions on digital platforms is complicated because the platforms are controlled by businesses, with researchers being placed outside and unable to fully understand the mechanisms and decisions for future development (Eaton et al., 2015). Combined with the diverse contexts of digital platforms, the nature of digital platforms is thus hard to capture and the scientific discourse is still growing (de Reuver et al., 2018).

A central aspect of digital platforms that researchers have to consider is how digital platforms ought to be *designed*. Designing digital platforms generates lambda knowledge, i.e., knowledge on how to solve problems and find utility (Hevner et al., 2004; Iivari, 2015; Gregor, 2006). Without this lambda knowledge of digital platforms, however, IS research can solely analyze existing platforms, but lack the ability to synthesize the existing knowledge to design new artifacts—a core component of IS research (Österle et al., 2011).

Central factors for the design of digital platforms are their *platform ecosystems*. These resemble natural ecosystems (Moore, 1996; Iansiti and Levien, 2004) by comprising the platform and relevant businesses and stakeholders (Gawer and Cusumano, 2014). Hein et al. (2020, p. 90) define that a digital platform ecosystem “comprises a platform owner that implements governance mechanisms to facilitate value creating mechanisms on a digital platform between the platform owner and an ecosystem of autonomous complementors and consumers.” Platform ecosystems encompass three building blocks—platform ownership, platform value co-creating mechanisms, and complementor autonomy (Hein et al., 2020)—and are subject to constant and substantial change (Parker and van Alstyne, 2012) based on the innovative and disruptive business models of digital platforms.

From a service perspective, digital platform providers need to interact with their customers to generate value through the provision of *service*, referring to the value co-creating mechanisms (Hein et al., 2020). Service science has been established as a suitable theoretical lens in IS research and related disciplines (Spohrer et al., 2014; Beverungen et al., 2019) to help understand the co-creation of value on digital platforms. Service science (or: service research) generally revolves around the design and analysis of a service system and the actors involved in co-creating value (Maglio and Breidbach, 2014). This co-creation process is characterized by the shared integration of resources and activities for the benefit of another, generating value-in-use based on the temporary access of resources (Vargo and Lusch, 2004; Vargo et al., 2008). Service systems as the basic unit of analysis cover a "dynamic value-cocreation configuration of resources, including people, organizations, shared information [...], and technology, all connected internally and externally to other service systems by value propositions (Spohrer et al., 2007)" (Maglio et al., 2009, p. 399). A platform ecosystem itself can be viewed as a system of multiple service systems—i.e., a service ecosystem (Vargo and Akaka, 2012)—engaging buyers and sellers as actors (Beverungen et al., 2021). On digital platforms, value can thus be co-created by facilitating interactions between the different actors engaging on a platform (van Alstyne et al., 2016). However, digital platforms can extend value co-creation by leveraging two- or multi-sided markets that engage customers and providers (Beverungen et al., 2021).

A promising strategy for platform providers is to offer service to customers in both B2B and B2C scenarios to support their *decision making processes* (Demirkan et al., 2015). Traditional decision making processes rely on intuition, whereas improved decision making is based on the analysis of data (Provost and Fawcett, 2013), also referred to as an analytics-based service (Schüritz et al., 2017). Digital platforms often have access to a vast amount of data of different types, as they trace the (inter)actions of different groups of users. For example, online retail platforms like Amazon can use purchase and search histories of multiple users to recommend suitable products to other users (Linden et al., 2003). By utilizing this data, platform operators can support the decision-making processes of users to choose products, or even influence this process to promote profitable products and increase the platform operator's revenue. However, businesses are still struggling to create business models for such an analytics-based service, and even for the platforms providing such service (Riemensperger and Falk, 2020), with a key challenge being the design of the platform ecosystem and the data specifically defined for the platform ecosystem (Brynjolfsson and McAfee, 2014).

A special data type analyzed on and by digital platforms is *location information* (also known as location data, or (geo)spatial data). Location information can provide insights about people and objects and is frequently available due to digitalized technology, i.e., mobile technologies combined with global positioning system (GPS) and Bluetooth, and geographic information systems (GISs) (Pick, 2004; Naous et al., 2019). For example, handheld devices and mobile applications allow to monitor user trajectories, guide users to certain places, and improve public service. This potential of utilizing location information has also reached the IS discipline, mostly for the provision of location-based service (LBS) as a special type of service (Lehrer et al., 2011) that can be provided to customers via digital platforms. Stemming from the service science discipline, an LBS utilizes location information to provide location-specific service (Xu et al., 2009), thus co-creating personalized value-in-use (Küpper, 2005; Raper et al., 2007). As such, LBS allow to improve the decision making process of the user in real-time (Pei Chin and Siau, 2012). Conceptually, LBS depend on their feasibility—describing the user moving or standing in physical proximity of the location where the service is provided (Bärsch et al., 2019; Molitor et al., 2016)—and locatability—characterizing the ability to locate a person or an object by pinpointing their geographic position (Junglas et al., 2008). Examples for instantiations of LBS on digital platforms are Google Maps' navigation service (Lehrer et al., 2011), location-based advertising (LBA) (Molitor et al., 2019), and the analysis and prediction of routes for carsharing (Wagner et al., 2014).

Location information can comprise points, lines, and areas (Haining, 1994), representing different objects from the real world, e.g., people, trajectories, and states. Location information can further be differentiated as consisting of either static data, where the objects are tracked at a fixed location for the period of analysis, or dynamic location information, when mobile entities change their physical location over time, e.g., people and cars (Lehrer et al., 2011). Dynamic location information can act as a link between the real world and the digital world a user engages with (Naous et al., 2019), e.g., a digital platform. For reasons such as privacy concerns (Roick and Heuser, 2013), motivation (Patil et al., 2012), and trust (Beldad and Citra Kusumadewi, 2015), users are, however, often reluctant to disclose their dynamic location information with service providers (Krumm, 2007), or, in case of platform businesses, with third-parties acting on the platform. Recent research has discovered monetary incentives that can be used to overcome the challenge of users not disclosing dynamic location information, with the opportunity of different types of incentives providing similar results (Naous et al., 2019).

So far, IS research has been investigating the design of LBS (e.g., Guo et al., 2018), user behavior in service systems based on LBS (e.g., Molitor et al., 2020), and the disclosure of location information related to, inter alia, privacy (e.g., Xu et al., 2012). Still, information systems involving the use of location information "largely remain a distant land of which little is known as far as IS research is concerned" (Keenan and Miscione, 2015, p. 8). Dynamic location information is, therefore, integrated to co-create value via an LBS. A specific focus here is the analysis of dynamic location information and LBS integrating them as resources (Lehrer et al., 2011; Keenan and Miscione, 2015). However, static location information can also be used to enhance service provided on platforms, creating future opportunities for improvements. Overall, location information can enable innovation on service provided via digital platforms and might thus be able to revolutionize the effects that digital platforms can have on their user groups.

In terms of managerial value, the usage of location information on service provided via digital platforms is also important. Each of the seven platform providers from the ten globally most valuable brands in 2021 (Ang, 2021) provides either service relying on location information (e.g., Google Maps navigation service) or service enabling the analysis of location information (e.g., Microsoft Azure Maps). Additionally, the availability of location information has been identified to generate up to $270 billion globally in 2013, with an expected annual growth rate of 13 % (Oxera Consulting Ltd, 2013). This rise might be fostered even more by the EU striving to make static location information publicly available (Minghini et al., 2021).

1.2 Research Problem and Research Questions

Generally, scientific research is seen as the "systematic, intensive study directed toward greater knowledge or understanding of the subject studied" (National Science Foundation, 2022). The discipline of IS research aligns with this definition (Nunamaker et al., 1990), aiming to generate and improve knowledge (Straub et al., 1994). According to Mokyr (2002), useful knowledge is divided into descriptive and prescriptive knowledge. Descriptive knowledge (propositional knowledge, omega knowledge) covers knowledge on natural phenomena and regularities, while prescriptive knowledge (lambda knowledge) comprises knowledge on human-made artifacts, applying omega knowledge (Mokyr, 2002). In IS research, omega knowledge involves sense-making and natural, artificial, and human phenomena, whereas lambda knowledge covers constructs, models, methods, instantiations, and design theories (Gregor and Hevner, 2013; March and Smith, 1995). Gregor (2006) defines five types of theory-shaping knowledge contributions in IS, namely (Type One) theories for analyzing, (Type Two) theories for explaining, (Type Three) theories for predicting, (Type Four) theories for explaining and predicting, and (Type Five) theories for design and action (Gregor, 2006). These types of theory align with the differentiation of knowledge contributions into omega knowledge (Types One to Four) and lambda knowledge (Type Five, i.e., theories for design and action).

Considering research on digital platforms in IS, there is a discrepancy between different types of knowledge: extensive omega knowledge is paired with scarce lambda knowledge. While concepts that constitute digital platforms have been thoroughly investigated, theories for design and action on digital platforms are thin on the ground. Openness, describing the degree to which a digital platform allows groups of users to participate, develop, and use the platform (Eisenmann et al., 2009), is a prominent example for this phenomenon in the literature on digital platforms (Beverungen et al., 2021; de Reuver et al., 2018). Research outputting lambda knowledge on the openness of digital platforms is only to be found in less than 4 % of published papers (Soto Setzke et al., 2019). Some of the identified examples still do not provide lambda knowledge on how to design openness on digital platforms, but rather conceptualize how openness and strategies applying openness can be categorized (Schlagwein et al., 2010).

This lack of lambda knowledge is problematic both from a research and from a managerial perspective. First, research will not be able to completely understand digital platforms and their value co-creating mechanisms without designing platforms (de Reuver et al., 2018). Second, lambda knowledge is able to provide instructions and (normative) conclusion for action (Österle et al., 2011). These instructions and conclusions help to understand and manage problems and phenomena in research and businesses. One prominent example is the "dark side" of social media platforms, which can lead to negative consequences (Baccarella et al., 2018). Lambda knowledge on the design of specific mechanisms on social media platforms can help to overcome these patterns and neglect the negative consequences of social media platforms

(Bunde, 2021). Third, lambda knowledge provides utility (Hevner et al., 2004; Iivari, 2015) as a path to innovation for business and society. Without lambda knowledge, researchers can solely analyze digital platforms, whereas with the help of design studies, IS enables the synthesis of omega knowledge to create innovative artifacts to foster innovation and shape the industries and societies of the future.

Prominent research agendas in IS, therefore, call for an intensive discussion and investigation of lambda knowledge on digital platforms (de Reuver et al., 2018; Pauli et al., 2021). Specifically, these calls-for-action substantiate that future research should be aimed at integrating lambda knowledge with omega knowledge on economic effects and behavioral studies (Beverungen et al., 2021; de Reuver et al., 2018). Location information as an important type of data already used on popular digital platforms promises fruitful results through the application of, e.g., LBS (Lehrer et al., 2011). The design of LBS is present in IS literature (e.g., Guo et al., 2018), however, integrating this lambda knowledge into the context of digital platforms is missing. Further, location information can be utilized in other ways as an LBS on digital platforms, which are also absent from the IS literature. Consequently, lambda knowledge on digital platforms—especially utilizing location information—is lacking in IS research and should therefore be provided, as is called for in related research (de Reuver et al., 2018). Hence, this dissertation approaches the following research problem:

Research Problem. *Comprehensive knowledge on how digital platforms ought to be designed is required by the IS literature because digital platforms are of crucial importance to research, businesses, and society. More specifically, the literature lacks lambda knowledge on how digital platforms ought to be designed to utilize location information.*

To solve this research problem one can derive four independent but complementary research questions. These four questions show manageable avenues leading to an integrated solution, providing lambda knowledge on digital platforms utilizing location information. The first question targets the *review* of the previous literature on platforms, the second question deals with *conceptualizing* the utilization of location information on digital platforms, the third question involves the *methodological cornerstones* of design science as a research paradigm to generate lambda knowledge, and the fourth question fosters the generation of lambda knowledge by *designing* digital platforms utilizing location information. The four questions, thus, align with the types of IT artifacts relevant in IS (March and Smith, 1995): constructs (digital platform constructs), models (conceptualization of utilization of location information on digital platforms), methods (to design digital platforms with context consideration), and instantiations (in two different context).

Starting with the review of the literature on digital platforms in IS, there exists a multitude of concepts of digital platforms, leading to different platform terms used across different sub-domains, targeting different phenomena related to digital platforms. Thus, the body of knowledge appertaining to digital platforms still appears to be fragmented and contains undefined or under-specified platform concepts, leading to interchangeably used terms and inaccurate understandings (de Reuver et al., 2018). For example, the term *service platform* is understood very differently by researchers from different domains within the IS discipline. Researchers with a technical background refer to the technical artifact providing IT services (Paschke, 2016), whereas service researchers refer to a digital environment in which actors co-create value (Lusch and Nambisan, 2015). The metaphor of a rhizome (Deleuze and Guattari, 1979) is fitting to describe the entangled nature of platform concepts and their connections. Hence, when designing digital platforms, the mere task of identifying existing artifacts and positioning designed digital platforms into the literature becomes problematic (Sørensen et al., 2015).

Different areas of research on digital platforms should tackle the described rhizomatic phenomenon. Resulting from conceptual ambiguity, de Reuver et al. (2018) recommend to provide clear definitions of the (analyzed or designed) digital platforms and their respective ecosystems, and specify the perspective taken on digital platforms, based on existing research. Due to the overlapping concepts, researchers are in need of a lexicon providing definitions for different types of digital platforms, alongside the theoretical lenses with which to analyze them. Further, de Reuver et al. (2018) identify differing units of analysis in digital platform research and recommend to clearly define the unit of analysis for specific research. However, current platform research does not allow for a clearcut embedding into the platform literature, as there is no consistent lexicon on digital platforms. Thus, the current rhizomatic nature of platform terms needs to be structured to help analysts and designers of digital platforms position their artifacts as unit of analysis, leading to the first research question:

Research Question 1. *Which digital platform types are investigated in the IS discipline and how do they allow to structure digital platform research?*

The second research question deals with the conceptualization of utilizing location information on digital platforms. As portrayed in the previous section, value on digital platforms can be co-created in the form of service by enabling groups of users to interact, and by establishing two- or multi-sided markets (van Alstyne et al., 2016; Beverungen et al., 2021). With service improving the ability to make decisions, location information, representing the physical location of an entity (i.e., a person or an object), can play an important role. LBS—utilizing location information for individual service consumption (McKenna et al., 2011; Rao and Minakakis, 2003)—can enable improved decision making. LBS can be further divided into five different types: (1) localized service provision, i.e., location-based advertising (LBA) (Molitor et al., 2019) and location-based participation in policy-making processes (Lee et al., 2011), (2) locating service, e.g., location-based recommendations (Guo et al., 2018), (3) navigation service (e.g., Lehrer et al., 2011), (4) location analysis service, e.g., in wearable fitness applications (Lehrer et al., 2011), and (5) management and monitoring service, e.g., for carsharing routes (Wagner et al., 2014) and mobile inventory management (Mathew et al., 2004).

An LBS involves a minimum of two entities, i.e., a user and one further entity (e.g., in the form of another user or an object). In all the characterized types of LBS, either the user, the further entity, or both entities separately provide dynamic location information. This dynamic location information is a result of the required locatability (Junglas et al., 2008) and feasibility (Bärsch et al., 2019) of LBS. However, there are other types of service utilizing static location information instead of dynamic location information or a combination of static and dynamic location information. In most cases, this information includes the location information of immovable objects, e.g., buildings or technical equipment. Examples for service provided on a digital platform utilizing solely static location information are job-offering platforms (Indeed, Monster), hotel booking websites, and Google Streetview. All of these digital platforms utilize GIS, a class of information system enabling the acquisition, representation and analysis of location information (Farkas et al., 2016; Chrisman, 1999). Research on such service on digital platforms, however, is scarce in IS. Hence, there seem to be other mechanisms apart from LBS explaining how location information can be utilized to co-create value on digital platforms. This lack of understanding leads to the second research question:

Research Question 2. *How can the utilization of location information on digital platforms be conceptualized?*

Generally, developing theories for design and action (Gregor, 2006) to generate lambda knowledge, pursuing the main goal to solve the research problem of this dissertation, requires design-oriented research. In IS, design science research (DSR) has been established as the dominant design-oriented research paradigm, and prescriptively deals with how artifacts ought to be in order to work properly (Hevner et al., 2004; Simon, 1996). Design revolves around the interplay of context—defining the problem—and form—the solution to the problem (Alexander, 1964). Thus, the aim of designing artifacts is not form alone, but reaching a high degree of fitness between form and context (Hevner et al., 2004; Alexander, 1964).

Even beyond targeting location information, research shows that digital platforms are highly context-dependent, meaning that an application of a successful platform in another context is mostly deemed to be a difficult if not impossible task (de Reuver et al., 2018). In their research agenda, de Reuver et al. (2018) account for this problem and recommend to clearly identify the unit of analysis—i.e., the digital platform and its context—and the boundaries—which are predominantly defined by the context (Hevner et al., 2004; Simon, 1996; Alexander, 1964). Poniatowski et al. (2021) additionally highlight the importance of context for digital platforms, as they identify the main concepts constituting digital platforms. The concepts identified are separated into two categories: internal factors, which can be controlled by a platform owner, and environmental dynamics, which platform owners cannot control themselves (Poniatowski et al., 2021; Tiwana et al., 2010). The environmental dynamics comprise the participation of third-parties, network effects, competition, multi-homing, and trust (Poniatowski et al., 2021). Network effects have also been found to have the greatest influence on the success of a digital platform (Pauli et al., 2021; van der Aalst et al., 2019). These context-related concepts show that a digital platform designed without considering its context will most likely fail because the platform owner cannot change certain aspects of the context. As a result, participation on the platform could be low, or the platform may be unable to compete with rivaling platforms. Thus, the community of customers and providers (Beverungen et al., 2021), organizations involved, and technologies used (Hevner et al., 2004) have to be placed sufficient emphasis on.

The insight that digital platforms seem to emerge in highly specific application categories and contexts has important implications for research and the application of theory on digital platforms, as identified by de Reuver et al. (2018). Without systematic contextualization, theory on digital platforms cannot be properly understood (de Reuver et al., 2018). Hence, context has to be incorporated into theories and explicitly communicated, to enable externals, such as researchers, to meaningfully understand and apply the mechanisms and properties of a theory (de Reuver et al., 2018; Avgerou, 2019).

Established methods of DSR already account for context in multiple and detailed ways (Hevner et al., 2004; Peffers et al., 2007; Jones and Gregor, 2007; Sein et al., 2011). However, the originally central emphasis that context has on the design of artifacts (Simon, 1996; Alexander, 1964) seems to be missing in a multitude of design research studies (zur Heiden, 2020). Additionally, four ontological challenges of IS research and its relation to context further expound the problems of context consideration: (1) Context-specific research findings have to be generalized, (2) contextual research trading off details and general validity, (3) a predominant social view of context instead of an IS-specific socio-technical view, and (4) challenges from ontologies that challenge the very notion of context (Avgerou, 2019). As digital platforms are highly context-specific and context-dependent, this results in the third research question, striving to improve methodological clarity on the consideration of context:

Research Question 3. *How should IS research consider context for the effective and efficient design of IT artifacts, such as digital platforms?*

Answering the first three research questions would allow for the generation of omega knowledge on digital platforms that utilize location information and adequately consider their respective contexts. However, answering these questions does not provide lambda knowledge about the design of digital platforms itself, thus requiring a fourth research question. Due to the different characteristics of contexts (cf. the third research question), knowledge on the design of digital platforms is a difficult if not impossible task (de Reuver et al., 2018). This difficulty is also related to digital platforms being homogeneous (Pauli et al., 2021; Tilson et al., 2013), i.e., general knowledge would not be usable for all other digital platforms.

To develop new design knowledge pertaining to different contexts, this dissertation focuses on the design of two different types of digital platforms. DSR as the research paradigm always strives for a dual mission, i.e., generating design knowledge and solving problems (Sein et al., 2011; vom Brocke et al., 2020). Hence, this dissertation should design digital platforms for contexts that have experienced recent changes or challenges in order to solve upcoming, relevant problems. Further, the digital platforms should utilize location information according to the conceptualizations identified by answering the second research question to further elaborate on the different mechanisms of location information that can be utilized on digital platforms. Therefore, the fourth research question is applied in two specific contexts: high street retail using dynamic location information of customers in high streets, and the energy distribution grid utilizing static location information on immovable objects.

First, digital platforms for online retail have seen a rise in turnover and revenues, whereas local high street retail—mainly operated by small and medium-sized enterprises (SMEs)—fails to keep up and loses customers (Hart et al., 2013). The COVID-19 pandemic has further exacerbated the situation for local high street retailers (Bryson, 2021), as customers were either unable to visit stores in high streets, or only in limited numbers. Online retail has also claimed the former strengths of high street retail: Before the rise of the Internet, store owners knew customers personally and could advise them on products and services. Digital retail platforms like Amazon, however, gather data from millions of customers, excelling at analyzing the data and generating individually suited recommendations. However, high street retail also has a strong competitive advantage over digital retail platforms: Customers can see and feel products and services directly, e.g., products displayed in shopwindows when passing stores. With digital technology, i.e., smartphones and GPS, being available to customers, location information can be utilized to provide digital channels allowing to guide customers to relevant stores (Betzing et al., 2019). The analysis of location information on former and potential customers can therefore be a key when trying to keep up with the rise of online retail. However, SMEs lack the resources and capabilities to implement and manage digital interaction opportunities, which would allow them to increase customer engagement (Hänninen et al., 2018). Thus, the design of a digital platform, with customers and SMEs as distinct actor groups on the platform (Hänninen et al., 2018), allowing them to integrate their resources and co-create value (Breidbach et al., 2014), seems a promising strategy to overcome the stated challenge.

Second, the distribution grid faces critical challenges from the energy turnaround and the upcoming mobility revolution. Critical assets of the distribution grid—e.g., switchgears, which are in use for up to 40 years (IEC Market Strategy Board, 2015)—are put under increasing pressure if not maintained properly (Smith et al., 2022; Biener et al., 2016). New maintenance strategies are needed to maintain stable energy distribution and prevent blackouts, i.e., predictive maintenance[1] (Hashemian et al., 1998). Critical assets of the distribution grid are widespread, but require immediate attention in case of failures. Location information on these immovable assets can be utilized to improve the algorithms predicting failures and recommending maintenance activities. Digital industrial platforms (Pauli et al., 2021) can enable operators of the distribution grid to use superior maintenance strategies relying on location information.

Both of these contexts share the property that they need to fundamentally change due to digital transformation. While the distribution grid has to change to comply with external influences, high street retail faces existential threats if it fails to change. The selected contexts also feature significant differences apart from their use of location information, as they mostly consist of different business relationships (B2C and B2B), target different user groups (individuals and professionals), and allow for the design of different digital platforms (i.e., an actor engagement platform and a digital industrial platform). In both cases, digital platforms utilizing location information can help to overcome the stated challenges, leading to the fourth research question:

Research Question 4. *How ought digital platforms to be designed to co-create value based on location information?*

The purpose of this cumulative dissertation is to contribute omega knowledge on the structure of platform research in IS, the conceptualization on service on digital platforms utilizing location information, and on how to effectively consider context for DSR with an IS and a philosophical lens by adjusting and improving popular DSR methods and frameworks. Applying this omega knowledge, the dissertation contributes lambda knowledge on the design of digital platforms in two distinct contexts, which are predominantly transformed by digital technology and, therefore, capitalize on location information: high street retail and the distribution grid. In both cases, location information is utilized in different ways, first by enabling innovative value co-creation mechanisms based on service with dynamic customer location information, and second by improving existing service with static location information of immovable objects.

[1] The term *predictive maintenance* is used in the IS discipline, while engineering terms this maintenance strategy as *condition-based maintenance* (ISO/TC 108/SC 5, 2012). As this dissertation is rooted in IS research, it sticks to predictive maintenance.

1.3 Structure of the Dissertation

The identified research problem and the four resulting research questions are investigated in eleven separate research articles. To understand the connection between the research articles and their integration into the IS research domain, the dissertation is structured into two parts, Part A and Part B.

The remainder of Part A is structured as follows. Section 2 presents the theoretical foundations on the main research streams this dissertation is situated in. Drawing on research on service, digital platforms, and location information on digital platforms, the main assumptions shaping the design of digital platforms in this dissertation are presented in separate sub-sections. Section 3 summarizes the research design by presenting the underlying research paradigm—DSR—and research methods constituting the multi-methodological research approach, i.e., systematic literature reviews, data-driven research, conceptual research, taxonomy development, action design research (ADR), and design science research methodologies. Additionally, this section presents and justifies the integration of the research methods and its application throughout the different research articles. Section 4 provides a synopsis of the major research findings from the research articles, answering the research questions and integrating the results. Thus, this section presents the theoretical and managerial contributions and concludes with limitations and directions for further research.

Part B consists of eleven publications that have been published or are currently being considered for publication—i.e., under review—in peer-reviewed IS journals and conference proceedings[2]. Figure 1.1 shows the classification of the research articles in relation to the four identified research questions. Outlets include the journals *European Journal of Information Systems (EJIS)*, *Business & Information Systems Engineering (BISE)*, and *Electronic Markets (EM)*. Conference proceedings include the *European Conference on Information Systems (ECIS)*, *Hawaii International Conference on System Sciences (HICSS)*, *a Workshop at the International Conference on Wirtschaftsinformatik (WI)*, and *International Conference on Design Science in Information Systems and Technology (DESRIST)*. Additionally, one research article has been published in the non-IS journal *Sensors*.

[2] The layout, labels, tables, footnotes, abbreviations, and grammar in all eleven publications in Part B have been standardized to enable consistency within this dissertation. The content, however, has not been modified.

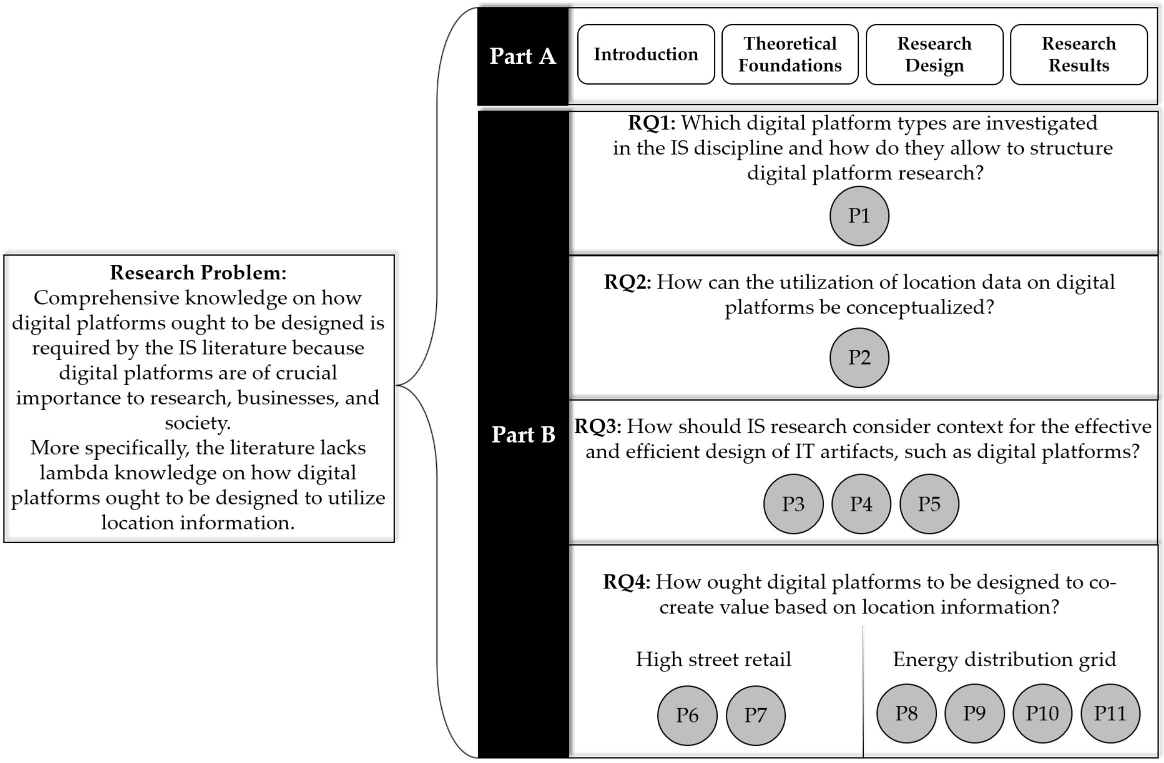

Figure 1.1: Organization of this dissertation

Part B is structured into four sections according to the identified research questions. Figure 1.1 depicts an overview of the structure of this dissertation and the research articles answering the four research questions, with an overview of the meta data on the research articles in Table 1.1. Subsequently, the main motivation, design, and contribution of each research article in Part B is summarized. This part includes the connection to the research problem and research questions identified.

P1. *Systematizing the Lexicon of Platforms in Information Systems: A Data-Driven Study.* The multitude of concepts used in IS literature on digital platforms fosters a fragmented, rhizomatic body of knowledge and a lack of conceptual consistency. The resulting ambiguity exacerbates the collective understanding and contributions of the IS discipline. The research by de Reuver et al. (2018) calls for clear-cut definitions and a lexicon to position research in the body of knowledge on digital platforms. This article utilizes data-driven methods (Müller et al., 2016), above all automated text mining and unsupervised machine learning to collect, analyze, and interpret 11,049 research papers on digital platforms, i.e., the comprehensive study of digital platforms in the history of IS research. The contributions made by this research article include a list of the IS discipline's most used platform concepts and their historical usage, the identification of six research streams on digital platforms, a decomposed model of platform terms applicable as lenses to study digital platforms in IS, and a lexicon comprising the most commonly used platform concepts. The decomposed model and the lexicon contribute to answering the first research question of this dissertation.

P2. *Location-Based Service and Location-Contextualizing Service: Conceptualizing the Co-creation of Value with Location Information* Research in IS and neighboring disciplines has investigated LBS in detail, describing service that is dependent on dynamic location information. In a first step, this research article systematically analyzes the literature (Webster and Watson, 2002) on service based on location information in IS research to identify properties and types of LBS. By its conception, service building on solely static location information, originating from immovable objects, is not included in LBS research. Examples for such immovable objects with static location information used in service systems or on digital platforms are hotels and assets of the distribution grid. Thus, in a second step, conceptual research (Jaakkola, 2020) is used to conceptualize location-contextualizing service (LCS) and define LCS as a service utilizing static location information to co-create superior value-in-use and support decision-making processes of customers. LCS enhance the value of a service that can be provided without location information, i.e. an LCS is an improvement, and use GIS as a boundary object and as an enabling technology. By comparing the conceptual characteristics of LBS and LCS and constructing hypotheses to be considered when designing LCS, this research article enables the design of a digital platform utilizing static location information. As such, the second research question is answered by analyzing LBS and conceptualizing LCS as two distinct types of service to utilize location information on digital platforms.

P3. *Considering Context in Design Science Research: A Systematic Literature Review.* Universalism and particularism are two opposing stances in IS research. Universalism aims to abstract research results, whereas particularism lays emphasis on the context of research (Davison and Martinsons, 2016). In the case of design research, especially DSR in IS, the designed artifact and its context are inextricably linked, as the design of an artifact is dependent on its context (Hevner et al., 2004). This research article uses a systematic literature review to provide the state-of-the-art of context consideration in DSR in IS. By analyzing 115 publications applying methods of DSR in high-quality IS publications, this research article uncovers a fundamental lack of context description and design implications resulting from the context in DSR studies. It also identifies that less than a quarter of DSR publications generalize their findings and their context, giving insight on the discord that DSR is neither aligning with universalism nor with particularism. The research article serves as a starting point to answer the third research question by providing an overview of the current consideration of context and deriving implications for further research on context consideration in DSR with a focus on the conflict between universalism and particularism.

P4. *Context in Design Science Research: Taxonomy and Framework.* Context is generally understood to be synonymous with the environment or setting in which something exists. In IS, context particularly refers to the aspects of the environment in relation to a focal phenomenon (Avgerou, 2019). However, these understandings do not adequately consider the properties and peculiarities of DSR in IS. Additionally, discussions and streams in IS question the very notion of context (Avgerou, 2019), which is not aligned with the understanding of context in DSR. This research article takes a step towards clarifying the notion of context for DSR by developing a definition of context for DSR in relation to discussions in IS and related disciplines (e.g., Avgerou, 2019). Taxonomy development (Nickerson et al., 2013) is used to generate a context taxonomy for DSR. Further, a context framework integrating key dimensions from the taxonomy and the procedural perspective of DSR is established to provide a sound foundation for DSR regarding context consideration. This research article yields a definition, taxonomy, and framework to understand context in DSR, providing omega knowledge for the third research question. Thus, it helps to understand the concept and characteristics of context from a design researcher's perspective.

P5. *A Renaissance of Context in Design Science Research.* The early literature on design as the science of the artificial already suggests that the ultimate goal of design is the ensemble of form and context (Alexander, 1964; Simon, 1996). Context shapes the form, defines requirements, shows boundaries, and ultimately defines the utility and fitness of an artifact (Hevner et al., 2004; Alexander, 1964; Simon, 1996). However, the most prominently used frameworks and methods of DSR—originally firmly rooted in the science of the artificial—downplay this inherent interconnection between form and context, making the artifact the central object of a design study. Multiple research papers designing artifacts neglect the context and its influence on design (zur Heiden, 2020). Therefore, design theories providing lambda knowledge are incomplete as they treat context as a stable frame. This research article uses design science methods to advocate for a renaissance of context in DSR, reestablishing the foundational ensemble of form and context in the core methods and frameworks that constitute DSR. Therefore, several adaptations to the methods and frameworks of Hevner et al. (2004), Peffers et al. (2007), Jones and Gregor (2007), and Gregor and Hevner (2013) are proposed and evaluated using recent publications that have partly adopted these methodological guidelines. The insights gained from adapting the methods and guidelines in combination with the evaluation provide lambda knowledge on how to consider context in DSR in IS research, thus contributing to the third research question.

P6. *Usage of Local Online Platforms in Retail: Insights from Retailers' Expectations.* High street retail in European cities faces multiple challenges: Online retail can offer lower prices and a wider retail assortment, digital business models outclass historic brick-and-mortar retail strategies, certain private goods become obsolete due to the sharing economy, and large retail chains drive SME competitors out of the market. With fewer and fewer retailers trying to improve the customer experience in high street retail, a vicious cycle is established. Digital platforms and especially local online platforms (LOPs)—a special type of digital platform restricted to a local area or city (ter Halle and Weber, 2014)—might enable high street retailers to overcome the stated challenges. In this qualitative research article, 19 small or medium-sized, interdependent retailers are interviewed about their experiences and expectations of using and intending to use digital platforms to target customers. The interviews show that retailers prefer LOPs to global, digital platforms—e.g., Facebook and Amazon—as long as the entry barriers are identical or lower. Further, such retailers will use LOPs to acquire new customers, promote customer loyalty, improve the customer experience, and strengthen local cooperation on the high street. The insights from this research article help to analyze the first context—high street retail—investigated in the fourth research question. They serve as a starting point and show that the design of a digital platform offers a promising way to strengthen local high street retail, especially when focusing on local communities, as done by LOPs.

P7. *Designing Digital Actor Engagement Platforms for Local High Streets: An Action Design Research Study.* The challenges of high street retail lead to a decreasing market share and make local retailers, especially SMEs, fall behind their online competitors. Digital platforms can help overcome these challenges. Digital actor engagement platforms represent a digital platform that enables both actor groups that engage on a digital platform—customers and retailers—to invest resources in the interactions occurring in a service ecosystem and to foster engagement (Blasco-Arcas et al., 2020). The digital actor engagement platforms provides physical and virtual touchpoints that enable the exchange and integration of resources (Breidbach et al., 2014). The dynamic location information of customers on the high street can serve as a resource this actor group can integrate. This research article attempts to overcome the stated challenges of high street retail by designing and evaluating a digital actor engagement platform. ADR is used as a research method (Sein et al., 2011) to design, develop, and implement such a digital actor engagement platform in a German high street with strong stakeholder involvement. A three-stage evaluation is conducted with field evidence from over 150 SMEs and over 2,300 customers. The real-world implementation in the context of high street retail shows that dynamic location information can be used to foster high street retail. Beyond providing lambda knowledge on the design of digital actor engagement platforms as a design theory (Gregor, 2006; Jones and Gregor, 2007), the results show that location-based advertising (LBA)—a form of LBS—can improve engagement in high street retail via the digital actor engagement platform. Thus, this research article provides lambda knowledge to answer the fourth research question in terms of co-creating value based on the combination of static location information—the retailers' stores—and dynamic location information, i.e., customers moving through high streets.

P8. *Integration of Novel Sensors and Machine Learning for Predictive Maintenance in Medium Voltage Switchgear to Enable the Energy and Mobility Revolutions.* Two recent "revolutions" impact the future energy distribution grid. First, the energy revolution leads to an increased usage of distributed energy generation in contrast to the current and previous, centralized energy creation in fossil fuel-driven power plants. Second, the mobility revolution fosters the usage of electric vehicles on the demand side of the distribution grid. Both revolutions combined will lead to higher load variations and an increased bidirectional flow of energy, thereby stressing central assets of the distribution grid, e.g., medium voltage switchgear. This research article deals with how to overcome the challenges that critical assets of the distribution grids face by analyzing the state-of-the-art maintenance strategies for these critical assets. The article shows that predictive maintenance strategies require current sensor data, advanced analysis methods for prediction, and adaptations to the business model, but can handle the challenges and provide a solid foundation for systems development. This research article analyzes the second context targeted in the fourth research question—the energy distribution grid with its static assets.

P9. *Transitioning to Condition-Based Maintenance on the Distribution Grid: Deriving Design Principles from a Qualitative Study.* The effects of the energy and mobility revolutions and the resulting challenges to the critical assets of the distribution grid are most noticeable for operators of electric utilities. These comprise municipal utilities, operating in low and medium voltage ranges, and distribution grid operators, ranging from medium to high voltage. Applying qualitative interviews with six electric utilities of different sizes, this research article investigates the problems from the viewpoint of the electric utilities. The processes and IT systems of the electric utilities are well-defined and mature, but they have little to no insight into the status of their critical assets. Framed as a the first two steps of a design study (Peffers et al., 2007), the study derives five design principles (Gregor et al., 2020) necessary to transition from a reactive or preventive maintenance strategy to a strategy applying predictive maintenance. As such, this study's contribution to the fourth research question is twofold: First, it further analyzes the context of the distribution grid from an electric utility provider's perspective. Second, it provides design principles for a predictive maintenance system on the distribution grid, serving as a step towards a full design theory.

P10. *Utilizing Geographic Information Systems for Condition-Based Maintenance on the Energy Distribution Grid.* The energy distribution grid is bound to adapt to challenges to its central assets caused by the energy and mobility revolution, and predictive maintenance has shown to be a valuable strategy to overcome the stated challenges. However, the knowledge base in IS research does not provide lambda knowledge on the design of an information system for predictive maintenance on the distribution grid. This design research study conceptualizes and designs an information system for predictive maintenance of legacy assets in medium voltage distribution grids. The system utilizes static location information of relevant central assets, such as switchgear cabinets and circuit breakers. To this end, the design of the information system combines a GIS for integrating location information and result presentation, an enterprise resource planning (ERP) system for master data management and service management, and a machine learning system for analyzing the status data and predicting failure probabilities. A proof-of-concept is presented and the study concludes with a set of theoretical hypotheses that can be used to evaluate such an artifact in a real-world scenario. With this design knowledge, the article helps to answer the fourth research question by providing lambda knowledge on how to design an information system for predictive maintenance on the distribution grid.

P11. *Predictive Maintenance on the Energy Distribution Grid: Design and Evaluation of a Digital Industrial Platform in the Context of a Smart Service System.* The stated challenges for distribution grid operators and the critical assets of their distribution grid have been shown to be solvable in the previous articles. An important part of the problem, however, are the heterogeneous assets, produced by different manufacturers and with typical lifespans of up to 40 years. Thus, there is a need for a digital industrial platform—a distinct type of digital platform operating in complex B2B-scenarios and collecting and integrating data from heterogeneous industrial assets and devices (Pauli et al., 2021). Considering solely the technical design of artifacts, however, does not adequately address the co-creation of value in such complex ecosystems. Therefore, this research paper shows a DSR study featuring the design, prototypical implementation, and evaluation of an ensemble artifact comprising a digital industrial platform and a smart service system for predictive maintenance on the distribution grid. This design is abstracted to design principles for an ensemble of a smart service system and a digital industrial platform in a predictive maintenance context. This study provides lambda knowledge for a special type of platform, i.e., digital industrial platforms, utilizing static location information from industrial assets and presents a willingness-to-pay analysis as a novel evaluation method in DSR. It thus answers the fourth research question for considering the second context—the energy distribution grid.

No.	Authors	Title	Outlet	VHB JQ3	Points
Research Question 1: Which digital platform types are investigated in the IS discipline and how do they allow to structure digital platform research?					
P1	Bartelheimer, C. zur Heiden, P. Lüttenberg, H. Beverungen, D.	Systematizing the Lexicon of Platforms in Information Systems: A Data-Driven Study	Electronic Markets	B	0.3
Research Question 2: How can the utilization of location information on digital platforms be conceptualized?					
P2	zur Heiden, P. Priefer, J. Beverungen, D.	Location-Enhanced Service: Capitalizing on Location Information of Immovable Objects	HICSS 2023	C	0.5
Research Question 3: How should IS research consider context for the effective and efficient design of IT artifacts, such as digital platforms?					
P3	zur Heiden, P.	Considering Context in Design Science Research – A Systematic Literature Review	DESRIST 2020	C	1.0

P4	Herwix, A. zur Heiden, P.	Context in Design Science Research: Taxonomy and Framework	HICSS 2022	C	0.5
P5	zur Heiden, P. Beverungen, D.	A Renaissance of Context in Design Science Research	HICSS 2022	C	0.5
		Research Question 4: How ought digital platforms to be designed to co-create value based on location information?			
P6	Berendes, C.I. zur Heiden, P. Niemann, M. Hoffmeister, B. Becker, J.	Usage of Local Online Platforms in Retail: Insights from Retailers' Expectations	ECIS 2020	B	0.25
P7	Bartelheimer, C. zur Heiden, P. Berendes, C.I. Beverungen, D.	Designing Digital Actor Engagement Platforms for Local High Streets: An Action Design Research Study	EJIS (3rd Round, Minor Revision)	A	0.3
P8	Hoffmann et al.	Integration of Novel Sensors and Machine Learning for Predictive Maintenance in Medium Voltage Switchgear to Enable the Energy and Mobility Revolutions	Sensors	-	0.06
P9	zur Heiden, P. Priefer, J.	Transitioning to Condition-Based Maintenance on the Distribution Grid: Deriving Design Principles from a Qualitative Study	WI 2021 (Workshop)	C	0.5
P10	zur Heiden, P. Priefer, J. Beverungen, D.	Utilizing Geographic Information Systems for Condition-Based Maintenance on the Energy Distribution Grid	HICSS 2022	C	0.5
P11	zur Heiden, P. Priefer, J. Beverungen, D.	Predictive Maintenance on the Energy Distribution Grid — Design and Evaluation of a Digital Industrial Platform in the Context of a Smart Service System	BISE (Submitted)	B	0.5
Σ					**4.91**

Table 1.1: Research articles comprising this dissertation

2 Theoretical Foundations

2.1 A Service Science Perspective on Value Co-Creation

When aiming to understand how *value on digital platforms can be co-created* utilizing location information, the first step is to understand how value co-creation generally works, why value is co-created rather than simply created. For this approach, service science has been established as a central research discipline rooted in marketing and adapted in IS research (Böhmann et al., 2018; Spohrer et al., 2014; Beverungen et al., 2019). The definition by which service science revolves around "the study of the application of the resources of one or more [service] systems for the benefit of another system in economic exchange" (Maglio et al., 2009, p. 405) already points to the central element and characteristics of service and service systems. *Service*[3] characterizes the "application of specialized competences [...] through deeds, processes, and performances for the benefit of another entity or the entity itself" (Vargo and Lusch, 2004, p. 2). A *service system* integrates resources—people, organization, information, and technology—into dynamic value-co-creation configurations, which are connected to other service systems by value propositions (Spohrer et al., 2007; Maglio et al., 2009). Thus, a service system encompasses a service, its different resources and its application in connection to other actors and service systems (Maglio et al., 2009).

The *foundation of service science* is the service-dominant logic of marketing (S-D logic), a theoretical lens for understanding and analyzing value-co-creation established by Vargo and Lusch (2004). S-D logic consists of a set of foundational premises including the thesis that service is the basis for all economic exchange (Vargo and Lusch, 2004). S-D logic has been improved multiple times in service science, but is still accepted as the foundations of service science (as seen in, e.g., Lusch and Vargo,

[3] Service research distinguishes between service (singular form) as defined above and services (plural form), describing units of output (Lusch and Vargo, 2006).

2006; Vargo and Lusch, 2008; Vargo and Lusch, 2016; Vargo and Lusch, 2017; Maglio et al., 2009). S-D logic contrasts with an economic view of a goods-dominant logic, which considers goods as the primary unit of exchange (Vargo and Lusch, 2004; Vargo and Lusch, 2016). The difference between S-D logic and a goods-dominant logic is also encapsulated by the notion of *operand* and *operant resources* (Vargo and Lusch, 2004; Lusch and Vargo, 2006). Operand resources are physical, tangible, static, and finite—e.g., natural resources and goods. Operant resources, on the other hand, are dynamic, infinite, and intangible—e.g., knowledge, skills, and service (Vargo and Lusch, 2004; Constantin and Lusch, 1994). From a goods-dominant perspective, value is determined by the producer of a good, whereas a customer is seen as an operand resource (Vargo and Lusch, 2004). This understanding of value, however, is not practically usable in a world of individualized and customized products and services (Beverungen et al., 2017). Instead, S-D logic advocates the co-creation of value, in which actors integrate resources (Vargo and Lusch, 2004). Here, customers are seen as active participants, i.e., operant resources (Vargo and Lusch, 2004).

Resources have to be integrated by actors, since resources used in isolation cannot contribute value (Lusch and Nambisan, 2015). Additionally, combining multiple resources is a promising way to foster innovation (Lusch and Nambisan, 2015; Beverungen et al., 2018; Arthur, 2009). However, co-creation of value implies that value cannot be created (or determined) prior to consumption (Sandström et al., 2008), because it is ultimately determined by a consumer during consumption—symbolized by the notion of *value-in-use* (Vargo and Lusch, 2004; Chandler and Lusch, 2015). Instead, producers (from here on to be referred to as service providers) are solely able to offer value propositions, which consumers can voluntarily integrate with their resources to co-create value (Chandler and Lusch, 2015).

In an interconnected world of interacting service and changing roles—especially for digital platforms—service systems engage with one another and form *service ecosystems* (Vargo and Akaka, 2012), defined as "relatively self-contained self-adjusting systems of resource-integrating actors connected by shared institutional logics and mutual value creation through service exchange" (Lusch and Nambisan, 2015, p. 161). Service researchers adopt a service-ecosystem view to study the co-creation of value of multiple actors who exchange service for service (Vargo and Akaka, 2012). In a service-ecosystem view, the emphasis lies on the social context—i.e., the relationships formed by different actors and which they are bound to (Lusch and Nambisan, 2015)—and institutions—i.e., social norms and rules (Williamson, 2000; Edvardsson et al., 2011). Actors in a service ecosystems are bound loosely by the social contexts and especially by the institutions that shape a service ecosystem (Vargo et al., 2015).

With these perspectives in mind, designing value is deemed to be impossible, as value has to be co-created through the integration of resources. Instead, what can be designed are value propositions and actor roles in service systems and service ecosystems (Böhmann et al., 2014; Beverungen et al., 2018). This design strategy is termed as *service systems engineering* (Böhmann et al., 2014) and features a plethora of methods (a review of which is provided in Beverungen et al., 2018). As it is impossible to design a service system in its entirety, designers develop resources and integration processes (Böhmann et al., 2014; Joly et al., 2019) that may or may not lead to emerging service systems.

In a technologically advanced service, design can revolve around smart products, e.g., physical products equipped with sensors to monitor their status and environment (Beverungen et al., 2017; Porter and Heppelmann, 2014). A smart service can then utilize smart products to analyze data and integrate further resources of actors in order to co-create value (Beverungen et al., 2019). A service system encapsulating a smart product and multiple actors is called a *smart service system*, a concept that has garnered increasing interest in service science and IS research (Beverungen et al., 2017; Beverungen et al., 2019; Beverungen et al., 2021; Lim and Maglio, 2018). An example of designing a smart service system is portrayed in zur Heiden et al. (2022b).

To sum up, the conceptualization of value has *four central characteristics* concerning an S-D logic and a service-ecosystem perspective (Vargo et al., 2017): (1) Value has to be *co-created* through the integration of resources of different actors. (2) Value is *phenomenological*, i.e., perceived differently by different actors integrating resources for value co-creation. (3) Value is *multidimensional*, as it comprises multiple facets, e.g., individual, social, technological, and cultural components. Finally, (4) value is *emergent*, i.e., it cannot be determined prior to consumption.

2.2 Digital Platforms

2.2.1 Foundations of digital platforms

Before elaborating on how value can be co-created on digital platforms, this section introduces the foundational basis of digital platforms. There exists a plethora of definitions of the term *digital platform* in IS and related disciplines, examples of which are shown in Table 2.1.

Generally, Constantinides et al. (2018, p. 381) define a digital platform as a "set of digital resources—including services and content—that enable value-creating interactions between external producers and consumers". The characteristic of being *digital* describes that a platform is editable, interactive, open and thus reprogrammable by actors, self-referential, distributed, and containing homogenized data (Kallinikos et al., 2013; Yoo et al., 2010). Digital platforms, therefore, drastically differ from non-digital platforms (Yoo et al., 2010), such as product platforms (Gawer and Cusumano, 2014). The general definition of a digital infrastructure, however, also covers the Internet (Constantinides et al., 2018), which is rarely considered in digital platform research in IS. Hence, detailed definitions have become established that focus on the different views that IS research can take on digital platforms—a technical view, and a sociotechnical and economic view (de Reuver et al., 2018; Asadullah et al., 2018). These two roles also relate to two main types of platforms identified by Bonina et al. (2021): transaction platforms and innovation platforms. Transaction platforms match actors of different actor groups (Cusumano et al., 2019)—implying an economic exchange between them—whereas innovation platforms enable the creation of applications extending a platform core (Gawer, 2011; Bonina et al., 2021).

From a *technical view*, digital platforms are seen as a software-based, extensible core to which third-parties can add applications extending a digital platform (de Reuver et al., 2018; Tiwana et al., 2010; Boudreau, 2012). The core of a platform offers low variety and is relatively stable, while the applications—"executable pieces of software that are offered as applications, services or systems to end-users of the platform" (Ghazawneh and Henfridsson, 2013, p. 175)—in the periphery of a digital platform have high variety (Baldwin and Woodard, 2009). Digital platforms are described as having a layered modular architecture (Yoo et al., 2010; Baldwin and Woodard, 2009; Gawer, 2011; Constantinides et al., 2018; de Reuver et al., 2018), i.e., a hybrid

Reference	Definition of *Digital Platform*
Constantinides et al. (2018, p. 381)	"set of digital resources—including services and content—that enable value-creating interactions between external producers and consumers"
Tiwana et al. (2010, p. 676)	"extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate"
de Reuver et al. (2018, p. 126)	"purely technical artefacts where the platform is an extensible codebase, and the ecosystem comprises third-party modules complementing this codebase (Tiwana et al., 2010; Boudreau, 2012)"
Asadullah et al. (2018, p. 2)	"commercial network or market that enables transactions in the form of business-to-business (B2B), business-to-customer (B2C), or even customer-to-customer (C2C) exchanges (B. Tan et al., 2015; Koh and Fichmann, 2014; Pagani and Bocconi University, 2013; Ye et al., 2012)"
Beverungen et al. (2021, p. 513)	"a mediating entity operating in two- or multi-sided markets, which uses the internet to enable direct interactions between two or more distinct but interdependent groups of users (e.g., in the case of a two-sided market: buyers and sellers) to generate value for at least one of the groups (Hagiu and Wright, 2015; Rochet and Tirole, 2004; Rysman, 2009; Weyl, 2010)"
de Reuver et al. (2018, p. 126)	"a sociotechnical assemblage encompassing the technical elements (of software and hardware) and associated organisational processes and standards (Tilson et al., 2012)"
Bonina et al. (2021, p. 871)	"a distinct type of information technology (IT) artefact with distinct properties, which lend particular affordances for development", "a socio-technical phenomenon that require careful consideration of how they function in a social context"

Table 2.1: Definitions for the concept of a digital platform in the IS literature

between a layered architecture (device, network, service, and content layers) and a modular architecture (components with standardized interfaces), combining both trends (Yoo et al., 2010). This combination of stable and flexible elements of the technical composition of a digital platform allows for controlling the different elements and users on a digital platform, but also for flexibility (Tilson et al., 2010). Taking a technical view, digital platforms can be viewed as a less complex type of digital infrastructure with centralized control (de Reuver et al., 2018; Hanseth and Lyytinen, 2010). Thus, research appertaining to a technical view targets the architecture and infrastructure of digital platforms (e.g., Baldwin and Woodard, 2009; Arnold et al., 2022; Spagnoletti et al., 2015), evolution paths and opportunities (e.g., Agarwal and Tiwana, 2015; Cennamo, 2018; Staykova and Damsgaard, 2017), and applications of and for third-party providers (e.g., Ghazawneh and Henfridsson, 2013; Ghazawneh and Henfridsson, 2015; Eaton et al., 2015).

From a *sociotechnical and economic view*, digital platforms are seen as a form of digital infrastructure associated with organizational roles, processes, and standards (de Reuver et al., 2018). Roles and actor groups on digital platforms comprise sellers and buyers, a platform owning a platform, and a platform provider providing a platform (van Alstyne et al., 2016; Beverungen et al., 2021), although in many cases the roles of platform owner and provider overlap. The roles of platform owners and providers are also relevant for the technical view. The focus of sociotechnical and economic research on digital platforms lies on the role of digital platforms in different business relationships, i.e., B2B and B2C, or even C2C (Asadullah et al., 2018). A digital platform is operated in a multi-sided market (Beverungen et al., 2021; Hagiu and Wright, 2015; Rochet and Tirole, 2004). The digital platform either functions as a mediator or as an intermediary to enable direct interactions between actor groups and indirect interactions among actors of the same group (van Alstyne et al., 2016; Weyl, 2010; Beverungen et al., 2021). When conceptualizing a digital platform as constituting of a platform periphery, a platform core, and a platform infrastructure (Poniatowski et al., 2021), sellers and buyers interact on the platform periphery. The core is managed by the platform owner, whereas the platform infrastructure is controlled by the platform provider, also termed platform sponsor (Poniatowski et al., 2021). The sociotechnical and economic view on digital platforms focuses mainly on four different concepts over which platform owners have control (Poniatowski et al., 2021), as visualized in Figure 2.1: direct interaction, affiliation, network effects, and openness (Beverungen et al., 2021).

Direct interaction describes the interaction a platform enables between two groups of actors, e.g., between buyers and sellers. A platform does not monopolize the control over the interaction, but enables actors to manage details of their interaction themselves, e.g., pricing, marketing, or delivery (Hagiu and Wright, 2015; Beverungen et al., 2021). Still, a platform sets boundaries to these details of interaction, and can

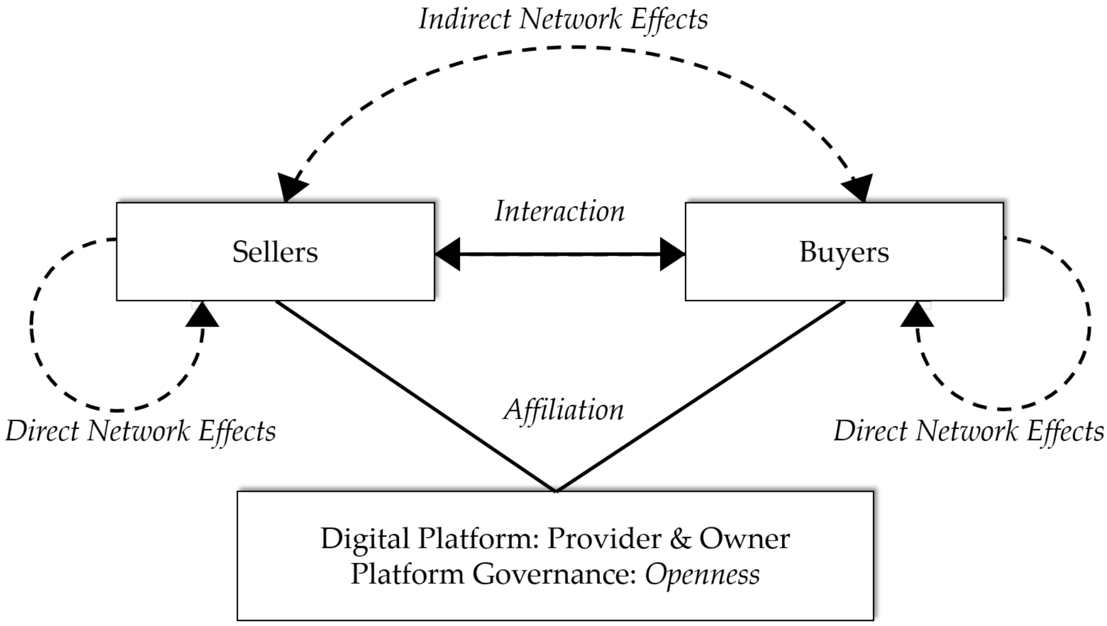

Figure 2.1: Selected roles and core concepts of digital platforms (Beverungen et al., 2021)

even take full control over these terms in certain scenarios (van Alstyne et al., 2016). *Affiliation* characterizes the investments different actors have to make to be able to participate on one side of a platform (Hagiu and Wright, 2015). These affiliations are ideally designed to portray nonzero entry and exit costs, so that actors keep a connection to the platform, e.g., in the form of access fees or opportunity costs (Hagiu and Wright, 2015).

Further, economic research on digital platforms in IS investigates *network effects*, i.e., the effect of additional actors using a service on a digital platform (Boudreau, 2012; Rysman, 2009; Parker and van Alstyne, 2005). Network effects can occur among actors of one group (direct network effects) and between multiple groups of actors (indirect network effects), so that more buyers can attract either more buyers via direct network effects or more sellers via indirect network effects (Beverungen et al., 2021). Two phenomena related to network effects are investigated. First, during a launch of a digital platform, owners have to face the *chicken-and-egg dilemma*, which portrays a situation in which network effects do not yield a positive effect yet, i.e., there are too few sellers to attract buyers and too few buyers to attract sellers (Caillaud and Jullien, 2003; Stummer et al., 2018). Stummer et al. (2018) present strategies to overcome the chicken-and-egg dilemma, e.g., focusing on a specific region or industry, or allowing one actor group to use the platform for free while the other actor group has to pay for its service until network effects apply. Second, once a digital platform has been successfully established in a market, network effects can be so strong that a *winner-takes-all* situation establishes in which no other digital platform or market can keep up with a platform's popularity and success (Eisenmann et al., 2006). As such, getting a critical number of different actors from each group acting on a digital platform is a key success factor (Evans, 2003; Rochet and Tirole, 2006).

Openness describes the degree of control that platform operators give to the access of a digital platform (Gawer and Cusumano, 2014; Benlian et al., 2015; Ondrus et al., 2015). Openness can be controlled on multiple sides of a digital platform, targeting different actor groups or even integration with other platforms and services (Ondrus et al., 2015). As openness can lower the number of possible actors, it is strongly connected to the network effects emerging on a digital platform (Beverungen et al., 2021), and as such is a critical managerial factor for successfully establishing a digital platform.

Research accounting for both perspectives of digital platform research—i.e., the *technical view* and the *sociotechnical and economic view*—is rare in the IS literature. Gawer (2011) differentiates between internal platforms, supply chain platforms, industry platforms, and multi-sided platforms to differentiate between different properties and characteristics of platforms according to both views, e.g., participants, design rules, and platform objectives. Gawer (2014) presents a framework for integrating both perspectives in the *organizational view*, seeing platforms as evolving organizations in regards to both technical and economic aspects. Other examples feature literature reviews of digital platform research in IS (Asadullah et al., 2018; Sutherland and Jarrahi, 2018) and research agendas (de Reuver et al., 2018; Sutherland and Jarrahi, 2018). Still, digital platforms are a contemporary phenomenon in IS research, because they significantly reduce transactions costs so that they are omnipresent in business and society and transform whole branches of industries (Eisenmann et al., 2006; de Reuver et al., 2018; Pagani and Bocconi University, 2013; Tiwana, 2014; Parker et al., 2016)—consider, for example, transitions from video rental stores to online streaming platforms.

2.2.2 Value co-creation on digital platforms

As discussed in Section 2.1, a service science perspective emphasizes that value can only be co-created through the integration of resources of different actors (Vargo et al., 2017). This dissertation revolves around digital platforms, requiring a detailed view of how value on digital platforms is co-created. Digital platforms co-create value by incorporating information from and interactions between different actor groups (van Alstyne et al., 2016). In contrast to a service that is not based on a digital platform, digital platforms "leverage (digital) two- or multi-sided marketplaces that allow different types of users to interact and transact with each other" (Beverungen et al., 2021, p. 508). Thus, digital platforms act as a boundary resources, enabling interaction and resource exchange to co-create value (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013). A platform owner can capture parts of the value co-created on a digital platform (Ceccagnoli et al., 2012) so that not only the different actor groups, but also a platform owner benefit from exchanges on a platform, for instance, by monetizing access to a platform or charging transaction fees.

The service ecosystem of a digital platform comprises a digital platform and its different actors—sellers, buyers, platform owner, and platform provider (van Alstyne et al., 2016; Beverungen et al., 2021). As a specialization of a service ecosystem, this *digital platform ecosystem* acts as a concept to study the value co-creation on digital platforms, featuring the presented actor groups (Ghazawneh and Henfridsson, 2015). Therefore, a digital platform ecosystem includes the internal factors, which can be controlled by a platform owner—e.g., strategies, technical architecture, and openness—and environmental dynamics, which cannot be controlled by a platform owner—e.g., network effects, trust, and third-party participation (Poniatowski et al., 2021; Tiwana et al., 2010). When further characterizing digital platform ecosystems, Hein et al. (2020) suggest *three building blocks*: platform ownership, value-creating mechanisms, and autonomy of sellers and buyers. First, platform ownership shapes the interactions on a platform as it defines relationships by governance mechanisms (Hein et al., 2020; Tiwana et al., 2010; Bakos and Katsamakas, 2008). Platforms are in most cases owned by one party, but can also be owned by a consortia or governed by a decentralized community (Hein et al., 2020). Second, the main mechanisms shaping value-co-creation on a digital platform have already been presented by the two distinct groups of platforms, i.e., transaction platforms and innovation platforms (Bonina et al., 2021; Cusumano et al., 2019; Hein et al., 2020). Transaction platforms connect actors of different groups to enable interaction and exchange, where the digital platform acts as an intermediary (Hein et al., 2020). Innovation platforms allow for the creation of third-party applications to a digital platform to co-create value (Hein et al., 2020; Tiwana, 2014). Third, the autonomy of sellers and buyers describes the degree to which sellers and buyers are free to co-create value on a digital platform (Ye and Kankanhalli, 2018; Hein et al., 2020). Loosely coupled relationships denote high autonomy, whereas dependence on each other denotes low autonomy (Orton and Weick, 1990; Hein et al., 2020).

Thus far, digital platforms were either conceptualized as IT artifacts with a technical view, or as ecosystems comprising relevant stakeholders (cf. Table 2.1). Zooming out further, digital platforms can also be conceptualized as systems for actor engagement (Poniatowski et al., 2021). *Actor engagement* in a service ecosystem describes the "dynamic and iterative process, reflecting actors' dispositions to invest resources in their interactions with other connected actors in a service system" (Brodie et al., 2019, p. 183). Thus, actor engagement generalizes engagement concepts of specific actor groups (customers, employees, communities) at a platform level through a service ecosystem perspective (Brodie et al., 2019; Blasco-Arcas et al., 2020). Actor engagement is highly important for the success of digital platforms as it directly relates to network effects and participation on a digital platform (Poniatowski et al., 2021; Tiwana et al., 2010). For a digital platform to enable sustainable actor engagement, it needs to encompass stability—portrayed by its transaction rules—and flexibility—enabled by its modular architecture (Blasco-Arcas et al., 2020).

In summary, de Reuver et al. (2018) recommend to clearly define what researchers mean when using the terms *digital platform* and *digital platform ecosystem*. This dissertation aligns with the definition of Bonina et al. (2021) because it covers both transaction and innovation platforms and includes both the technical and sociotechnical / economic view on digital platforms. For holistic platform research and design, other definitions adopt a singular view (cf. Table 2.1) without giving enough emphasis to the context of a platform (cf. Section 1.2). For digital platform ecosystem, this thesis aligns with the conceptualization of Hein et al. (2020).

2.2.3 Design of digital platforms

The design of digital platforms[4] is a complex task as it has to cover different areas relevant to the success of a digital platform. In a longitudinal case study, Fürstenau et al. (2019) investigate the relevant aspects of platform design and propose a framework composed of four areas: platform strategy and governance (including integration into a business ecosystem, openness, and control), technical architecture (standards, interfaces, modularity), participation and community building (roles, growth strategies, marketing), and engagement outside the platform ecosystem (connection to other platforms, industries, and alliances). This framework reflects the main views on digital platforms—i.e., technical or sociotechnical and economic views—adopted in digital platform research. In a similar fashion, Tura et al. (2017) derive a framework for relevant areas of platform design with a sociotechnical and economic focus. Although their four areas appear to be identical to the ones proposed by Fürstenau et al. (2019)—platform architecture, value creation logic, governance, platform competition (Tura et al., 2017)—their areas refer solely to sociotechnical and design aspects. For instance, *platform architecture* refers to market structures, key actors, and openness (Tura et al., 2017), whereas the holistic framework (Fürstenau et al., 2019) also refers to modules and technical implementations.

On the one hand, research on the design of digital platforms taking the *sociotechnical and economic view* mainly investigates strategies and network effects (Bakos and Katsamakas, 2008; Tura et al., 2017; Michalke et al., 2022). Bakos and Katsamakas (2008) research two-sided transaction platforms to analytically derive insights for designing such digital platforms. They identify that an investment that is focused on the side that has larger network effects is the most profitable strategy for a platform owner (Bakos and Katsamakas, 2008). As such, the design for sellers and buyers on a digital platform is asymmetric (Bakos and Katsamakas, 2008). Further, Bakos and Katsamakas (2008) recommend that platform owners set pricing strategies after concentrating their investment on one side of a platform, then invest into the least favored side of a platform to attract participation and ensure that the asymmetric design co-creates value. Tura et al. (2017) design a digital platform for the integration and exploitation of mobility information for door-to-door traveling—connecting different actors of a mobility business. Applying the sociotechnical and economic view,

[4] This section elaborates on existing design studies on digital platforms. It does not cover the methodological aspects of digital platform design, which will be discussed in Section 3.1.

the design of the central areas of actor roles, platform openness, value proposition, network effects, revenue model, platform rules, and growth strategies, among other aspects, is reported, whereas the technical implementation of a platform is neglected (Tura et al., 2017). Michalke et al. (2022) develop design principles for engagement platforms, stating that they have to attract and bind actors, achieve mutual growth, foster interaction and value co-creation, and improve competitiveness. These factors are closely related to the mechanisms on digital platforms, i.e., affiliation, openness, and network effects.

On the other hand, research on the design of digital platforms taking the *technical view*—platforms as IT artifacts (Poniatowski et al., 2021)—revolves around the architecture of a digital platform and its design to support the purpose of a digital platform (Hönigsberg, 2020; Arnold et al., 2022). Arnold et al. (2022) do not design platforms themselves, but investigate the design of existing platforms and derive five archetypes of industrial internet of things (IIoT) platforms differentiated by their architecture—all-rounder, device controller, data hubs, service enablers, and connectors. Hönigsberg (2020) designs a digital platform for value-co-creation and service innovation as a cross-company solution for the textile industry. The focus of their research lies on developing a digital platform as an artifact, characterized by design principles for the design and functions of a platform to enable service innovation.

Whereas only a few studies investigate the design of digital platforms with either the technical or the sociotechnical and economic view, even fewer papers investigate the design accounting for *both perspectives of digital platform research* (Otto and Jarke, 2019; Spagnoletti et al., 2015). Spagnoletti et al. (2015) design a digital platform for supporting online communities. The technical view is addressed through modularization and the technical implementation of a platform, whereas the different forms of online communities (information sharing, collaboration, and collective action) and their consequences for the design of a digital platform address the sociotechnical and economic view (Spagnoletti et al., 2015). Overall, Spagnoletti et al. (2015) present a set of propositions for the design of digital platforms supporting online communities. Otto and Jarke (2019) investigate a multi-sided platform for the secure and trusted exchange of data. The platform is governed by an alliance of stakeholders rather than a single provider (Otto and Jarke, 2019). Their platform design covers rationales, use cases, actor roles, the platform architecture, the design of the ecosystem, and governance mechanisms (Otto and Jarke, 2019)—accounting for both views on digital platforms.

The low number of design studies on digital platforms found in IS research and related disciplines is underlined by calls for design research. Multiple researchers call for more design research on digital platforms (de Reuver et al., 2018), more diverse research methods studying the design of digital platforms (Asadullah et al., 2018), and an integration of the different views on digital platforms to account for a holistic perspective on digital platforms (Gawer, 2014; Beverungen et al., 2021; de Reuver et al., 2018). To understand the contemporary phenomenon of a digital platform, IS research needs to integrate both omega and lambda knowledge in the form of different theory types (Gregor, 2006). Targeting design studies on digital platforms enables IS research to both understand platform mechanisms and market transformations and to inform the future of digital platforms in research and society.

2.3 Location Information on Digital Platforms

When looking at different digital platforms dominating the market—for instance, Facebook, Amazon, Google—they share many common properties investigated in research on digital platforms in IS. Nearly no studies in IS research, however, investigate the use of *location information* these digital platforms utilize, whether it is, for example, Facebook tagging the location of posts, Amazon using such information for deliveries, or Google for the visualizations on Google Maps or for content restrictions on their app store.

Location information[5] represents geographic features, i.e., things on the surface of the real world, by longitude and latitude (Haining, 1994; Larson, 1996). Location information can be differentiated by different categories: type of data (Couclelis, 1992), information contained (Quesnot and Roche, 2015), and stationary aspects (Lehrer et al., 2011). For type of data, object data (also called vector data) comprise points, lines, and polygons (areas). While human-made artifacts like bridges, roads, and buildings can be represented with object data, these points, lines, and polygons

[5] Location information is also referred to as location data, geospatial data, spatial data, or spatial information, without guidelines for delineating the concepts or when to use which term. This dissertation opts for location information and includes the related concepts.

do not exist in the natural geographic world[6] (Couclelis, 1992). Location information as field data (raster data) ignores the nature of the real world and portrays groupings of pixel arrays (Couclelis, 1992), most prominently seen in weather services. Location information can be enriched by platial data, comprising information and experiences of places, i.e., their identities, meanings, and semantics (Quesnot and Roche, 2015). For stationary aspects, location information can be divided into *static* and *dynamic* information (Lehrer et al., 2011). Static location information describes the permanent attributes of location information, e.g., the physical position of a building or the (mostly) stable national borders. Dynamic location information describes location information over period of observation, as a physical location changes (Lehrer et al., 2011), for instance, for cars or tides on a shore. Technically, there are different formats for storing location information, depending on the type of information system or digital platform used for data management (Garmash, 2001).

The most common information systems used for acquiring, managing, analyzing, and presenting location information are *geographic information system (GIS)* (Chrisman, 1999; Farkas et al., 2016). A GIS is defined as a "system of hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing, and disseminating information about areas of the earth" (Dueker and Kjerne, 1989, p. 7–8). Despite this definition being relatively old, it still serves its purpose, and research investigating GIS still improves functionality through new methods and improved algorithms (e.g., Mobasheri et al., 2020). Although GIS have been investigated in a few IS studies (Keenan and Miscione, 2015), they share a strong connection to other information systems studied in IS, for instance, decision support systems and big data analytics (Farkas et al., 2016). With open data initiatives such as INSPIRE (European Commission, 2007; Minghini et al., 2021), however, it is reasonable to assume that GIS will be increasingly investigated as a topic in IS research in the future.

From a service science perspective, location information constitute a type of operand resource that can be integrated with other resources to co-create value in innovative service systems (Lusch and Nambisan, 2015), e.g., on digital platforms. GIS can

[6] The real, natural world does not clearly delineate between two types of areas, for instance a sea and a beach. Therefore, representing the coastline of an island can be done by a polygon or a line. However, the higher the measuring accuracy, the longer the length of a coastline will be estimated, characterized as the coastline paradox (Richardson, 1961; Mandelbrot, 1967). Thus, location information of natural things—in contrast to human-made artifacts—are always subject to a degree of uncertainty (Couclelis, 1992).

take the role of a boundary object in such service systems as they enable a connection between service customers and service providers by providing an interface for integrating resources (Star and Griesemer, 1989; Star, 2010; Becker et al., 2013). A particular type of service is investigated in IS research and related disciplines regarding the utilization of location information: *location-based service (LBS)*. LBS utilize location information (Xu et al., 2009) of mobile devices for a location-sensitive service within a defined physical proximity (Mathew et al., 2004). By reacting to the up-to-date geographic position of a service customer and the ability to provide a service based on the position, service customers and service providers can co-create personalized value-in-use with an LBS (Küpper, 2005; Raper et al., 2007). LBS are characterized by two attributes: feasibility and locatability. First, feasibility refers to a service customer being in physical proximity to the location where a service is ultimately provided (Bärsch et al., 2019; Molitor et al., 2016). Second, locatability describes the ability of a technical device to communicate its physical position as location information in real-time (Junglas et al., 2008; Pei Chin and Siau, 2012).

The impact of location-sensitive services, especially LBS, was already discovered at the start of this century (Rao and Minakakis, 2004). As argued by Rao and Minakakis (2004, p. 4), "location is correlated with, if not a determinant of consumers' information needs, and product or service choices". Thus, if the location of a customer is known, the value co-created might be increased due to the high individualization of a service (Rao and Minakakis, 2004). Nevertheless, business models for LBS were not mature at that time, and as a consequence, LBS were rarely adopted (Ryschka et al., 2014).

In recent years, LBS have been heavily investigated in IS research. The main topics of interest concerning LBS are the design (e.g., Guo et al., 2018), service customer behavior in service systems based on LBS (e.g., Molitor et al., 2020), and the disclosure of location information (e.g., Xu et al., 2012). Especially the disclosure of location information in LBS has been an controversial topic, with reasons for not disclosing location information being privacy concerns, motivation, and trust (Roick and Heuser, 2013; Patil et al., 2012; Beldad and Citra Kusumadewi, 2015). Findings reveal that—despite the considerable growth of smartphone—LBS customers are aware of privacy risks and are reluctant to use and share location information (Yun et al., 2013; Xu and Gupta, 2009). Service providers of LBS, therefore, should minimize concerns associated with privacy as much as possible to be able to co-create value with as many service customers as possible (Yun et al., 2013).

Many popular, digital platforms offer value propositions through LBS. Facebook, for instance, allows users to connect with people in an area and recommends new contacts based on similar locations of different users of their digital platform. Further, Facebook offers a check-in function for events with a static location to share the location among contacts (Kim, 2016). Google offers navigation services classifying as LBS (Lehrer et al., 2011) and other functionality related to LBS on Google Maps, e.g., showing recommended stores or restaurants in the surroundings of a service customer. Further, digital platforms for electric scooter sharing in cities utilize LBS to guide service customers to their scooters and even to bill them based on the distance traveled.

Location information can play an essential role concerning direct interaction and affiliation as the mechanisms constituting a digital platform. Feasibility as a criterion for an LBS (Bärsch et al., 2019; Molitor et al., 2016) enables direct interaction via a digital platform. Thus, location information serves as an enabler for direct interaction. Providing location information for different actor groups on a digital platform is either a requirement to participate on a digital platform or enables further service, which might incentivize location information sharing. Thus, location information offers one way of strengthening affiliation to a digital platform.

Although the use of LBS to co-create value based on location information is investigated in IS research, classifying different categories of LBS or even other ways how location information can be integrated with other resources are seldom theorized. For categories of LBS, Lehrer et al. (2011) differentiate between static, general, interdependent, and mobile LBS, A. Z. Y. Tan et al. (2014) distinguish between push and pull LBS. Other researchers only suggest different types of LBS based on existing LBS instantiations (Junglas et al., 2008; Lehrer et al., 2011; Mathew et al., 2004; Pei Chin and Siau, 2012). Considering the main criteria of LBS—feasibility and locatability—other digital platforms provide service based on location information while not demanding feasibility and locatability. Examples include job portals, hotel selection platforms, and transaction platforms such as eBay, which all allow filtering based on location information to provide further details to the offerings on their platforms.

3 Research Design

3.1 Design Science Research Paradigm

The core of IS research lies at the intersection of information systems, the people using them, and the organizations deploying them (Hevner et al., 2004; Silver et al., 1995). More specifically, IS relates to the analysis, construction, deployment, use, evaluation, evolution, and management of information systems (Hevner et al., 2004). As it stems from the intersection of organizational research and information technology research (Orlikowski and Barley, 2001), IS integrates multiple perspectives with its interdisciplinary nature (Becker and Niehaves, 2007). Thus, IS integrates two intertwining *research paradigms*—a term referring to a scientist's worldview and way of understanding and thinking about the real world (Kaushik and Walsh, 2019; Patton, 2002; Guba and Lincoln, 1994)—notably behavioral science and design science (Hevner et al., 2004).

Philosophical assumptions and *theoretical preconceptions* for research paradigms provide a philosophical embedding and comprise the dimensions of ontology, epistemology, concept of truth, source of cognition capability, and methodological aspects (Becker and Niehaves, 2007). The ontological dimension refers to the central object of cognition, distinguishing between ontological realism, which acknowledges that the real world exists regardless of a researcher observing it, and ontological idealism, which assumes that the real world does not exist objectively and without human cognition (Becker and Niehaves, 2007). Kantianism—a third manifestation of the ontology—combines both approaches to separate objects and phenomena (Becker and Niehaves, 2007; Kant, 1997). The epistemology dimension differentiates between the relationship between cognition and an object of cognition, i.e., how knowledge can be gained about the real world (Hay, 2002; Becker and Niehaves, 2007). Epistemological realism aligns with ontological realism in that objective cognition is possible, whereas constructivism aligns with ontological idealism by assuming that every effort invested in gaining understanding and knowledge is subjective and up to the individual (Becker and Niehaves, 2007). The different concepts of truth distinguish between ways that deem research and cognition as true and reliable (Becker and Niehaves, 2007). Popular concepts of truth include correspondence theory, consensus theory, coherence theory, and semantic theory (Becker and Niehaves, 2007; Österle et al., 2011). For the correspondence theory, truth is based on facts, determined by the evaluation of hypotheses in natural science. The consensus theory declares truth as what everyone or a relevant group accepts as truth, i.e., their consensus. For literature reviews, the coherence theory of truth applies, as it declares truth to be what is consistent with previous research results. Finally, the semantic theory of truth is based on an object and a meta-language to validate the correctness of the language. The source of cognition capability describes the source which is viewed to be most important for gaining knowledge (Becker and Niehaves, 2007). Empiricism relies on experience and knowledge, whereas rationalism considers the human intellect as this source. Combining both, the Kantian approach considers both knowledge sources as valid (Becker and Niehaves, 2007). Methodological aspects describe how the process of knowledge acquisition can be encompassed, i.e., either inductively or deductively (Becker and Niehaves, 2007). Additionally, combining deductive and inductive activities in hermeneutic cycles aggregates both approaches (Becker and Niehaves, 2007).

The *behavioral research paradigm* mainly revolves around the development omega knowledge in the form of theory Types One to Four, i.e., theories for analyzing, predicting, and/or explaining (Gregor, 2006). In IS research, behavioral research is focused on these theory types in relation to IT artifacts and their use in organizations (Hevner et al., 2004). Therefore, it utilizes research methods from the natural sciences and seeks to find truth (Hevner et al., 2004), for instance, through quantitative studies. Thus, the behavioral research paradigm aligns in most cases with the correspondence theory of truth, an empirical source of cognition, and either a inductive or deductive methodology (Becker and Niehaves, 2007). The selection of ontology and epistemology are up to the researchers in their study.

The *DSR paradigm* fundamentally differs from the behavioral research paradigm, but a combination of both paradigms is critical to conduct relevant and rigorous research in IS. Rooted in engineering sciences and the sciences of the artificial (Simon, 1996; Hevner et al., 2004), the main aim of DSR is to solve problems—not striving for truth, but for utility (Hevner et al., 2004; Iivari, 2015). Research differentiates between natural and artificial objects. Research following the DSR paradigm synthesizes artifacts to achieve certain goals and functions, imitating appearances in common natural objects (Simon, 1996). Thus, artifacts are to be positioned at the interface between their outer and their inner environment (Simon, 1996), serving as boundary objects. The nature of *IT artifacts* is conceptualized based upon five premises (Orlikowski and Iacono, 2001): (1) IT artifacts are neither given nor neutral, nor universal, nor natural, but formed by the interests, values, and assumptions of stakeholders. (2) They integrate into a context. (3) They usually consist of multiple components, which serve a common goal when being integrated. (4) They are neither bound nor independent, but emerge and develop through social or economic practices. (5) They are not static, but malleable to suit new functions and technologies (Orlikowski and Iacono, 2001).

As IT artifacts are not static, they are viewed as actors in their own right because they might modify certain statuses (Markus and Silver, 2008). If IT artifacts prove useful by solving a novel problem or are more effective or efficient than existing artifacts, they contribute valuable insights to the knowledge base (Hevner et al., 2004; March and Smith, 1995). Thus, IT artifacts are designed to benefit people and their goals in a certain context (Zhang et al., 2011; Orlikowski and Iacono, 2001)—their outer environment (Simon, 1996). IT artifacts can come in different forms: constructs, models, methods, and instantiations (March and Smith, 1995). Constructs are seen as a basic form of artifacts providing a language for problems or solutions (Winter, 2008), e.g., the concept of a digital platform. Multiple constructs are linked by models to represent complex problems and solutions (Winter, 2008; March and Smith, 1995), e.g., models of the integration of different modules in digital platforms. With methods, researchers gain insights into processes capable of solving problems and finding solutions (Winter, 2008), e.g., methods for designing digital platforms. Instantiations aggregate different constructs, models, and methods to solve instantiated problems (Winter, 2008; March and Smith, 1995), e.g., the digital platform *Amazon* connecting online retailers and online customers. Creating innovative IT artifacts for the purpose of resolving problems by purposefully organizing resources is called *design* (Hevner et al., 2004). Simon (1996, p. 111) extends this view and characterizes design as "the core of all professional training", emphasizing that design does not focus on a perceived phenomenon, but how things ought to be designed in order to function properly (Simon, 1996). Design can therefore describe both a process and a product, i.e., the artifact (Hevner et al., 2004; Walls et al., 1992).

DSR also fundamentally differs from the behavioral research paradigm, as it is rooted in *pragmatism* (Hevner et al., 2004; Goldkuhl, 2012a; Goldkuhl, 2020), which "is a school of thought that considers practical consequences or real effects to be vital components of both meaning and truth" (Hevner, 2007, p. 91). Pragmatism has its own truth criterion of *successful working* (Hayes et al., 1988; Zettle et al., 2016), i.e., something is true if it is working as intended to solve relevant problems. This pragmatic view shapes the philosophical assumptions and theoretical preconceptions for research. DSR adopts the Kantian ontology with a Kantian approach to the source of cognition. With hermeneutic cycles, two processes form the core of IS research, each resembling aspects of both research paradigms: develop/build and justify/evaluate (Hevner et al., 2004; March and Smith, 1995).

Figure 3.1 shows the interplay of these two processes in the center of the conceptual framework for understanding, executing, and evaluating IS research as conceptualized by Hevner et al. (2004). The context—originally called environment (Hevner et al., 2004)—describes the phenomenon of interest, characterized as the *problem space* (Simon, 1996; Hevner et al., 2004). Maedche et al. (2019) conceptualize the problem space in DSR to consist of needs, goals, requirements, and stakeholders. Needs describe something that is needed to solve a problem, whereas the goal is to solve a problem (Maedche et al., 2019). In addition to the needs and the goal, there is a list of requirements (which is potentially endless, according to Alexander, 1964) that is important in relation to solving a relevant problem (Maedche et al., 2019). All of these concepts are voiced by stakeholders that have any involvement in the quest to solve a problem (Maedche et al., 2019). The problem space relates to a solution space, in which designed artifacts are situated (Maedche et al., 2019; vom Brocke et al., 2020). The problem space in DSR is a complex entity of its own, as DSR is rarely adopted for solving small-scale or easy-to-solve problems, but is rather focused on so-called wicked problems (Rittel and Webber, 1973; Hevner et al., 2004), where the situation of a problem changes with a possible solution and a problem often does not simply disappear.

Based on the model of Hevner et al. (2004), on the one hand, behavioral science in IS research targets the development and justification of theories which are able to explain and predict phenomena related to an identified context (Hevner et al., 2004). On the other hand, DSR investigates artifacts, building and evaluating them to fulfill the requirements stemming from a context (Hevner et al., 2004). For IS research to contribute knowledge, both research paradigms have to be applied. Therefore,

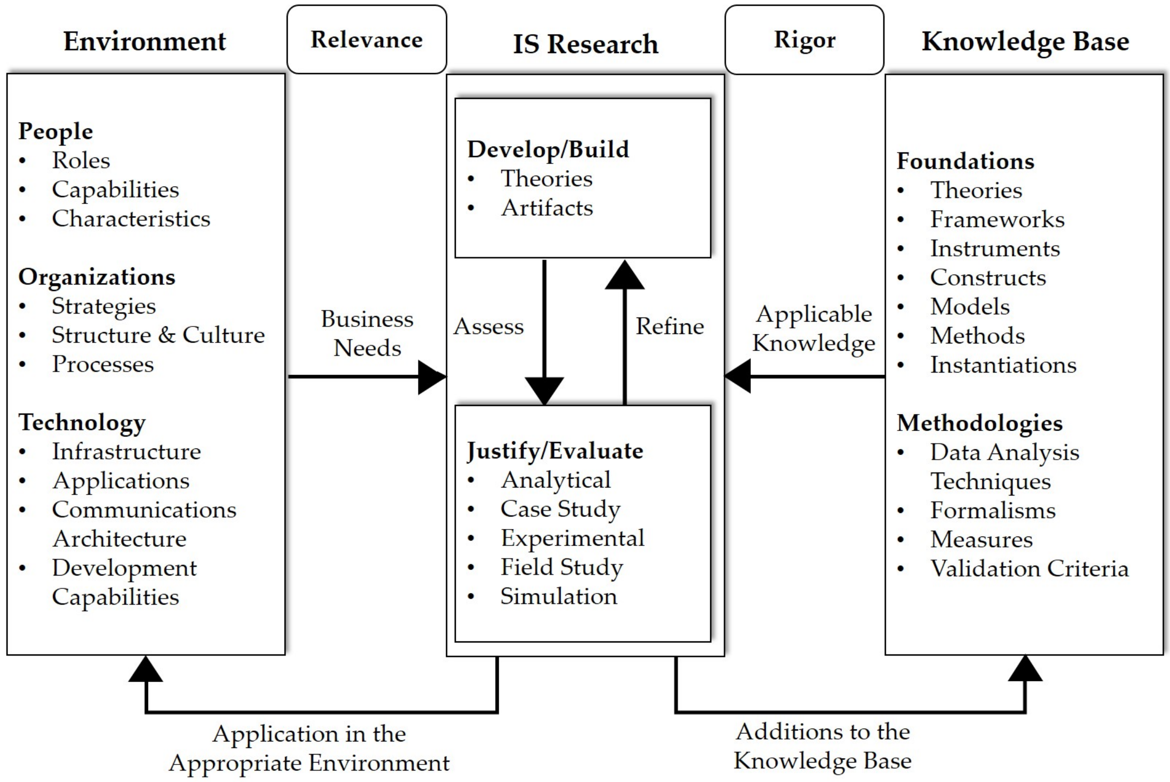

Figure 3.1: Framework for information systems research by Hevner et al. (2004)

the knowledge base provides foundations—i.e., theories, frameworks, instruments, and artifacts—and methodologies—i.e., guidelines for evaluation and justification (Hevner et al., 2004). IS research is deemed to be rigorous when transparently adhering to these foundations and methodologies (Hevner et al., 2004; Nunamaker et al., 1990). Thus, DSR pursues a dual mission (Sein et al., 2011; Hevner et al., 2004): solving problems relevant to a context by applying artifacts in a context, and contributing to theoretical knowledge by developing and justifying theories.

Apart from design itself, *evaluation* is the most crucial step for proper DSR (March and Smith, 1995; Hevner et al., 2004; Venable et al., 2016; Venable et al., 2012). Without a proper evaluation, the theoretical value and knowledge created from designing an artifact cannot be verified (Venable et al., 2016). Thus, evaluation also pursues a dual mission: evaluating the quality of a designed artifact, and evaluating the quality of the knowledge outcome (Venable et al., 2016)—differentiating design from DSR (Venable et al., 2016). Additionally, evaluation can help to further understand a problem motivating a DSR study (Hevner et al., 2004). For an evaluation, relevant criteria and metrics have to be selected before a research method is selected (Hevner et al., 2004). Evaluation methods include, but are not limited to, observations, statistical analytical, experiments, functional or structural tests, and descriptive methods (Hevner et al., 2004; Peffers et al., 2007). The key challenge is to match an evaluation method to an artifact and to its goal (Hevner et al., 2004). Therefore, Venable et al. (2016) develop a framework with four different strategies for evaluation in iterative DSR projects. First, a *quick and simple* strategy aims to evaluate small or simple designed artifacts by only applying few evaluations. Second, the *human risk and effectiveness* strategy—appropriate for artifacts with multiple user groups or if an evaluation with real users is comparably cheap—involves real users early on and then scales up the functionality to a fully designed artifact. Third, the *technical risk and efficacy* strategy emphasizes the need to quickly evaluate a summative artifact and postpone to involve real users. Thus, this strategy is suited for technical artifacts or when evaluation with real users is costly. Fourth, for artifacts without user involvement, a *purely technical evaluation* strategy targets a summative artifact (Venable et al., 2016).

The environment in Figure 3.1 can be considered a synonym for *context* (Merriam-Webster, 2021; Scharfenstein, 1989; Avgerou, 2019). Context lacks—despite its enormous influence on design research—a clearly definition in the literature. In a more general manner, Avgerou (2019, p. 978) proposes a definition from an IS perspective, defining context as "that which environs the object of our interest and helps by its relevance to explain it", relating to Scharfenstein (1989, p. 1). The attention for context has increased over the last two decades in IS research (e.g., Avgerou, 2019; Bamberger, 2008; Davison and Martinsons, 2016; Elsbach and Pratt, 2007; Hayes and Westrup, 2012; Hayes et al., 1988; Johns, 2006; Rousseau and Fried, 2001; Scheff, 2005; Zettle et al., 2016). Context is deemed to be a multi-dimensional and obscure construct (Alexander, 1964; Sarker, 2016; Scharfenstein, 1989). In this dissertation, I apply the definition constructed and reasoned by answering the third research question, i.e., *the aspects of the environment that are relevant for an actor to achieve a particular analytical goal in relation to a focal phenomenon* (Herwix and zur Heiden, 2022, p. 5788). This conceptualization underlines the notion that a context has to be framed in relation to the analytical goal an actor sets when analyzing a phenomenon—which, in DSR, is in most cases an artifact.

In the IS research framework depicted in Figure 3.1, Hevner et al. (2004) identify the dimensions of people, organizations, and technology to characterize the context. Especially for DSR, context sets boundaries and defines requirements for an artifact to be designed (Hevner et al., 2004). The crucial position of a context in relation to an artifact was already highlighted in early studies of DSR (Alexander, 1964; Simon, 1996). According to Alexander (1964, p. 16), for design "the real object of discussion is not form alone, but the ensemble comprising the form and its context". Considering each context individually is important for design research and even more so for the design of digital platforms, as an ecosystem of a digital platform, with its attendant economic and social implications, can only be influenced indirectly by the platform design (Hein et al., 2018). Without proper consideration of an artifact's specific context, research results would have a general applicability and universal relevance—but as this does not hold true, this has to be avoided (Davison and Martinsons, 2016). As such, context functions as a constraint for IS research. The third research question—*How should IS research consider context for the effective and efficient design of IT artifacts, such as digital platforms?*—investigates the consideration of context especially for DSR. Throughout answering this third question, I adapt the framework of IS research offered by Hevner et al. (2004) with a focus on context consideration, as visualized in Figure 3.2.

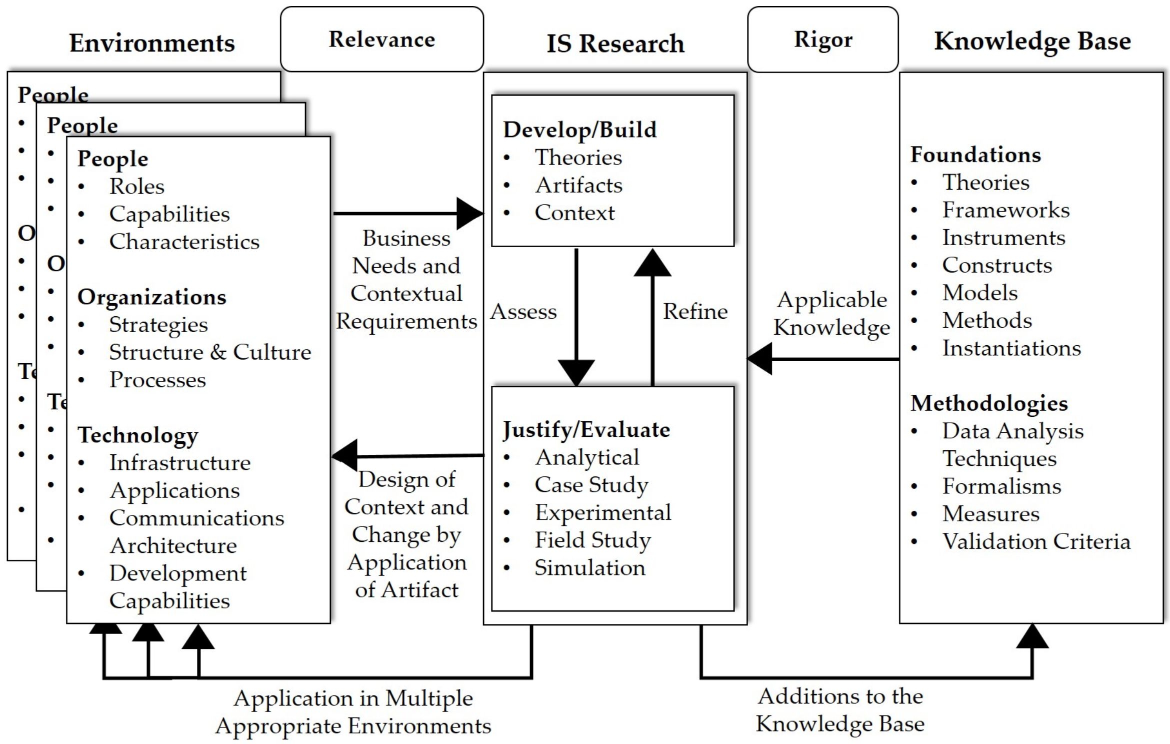

Figure 3.2: Framework for information systems research by Hevner et al. (2004), adapted with a focus on context consideration (zur Heiden and Beverungen, 2022)

To categorize the *knowledge contribution* of IS and DSR in particular, Gregor and Hevner (2013) frame contributions according to solution maturity and application domain maturity. With a low solution maturity, improvements (high application domain maturity) consist of new or better solutions for known problems, whereas inventions (low application domain maturity) characterize new solutions for new problems. Considering high solution maturity contributions, routine design (high application domain maturity) applies known solutions to known problems, and an exaptation (low application domain maturity) extends a known solution to a new problem (Gregor and Hevner, 2013). Routine design is explicitly stated as not depicting a research opportunity and, therefore, deemed not to contribute valuable knowledge (Gregor and Hevner, 2013; Hevner et al., 2004).

3.2 Research Methods

3.2.1 Design science research methods

Following the in-depth presentation of the DSR paradigm, several design-oriented research methods build on the foundations of DSR. This section covers the general *design science research methodology* (Peffers et al., 2007) before describing general results of DSR in the form *design principles* (Gregor et al., 2020) and *design theories* of different ranges (Jones and Gregor, 2007). Subsequently, specialized DSR methods for developing specific types of artifacts are considered, focusing first on taxonomy development (Nickerson et al., 2013), which is used as a research method in this dissertation, and second, on the combination of action research (Avison et al., 1999) with DSR—action design research (Sein et al., 2011)—another methodological specialization of the DSR paradigm.

Generally, every method proposed as DSR aligns with the *three cycle view* of Hevner (2007). The relevance cycle (combining the environment and the IS research domains in Figures 3.1 and 3.2) initiates DSR (Hevner, 2007) as it encompasses a problem space with its stakeholders, needs, goals, and requirements (Maedche et al., 2019). In an iterative fashion, designed artifacts as a result of DSR are put back into a relevant context to evaluate whether a problem could be solved adequately (Venable et al., 2016; Hevner, 2007). Through multiple cyclic iterations the fit between artifact and context can be verified (Hevner, 2007; Alexander, 1964).

The rigor cycle—connecting the IS research domain with the knowledge base on the right side of Figures 3.1 and 3.2—ensures that existing knowledge is considered for the methodological foundation of the research and for already existing artifacts of the application domain (Hevner, 2007). Results of DSR in the form of constructs, models, methods, and instantiations are added to the knowledge base after design and evaluation are completed (Hevner, 2007). Thus, even new or improved methods for conducting DSR itself can be designed (see, e.g., Gregor and Hevner, 2013). The design cycle, which operates at the center of the IS research framework (Hevner et al., 2004), considers input from both the relevance and the rigor cycles to design and evaluate artifacts in iterations (Hevner, 2007). Although by its name DSR might be focused on design, Hevner (2007) recommends to balance efforts between designing and evaluating to ensure that a design fits its context.

To formalize knowledge and make it available to other researchers and the public, researchers propose theories for design and action (Gregor, 2006). However, there are different types of theories for design and action that have established in the DSR community in IS research. The main implementation of these Type Five theories are *design theories* (Jones and Gregor, 2007). By definition, a design theory "shows the principles inherent in the design of an IS artifact that accomplishes some end, based on knowledge of both IT and human behavior" (Jones and Gregor, 2007, p. 322). Design theories consist of six core components—purpose, constructs, principles of form and function, artifact mutability, testable propositions, and justificatory knowledge—and principles of implementation and expository instantiation as two additional components (Jones and Gregor, 2007). *Design principles* as a core component of a design theory (principles of form and function) also make valid theoretical contributions to formalizing knowledge in IS (Gregor et al., 2020), being defined as "prescriptive statements that indicate how to do something to achieve a goal" (Gregor et al., 2020, p. 1622) A design principle should—according to Gregor et al. (2020)—contain an aim, an implementer, a user, mechanisms that lead to an aim or allow an user to accomplish an aim, enactors that perform actions encompassing mechanisms, and a rationale underlining a theoretical or empirical justification. In some cases, actor roles (implementer, user, and enactor) can overlap (Gregor et al., 2020).

Peffers et al. (2007) provide a nominal process for conducting DSR projects with their *design science research methodology*, visualized in Figure 3.3. The process consists of six activities, i.e., (1) identify the problem and motivate, (2) define objectives of a solution, (3) design and development, (4) demonstration, (5) evaluation, and

(6) communication (Peffers et al., 2007). The process can be started at either one of the first four steps depending on the status of the research project. For instance, a problem-centered initiation begins the process from the first Activity (identify the problem and motivate), whereas in the presence of a concept to design an artifact one would start with the third Activity (design and development) (Peffers et al., 2007). The cyclic nature of DSR (Hevner, 2007) is achieved through iterations between the different activities (Peffers et al., 2007). As such, the design cycle comprises design (Activity 3) and evaluation (Activity 5), the relevance cycle encompasses the identification of a problem (Activity 1), the definition of objectives of a solution (Activity 2), and evaluation (Activity 5), whereas the rigor cycle is achieved by considering the process model itself and by communicating the results in the form of knowledge contributions (Activity 6).

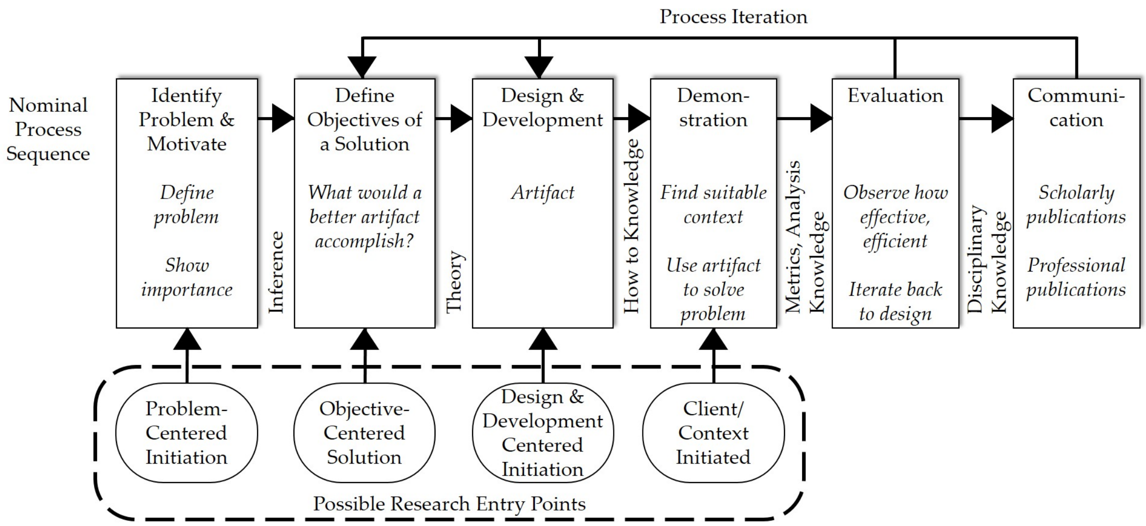

Figure 3.3: Nominal process of the DSR methodology (Peffers et al., 2007)

3.2.2 Taxonomy development

A taxonomy is a model classifying different objects or phenomena under study to help researchers and practitioners in analyzing and understanding complex problems on the way to theory-building (Nickerson et al., 2013; Szopinski et al., 2019). Thus, taxonomies are useful for research, but can also provide additional value in discussions (Miller and Roth, 1994). Another benefit of a taxonomy in the context of DSR is its guidance on the design of artifacts (Liu et al., 2020). Taxonomies are a valid form of a DSR contribution, as they combine descriptive and prescriptive knowledge in the form of a model[7] (Iivari, 2007; March and Smith, 1995; Nickerson et al., 2013).

Taxonomies consist of dimensions, each of which include different characteristics (Nickerson et al., 2013). By definition, an object studied with a taxonomy has to portray one characteristic for each dimension (Nickerson et al., 2013). To develop a taxonomy, Nickerson et al. (2013) present a method rooted in iterative design cycles (cf. Figure 3.4). At the beginning of the process, a researcher has to define a meta-characteristic—providing a point of reference and logical predecessor for all characteristics to be developed (Nickerson et al., 2013). In a second step, ending conditions have to be defined. Ending conditions are analyzed after each iteration of the process, to check whether the taxonomy is finalized or another iteration is necessary. Nickerson et al. (2013) provide a list of subjective and objective ending conditions that can be used as such, or adapted.

An iteration of the taxonomy development method consists of adopting either an empirical-to-conceptual approach or a conceptual-to-empirical, depending on the current situation of a taxonomy and the available data (Nickerson et al., 2013). For the *empirical-to-conceptual* approach, a set of objects that can be classified by a taxonomy has to be available and is identified in a first step. Second, to group these objects accordingly, similarities and differences between objects in a set are identified. If, for a third step, groupings align with the definition of taxonomy's entities (dimension and characteristic) and its meta-characteristic, researchers can delineate characteristics and dimensions to create or revise a taxonomy (Nickerson et al., 2013).

By contrast, in a *conceptual-to-empirical* approach, the first step does not involve considering the objects that can be classified and grouped. Instead, this approach conceptualizes characteristics and dimensions based on deductive research, e.g., by considering existing theories or knowledge about the domain under study. Then, the conceptualized characteristics and dimensions are applied to objects to confirm or eliminate these characteristics and dimensions. Again, the taxonomy is adapted based on the results of this approach (Nickerson et al., 2013). With both approaches comprising a conceptual and an empirical approach, the research process aligns with the cyclic nature of DSR to design and to evaluate (Hevner et al., 2004; Hevner, 2007).

[7] Taxonomies are not in all cases considered design results. Especially when analyzing a set of objects, i.e., the majority of approaches being empirical-to-conceptual, the result is rather analytical than synthesized.

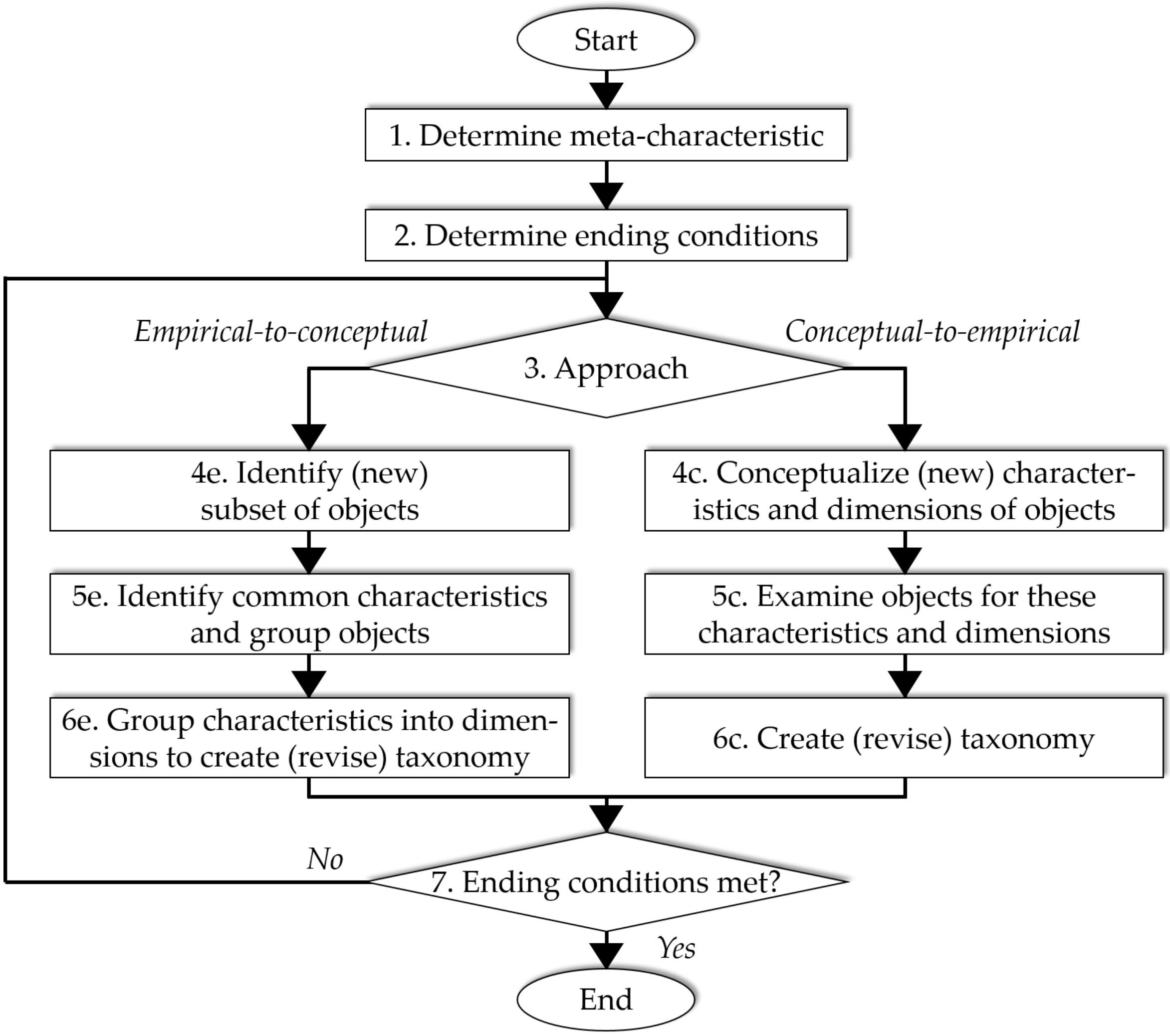

Figure 3.4: Method for taxonomy development by Nickerson et al. (2013)

Kundisch et al. (2022) present an update of the taxonomy development method by Nickerson et al. (2013), as they align the DSR process (Peffers et al., 2007) with the method of taxonomy development. Thus, they emphasize the evaluation of a taxonomy as a key step before reporting taxonomies as research results (Kundisch et al., 2022).

3.2.3 Action design research

Action research is a qualitative research method that iteratively combines theory and practice by investigating an immediate problem situation through problem diagnosis, action intervention, and reflective learning (Avison et al., 1999). By combining the principles of DSR and of action research, Sein et al. (2011) coined the term *action design research (ADR)* and provide a framework for applying ADR in IS research. The benefit that action research brings in combination with DSR lies in the interventions in organizational environments that can give insights through evaluation (Sein et al., 2011).

ADR consists of four stages (Sein et al., 2011). First, problem formulation investigates the context of the research, portrayed by an immediate organizational setting. Second, solutions to problems in the form of artifacts are designed and immediately used in the form of an intervention in an organizational setting to evaluate the value and potential to solve an existing problem. Third, the first two phases are reviewed to identify insights from the interventions. Cycles of the first three phases—problematize, build and evaluate, reflect—make up the iterative and interactive nature of ADR (Sein et al., 2011). Fourth, the outcomes of the first three stages are generalized and theorized to formalize the learning and knowledge. The formalization of learning can result in, e.g., design principles (Gregor et al., 2020) or a design theory (Jones and Gregor, 2007).

Generally, ADR and design-oriented methods building on the DSR paradigm have a lot in common, as ADR is also design-oriented and based on the DSR paradigm (Sein et al., 2011). Methods such as the design science research methodology (Peffers et al., 2007) sequentially design artifacts and then evaluate them in context. ADR avoids sequential design and evaluation by including organizational interventions (Sein et al., 2011; Dresch et al., 2015). Additionally, apart from design and evaluation through interventions to generate knowledge, ADR enables the direct participation of researchers (Sein et al., 2011; Sherer, 2014).

3.2.4 Conceptual research

Seen as the opposite of empirical research, *conceptual research* utilizes arguments and theories instead of empirical data, for theory development (Jaakkola, 2020; Mora et al., 2008). Conceptual research is a method that can align with either the behavioral research paradigm or the DSR paradigm, each of which underpinned by different philosophical preconceptions of research (Mora et al., 2008). Conceptual design research explores the design of artifacts, whereas conceptual behavioral research targets entities that stand in relation to the real world (Mora et al., 2008). Gonzalez and

Dahanayake (2007) frame constructs, frameworks, methods, and systems as viable contributions of conceptual design research. Conceptual behavioral research aims to generate theory synthesis, theory adaptations, typologies, and models (Jaakkola, 2020). While theory synthesis combines existing theories and arguments into new theories, theory adaptations modify existing theories by integrating and re-editing further arguments and insights from real-world phenomena (Jaakkola, 2020). Typologies explain variation and differentiation in similar phenomena, whereas models link theoretical concepts (Jaakkola, 2020)—similar to models in DSR (March and Smith, 1995). Whetten (1989) lists seven criteria that are essential for the theoretical contributions of conceptual papers: novelty, resulting change for a domain, underlying evidence, reasoned argumentation, being well-written, topicality, and target audience.

A conceptual research process starts with identifying a phenomenon that is either under-researched or its underpinning theory is deemed to receive increased attention (Jaakkola, 2020). After identifying a phenomenon of interest, a research method has to be selected and the purpose of the study defined (Mora et al., 2008). Over the course of several iterations, knowledge is discovered, integrated, and justified through testing (Mora et al., 2008). Empirical data is not a focus and is only used prior to a research process to motivate a study (Jaakkola, 2020) or after conducting a research process to validate the results (Gilson and Goldberg, 2015).

3.2.5 Literature reviews

Literature reviews are an integrative part of every research paper. As such, literature reviews can be embedded with a more narrative focus—e.g., as in this dissertation—or standalone research papers—e.g., P3—with a systematic focus (vom Brocke et al., 2015), the difference being only a “pragmatic matter” (Okoli and Schabram, 2010, p. 5). Literature reviews can contribute different insights depending on their type (standalone or embedded) and the type of research question posed in a study, i.e., synthesizing published knowledge, identifying research gaps, developing research agendas, aggregating evidence for theory testing (Rowe, 2014), criticizing published knowledge (Boell and Cecez-Kecmanovic, 2014), or even theory building (Webster and Watson, 2002; Paré et al., 2015). Quantitative literature reviews are "meta-analysis" for aggregating evidence and theory testing, whereas a qualitative literature review focuses on the synthesis, criticizing, the framing of research gaps, and establishing research agendas (Schryen, 2015). While these two types of literature reviews do not only vary in their type of contribution, they typically follow different types of processes to generate at different contributions (Schryen et al., 2020).

Webster and Watson (2002) recommend four steps for applying a *qualitative, systematic literature review*: identify relevant literature, structure the literature, develop theory, and evaluate theory. For the identification of the relevant literature, researchers should start with leading journals and define search strings to apply to search engines and databases (Webster and Watson, 2002). Further criteria can be defined to include or exclude literature depending on the aim of the literature review (Webster and Watson, 2002). In addition to scanning journals and databases, forward and backward searches are recommended activities (Schryen, 2015; Webster and Watson, 2002). A forward search identifies further literature, which cites the useful results, whereas a backwards search finds articles contributing to a useful result in its references (Webster and Watson, 2002; vom Brocke et al., 2015). The second step—structuring the literature—revolves around sorting the identified literature based on existing concepts, mostly resulting in a concept-matrix (Webster and Watson, 2002). Standalone literature reviews further discuss the results of the first two steps by developing theory—e.g., using conceptual research (see Section 3.2.4)—and should even strive to evaluate the theory, even if this step is often complicated (Webster and Watson, 2002).

3.2.6 Data-driven research

With *data-driven research*, a new method of inductive and empirical research has been established in recent years (Müller et al., 2016). Data-driven research starts with defining a research question that can be answered by analyzing vast amounts of data (Müller et al., 2016). In contrast to conceptual research, data-driven research continues with "data or data-driven discoveries, rather than with theory"(Müller et al., 2016, p. 291). The data might even be unstructured, thus requiring data collection, data analysis, and result interpretation (Müller et al., 2016). Data collection can comprise different types of data in varying quantities, depending on the aim of the data-driven research, and where it is applied. Data analysis can also comprise different strategies based in statistical analysis (Müller et al., 2016). For instance, topic modeling can be used on unstructured textual data, such as customer reviews to explain user satisfaction (Debortoli et al., 2016) and on twitter posts to derive affordances and constraints for the use of online conferencing systems (Hacker et al., 2020). For the third step of result interpretation, different established methods can be used to explain the results and derive theory, e.g., conceptual research (cf. Section 3.2.4). Thus, both theoretical (Berente et al., 2019) and managerial contributions (Müller et al., 2016) can be achieved.

Compared to the manual analysis of data, e.g., in the form of literature reviews, data-driven research is highly scalable and reliable, able to analyze vast amounts of data that it would not be possible to analyze manually (Miner et al., 2012; Debortoli et al., 2016). Additionally, decisions about rejecting certain parts of the data can be avoided to eliminate human bias in selecting papers (Indulska et al., 2012). However, the quality of the data might be unknown and negatively influence the outcome of an analysis. Also, retrospective conclusions are not possible when relying on data for the interpretation of the results (Müller et al., 2016). An overview of how data-driven research projects should be structured and executed can be found in Badura et al. (2022), to which the author of this dissertation also contributed.

3.2.7 Qualitative research methods

Qualitative research papers strive to investigate individual cases and derive understandings and meaning in an inductive fashion (Myers and Avison, 2002). As such, qualitative research is more subjective and unstructured compared to quantitative research (Myers and Avison, 2002). Qualitative research can take different theoretical perspectives, aligning with specific theoretical preconceptions and underlying research philosophies (Becker and Niehaves, 2007; Myers and Avison, 2002; Goldkuhl, 2012b).

Like quantitative research, qualitative research starts with setting a goal or research question and follows with data gathering and data analysis. However, data gathering in qualitative research typically consists of observations, interviews, questionnaires, or documents (Myers and Avison, 2002). Thus, qualitative research utilizes the human ability to talk and express individual understandings and reasoning (Myers and Avison, 2002). The sample size, i.e., the number of interview or documents, in qualitative research depends on the saturation necessary for research results (Marshall et al., 2013).

Qualitative research does not differentiate between gathering and analyzing data, but combines these with interpretation into the *mode of analysis* (Myers and Avison, 2002). The mode of analysis can, e.g., be hermeneutic (focusing on the meaning of a text), semiotic (focusing on the meaning of signs and symbols in language), or focus on narratives and metaphors (Myers and Avison, 2002), and harness manual coding tools, e.g., MaxQDA (Williams and Moser, 2019). Examples of specific methods categorized as qualitative research include case study research (Yin, 2011), grounded theory (Corbin and Strauss, 1990; Glaser and Strauss, 2017; Glaser, 1978; Glaser, 1992), and action research (Avison et al., 1999)—which was combined by Sein et al. (2011) to action design research (ADR) (cf. Section 3.2.3).

3.3 Applied Research Process

The first research question of this dissertation (*Which digital platform types are investigated in the IS discipline and how do they allow to structure digital platform research?*) aims to contribute knowledge to the design of digital platforms and the classification of the researched topics in the IS literature. By applying a data-driven research study, based on text mining and machine learning (Müller et al., 2016), on the body of knowledge on platforms in IS—comprising over 11,000 papers—I aim to provide conceptual clarity on platform types and to identify the dominant terms along with their definitions to sharpen the lexicon of digital platforms in IS (P1, see Table 1.1).

The second research question (*How can the utilization of location information on digital platforms be conceptualized?*) explicitly targets location information and its different applications on digital platforms. To this end, I conduct a systematic literature review (Webster and Watson, 2002) to analyze different types of service that can be provided on digital platforms utilizing location information. Conceptual research (Hirschheim, 2008; Jaakkola, 2020) is applied to conceptualize location-contextualizing service (LCS)—which I define as a new class of service where existing service is improved by location information on immovable objects (P2). LCS, and its differentiation from LBS, classifies as a typology contribution in conceptual behavioral research and is key for the subsequent design of digital platforms. The typology helps to answer the fourth research question aimed at providing guidance on the design of digital platforms, as one platform resembles an LBS, and the other an LCS.

To answer the third research question (*How should IS research consider context for the effective and efficient design of IT artifacts, such as digital platforms?*), I start by conducting a systematic literature review (Webster and Watson, 2002), investigating research papers that apply DSR (P3) to analyze the problem and motivate further research for context consideration in DSR. Building on the results of the literature review, which shows an overall lack of context consideration, I apply DSR to develop and adapt (improve) methods and frameworks for DSR properly, i.e., with due consideration of the context. More specifically, I conceptualize context in DSR by developing a taxonomy and framework for context (Nickerson et al., 2013) in P4, and use DSR to improve the methods and processes of DSR (Gregor and Hevner, 2013; Hevner et al., 2004; Peffers et al., 2007; Jones and Gregor, 2007) in P5.

The fourth research question (*How ought digital platforms to be designed to co-create value based on location information?*) aims to generate lambda knowledge on digital platforms that enable to co-create value in different contexts. I focus on two relevant contexts identified by a theoretical sampling approach, i.e., high street retail and maintenance on the distribution grid. For high street retail, I start with a qualitative interview study to assess its context and identify its problems (P6). Applying the method of action design research (Sein et al., 2011), I design and evaluate a digital actor engagement platform, aimed at fostering interaction between local SMEs and consumers, thus co-creating value (P7). On this digital actor engagement platform, high street service providers can integrate their existing physical resources with digital resources, while customers can contribute their current location to co-create value through direct interactions. Regarding predictive maintenance on the distribution grid, I first analyze the context and current situation to motivate the application of predictive maintenance (P8). Subsequently, using qualitative interviews allows to determine specific requirements stemming from the context of distribution grid operators (P9), which inform the subsequent design of a location-contextualizing smart service platform, that aims to improve maintenance of critical assets in the distribution grid (P10 and P11). This DSR approach follows the DSR methodology (Peffers et al., 2007) wand conducts a willingness-to-pay analysis to evaluate the value co-created on the digital platform.

As this dissertation is rooted in IS research, I combine methods of the behavioral and design science paradigms to answer my research questions, solve the research problem, and gain knowledge that contributes to IS research (Hevner et al., 2004; Goldkuhl, 2016). Methods of the behavioral science paradigm are used to answer the first and second research questions and to provide applicable knowledge for the design of artifacts. Thus, the answers to these research questions provide applicable knowledge to the research problem of this dissertation and are rooted in the rigor cycle (Hevner, 2007), i.e., the knowledge base visualized in Figure 3.5. The third and fourth research question each contribute multiple relevance and design cycles (Hevner, 2007). Starting with a systematic literature to analyze the context of DSR[8], the third research question uses different DSR methods to design and evaluate innovative artifacts for the application of DSR. The fourth research question then utilizes qualitative methods to first investigate the contexts—i.e., highstreet retail and maintenance on the distribution grid. Different iterations of the design cycle (Hevner, 2007) allow to integrate the knowledge of the problem domain (environment) and the applicable knowledge generated and aggregated in the first two research questions to contribute lambda knowledge on the design of digital platforms in both contexts. Figure 3.5 shows an overview of the classification of the research papers composing this dissertation into the adapted IS research framework (zur Heiden and Beverungen, 2022; Hevner et al., 2004).

Through the *combination of different research paradigms*—behavioral research and DSR—and the application of different research methods aligning with the research paradigms—e.g., literature reviews, conceptual research, and design-oriented methods—this dissertation is able to output different theory types according to Gregor (2006). In the initial studies (P1, P2, P3, P6, P8, and P9) this dissertation generates omega knowledge, e.g., in the form theories for explaining (P1) and theories for analyzing (P2). The design-oriented studies (P4, P5, P7, P10, and P11) utilize this omega knowledge and output lambda knowledge in the form of theories for design and action (Gregor, 2006) on digital platforms utilizing location information. Thus, combining methods from different research paradigms (Hevner et al., 2004) is essential to the ability to make a constructive and cumulative knowledge contribution, with knowledge that is sufficiently varied in type so that it can be integrated into a holistic contribution. Indeed, the improved understanding of different platform concepts, of service types to utilize location information, and of context consideration in DSR, together, enable the generation of superior knowledge on the design of digital

[8] Usually, a literature analysis would be applied to investigate the knowledge base and bundle applicable knowledge, i.e., placed on the right side of Figure 3.5. However, for the third research question the context (environment) comprises the application of methods of the DSR paradigm. Due to these circumstances, a systematic literature analysis can be placed in the environment, not in the knowledge base.

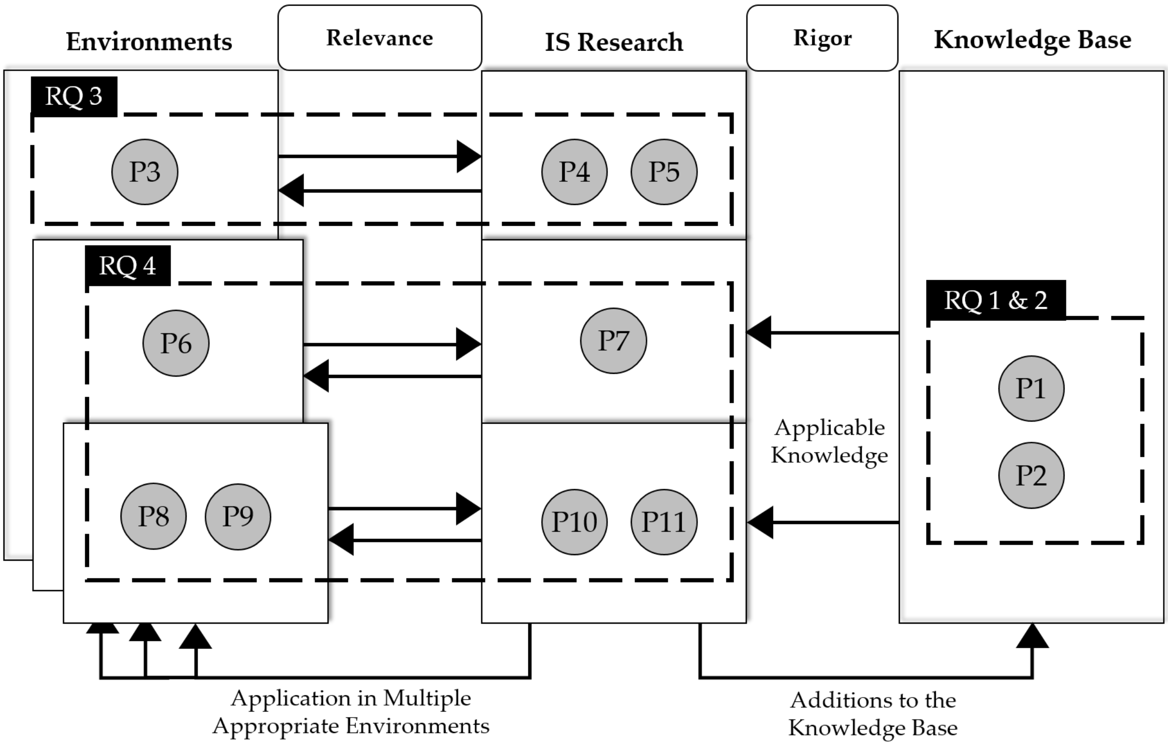

Figure 3.5: Research design of the papers composing this dissertation

platforms utilizing location information. A step-wise research approach, iterated in multiple hermeneutic cycles (cf. Figure 3.5), helps to gain a deeper and broader understanding of digital platforms utilizing location information as the phenomenon under study (Becker and Niehaves, 2007).

4 Research Results

4.1 Synopsis of Research Contributions

The contributions composing this dissertation examine particular aspects of the types of digital platforms in IS, the utilization of location information, the consideration of context in DSR, and the design of digital platforms utilizing location information in two distinct contexts. Using different platform concepts in IS research and their partly under-specified nature leads to interchangeably used terms and an overall inaccurate understanding of digital platform terms (de Reuver et al., 2018). Although researchers and practitioners have developed different platform concepts (Sørensen et al., 2015), the increasing focus on digital platforms in IS research has exacerbated this lexical confusion. The entangled nature of digital platform concepts is encompassed by the rhizome metaphor—a philosophical concept resembling a botanic rhizome, where nodes form a network without hierarchies and a multitude of entry and exit points (Deleuze and Guattari, 1979). In their research agenda, de Reuver et al. (2018) emphasize this rhizomatic structure of platform terms, and thus call for clear-cut definitions of different digital platform concepts.

Answering the first research question of this dissertation (*Which digital platform types are investigated in the IS discipline and how do they allow to structure digital platform research?*), we applied data-driven methods of text mining and machine learning (Müller et al., 2016) to identify and analyze the complete history of platform terms in IS research (Bartelheimer, zur Heiden, Lüttenberg, et al., 2022). The history covers 11,049 papers from 44 years of research and about 300 unique platform terms, each of which is used in at least ten different papers. The subsequent analysis was built on the platform terms used in at least 150 research papers, and a dendrogram was calculated based on the similarities between platform terms.

The terms in the dendrogram were clustered into six streams of platform research in IS: (1) abstract technology views on platforms, (2) specific views on hardware and software platforms, (3) social communities and online platforms, (4) economic platforms as digital markets, (5) general properties of platforms as IS artifacts for value co-creation, and (6) sharing platforms. With the help of decomposition allowing to break down complex structures (Alexander, 1964), we derived a decomposed model of platform terms in IS from the investigation and discussion of the identified platform terms, visualized in Figure 4.1. The term *digital platform* as the root of the model enables two overarching views on the study of platforms. *Service platforms* focus on the co-creation of value for the design and analysis of platforms, whereas *cloud platforms* take a technical perspective and are based on the foundations of cloud computing (Katzan, 2009). Both terms function as *general* views encompassing platform research from different perspectives. Three detailed perspectives portray *specific* aspects of digital platform research IS research accounts for—visualized in branches. The term *information technology platforms* and its subterms focus on the technical design of platforms as IT artifacts. *Social platforms* generalize implications of social relationships and interaction on digital platforms. *(Two-/multi-) sided platforms* encompass an economic view, in which platforms act as economic markets to facilitate exchange between actor groups. To further guide researchers and outline peculiarities and purposes of specific platform terms, we built a lexicon of platform research with established definitions from the literature.

The lexicon and the different perspectives identified on digital platforms align with the views on digital platforms in IS research being either technical, or sociotechnical and economic (de Reuver et al., 2018; Asadullah et al., 2018; Gawer and Cusumano, 2014). The decomposed model and the lexicon with its definitions for platform concepts provide a common ground to understand the rhizomatic phenomenon of platform concepts in IS. Thus, researchers can position their own platform studies in line with previous research on digital platforms and use the platform terms best fitted to the perspectives applied in their research. As such, the decomposed model contributes a Type Two theory for explaining (Gregor, 2006). The different perspectives and the ability to switch views on digital platforms enable new rationales and detailed insights, while the overarching terms and views on digital platforms comprise general insights on digital platforms, as called for by de Reuver et al. (2018). Still, the decomposed model and lexicon will have to be adapted to future trends and emerging technologies.

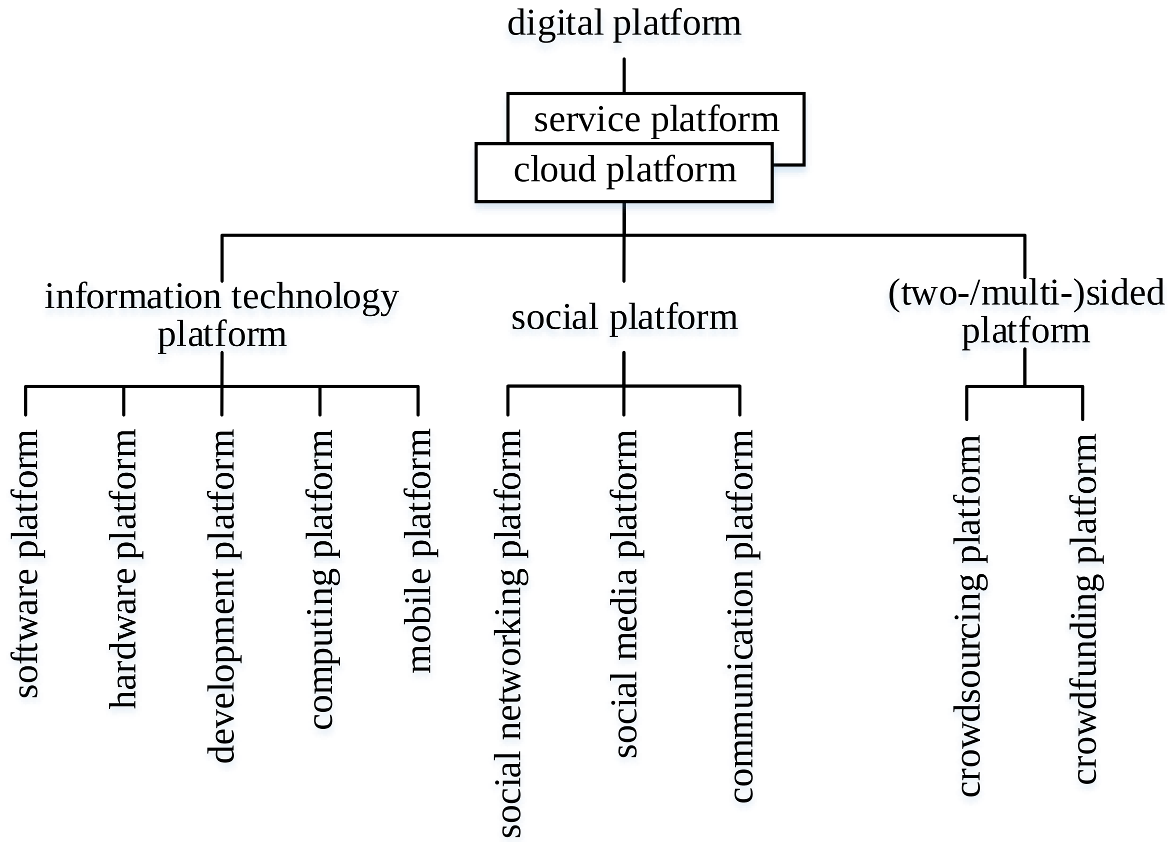

Figure 4.1: Decomposed model of platform terms in IS (Bartelheimer, zur Heiden, Lüttenberg, et al., 2022)

For the central research problem targeted by this dissertation, these insights help to position research on digital platforms (de Reuver et al., 2018). The different views taken by IS research on digital platforms are portrayed and popular types of digital platforms are identified and lexically specified. Thus, answering the first research question helps to review the existing literature on digital platforms and enables the positioning of the following results and insights into the body of knowledge on digital platforms in IS.

As portrayed in the previous sections, value on digital platforms can be co-created as service by enabling groups of users to interact and establishing two- or multi-sided markets (van Alstyne et al., 2016; Beverungen et al., 2021). Location information can play an important role in value co-creation on digital platforms. LBS can utilize location information for specific service on a digital platform. However, LBS remains the only conceptualization of how value can be co-created using location information

(Lehrer et al., 2011)—leading to the second research question of this dissertation (*How can the utilization of location information on digital platforms be conceptualized?*).

In a first step to answering this research question, we analyzed different types of LBS in the literature by conducting a systematic literature review (Webster and Watson, 2002). We identified six different types of LBS (zur Heiden et al., 2023): (1) Localized service provision, (2) locating service, (3) navigation service, (4) matching service, (5) location analysis service, and (6) management and monitoring service. Considering the position of customers and entities, either customers have a dynamic location and the entities have static positions (localized service provision, locating service, navigation service), or customers have a static position and the entities have dynamic locations (locating service, location analysis service, management and monitoring service). In special cases of locating service and matching service, both customer and entity positions are dynamic.

Another dimension to differentiating service utilizing location information is the initiation of the service: LBS can either be initiated by the user—called pull LBS—or triggered by an entity monitoring the location of the user—termed push LBS (A. Z. Y. Tan et al., 2014). Analyzing the different combinations of static and dynamic positions of both users and entities, combined with different service initiations shows that—thus far—a service utilizing static location information of users and entities is not covered by LBS research—neither push, nor pull— as visualized in Table 4.1.

Entity \ User	Static	Dynamic
Static		localized service provision, navigation service
Dynamic	locating service, location analysis service, management and monitoring service	matching service

(a) Location-based push service

Entity \ User	Static	Dynamic
Static		localized service provision, locating service
Dynamic	locating service, location analysis service, management and monitoring service	locating service, matching service

(b) Location-based pull service

Table 4.1: Classification of LBS types by location information and service initiation

As research on location-specific service on digital platforms is scarce in IS, we conceptualized location-contextualizing service (LCS) in a second step. LCS is a class of analytics-based service (Schüritz et al., 2017) that relies on analyzing location information of immovable objects to enable the co-creation of superior value-in-use compared to service not utilizing location information (zur Heiden et al., 2023). The main differences between LBS and LCS are depicted in Table 4.2.

Criteria	Location-Based Service (LBS)	Location-Contextualization Service (LCS)
Spatial proximity	Customer has to be close to the service location (Bärsch et al., 2019)	Not required, service is independent of the location of the customer
Locatability	Devices need to be capable of determining their geospatial position (Junglas et al., 2008)	Not needed, relies on static positions with fixed coordinates
Co-creation of value	Innovative service is not feasible without location information	Enhanced value of a service through location information
Geospatial entities	Devices, products, service, places (Mathew et al., 2004)	Immovable objects and places
Customer's position	Dynamic or static (Lehrer et al., 2011; Molitor et al., 2016)	Static (e.g., back office)
Data type	Real-time location and context data (e.g., service hours), enabling the service	Historical location data enhancing (not just enabling) the original service
Enabling technology	GPS, Bluetooth, mobile devices, GIS	GIS
Knowledge contribution	Invention, improvement	Improvement

Table 4.2: Conceptual comparison between LBS and LCS (zur Heiden et al., 2023)

The results contribute to the service science domain in IS, by enabling the design of new analytics-based service (Schüritz et al., 2019) and digital platforms to utilize location information and GIS. LCS research can enable superior value-in-use for service, especially in B2B contexts. Therefore, the second research question of this dissertation is answered by investigating LBS (e.g., Lehrer et al., 2011; Mathew et al., 2004; Rao and Minakakis, 2004), conceptualizing LCS, and distinguishing between both types of service (zur Heiden et al., 2023). The results contribute to the overall research problem of the dissertation by providing mechanisms—i.e., LBS and LCS—that enable to utilize location information for value co-creation on digital platforms. As this contribution is only conceptual, it has to be evaluated in further research

(Gilson and Goldberg, 2015). A promising strategy for evaluation is the design and implementation of LCS, e.g., on a digital platform, to test the application of LBS design and operating strategies (Tilson et al., 2004).

Independent of the design of an LBS or LCS, the connections of artifacts designed using DSR and the contexts in which these artifacts are to be applied to co-create value or solve problems provide an essential foundation of DSR (cf., e.g., Hevner et al., 2004; Alexander, 1964). Artifacts are inextricably linked to the context they were designed for. This focus on context is especially important for digital platforms (de Reuver et al., 2018; Poniatowski et al., 2021), i.e., considering their environmental dynamics, such as network effects (Tiwana et al., 2010; van der Aalst et al., 2019; Pauli et al., 2021). Thus, to answer the third research question of this dissertation (*How should IS research consider context for the effective and efficient design of IT artifacts, such as digital platforms?*), I empirically analyzed the extent to which high-quality DSR publications consider the context of their study (zur Heiden, 2020). I identified 115 papers from the basket of IS journals (Members of the College of Senior Scholars, 2011) that apply DSR and investigated their description of the context and their stated design implications resulting from context characteristics. Different views on context can help to identify the requirements and boundaries stemming from a context (Alexander, 1964). Thus, I drew on Hevner et al. (2004) and considered *people*, *organization*, and *technology* as different context dimensions. The results of the systematic literature review show that the people dimension is described in 52 % of papers, the organization dimension in 64 % of papers, and the technology dimension in 52 % of papers. In total, only 17 % of the identified papers sufficiently describe all three context dimensions, while 13 % do not describe the context of a designed artifact in any way. Design implications resulting from the people dimension are described in 36 % of papers, from the organization dimension in 29 % of papers, and from the technology dimension in 36 % of papers. With only 7 %, a minority of papers outlines the design implications resulting from all context dimensions.

Based on these findings, I derived high-level guidelines to further consider context in DSR (zur Heiden, 2020). First, authors should describe the three context dimensions of their designed artifacts in the problem description and explain the design implications resulting from the context dimensions in the artifact design section. Second, authors should specify anticipated changes of context resulting from the design and application of artifacts (cf. Schuster et al., 2018). Third, authors should generalize the findings of their DSR studies to abstract classes of problems, as their results otherwise are not useful for IS research on a more general level (as also called for by Davison and Martinsons, 2016).

Looking at context consideration from an IS perspective, there are multiple further issues that exacerbate the inherent connection of artifact and context in DSR (Avgerou, 2019). A reasonable next step, thus, is to conceptualize the properties of context and its relation to phenomena and actors to correctly understand context and its relevance in design projects (Avgerou, 2019). We defined context as "the aspects of the environment that are relevant for an actor to achieve a particular analytical goal in relation to a focal phenomenon" (Herwix and zur Heiden, 2022, p. 5789), rooted in pragmatism. A meaningful separation of artifact and context is, therefore, only possible when relating to a certain analytical goal of an actor, i.e., consensus, correspondence, or coherence (Mingers and Standing, 2020). By analyzing the existing publications of DSR studies featuring a mention of context, we developed a taxonomy of context for DSR through six iterations between conceptual-to-empirical and empirical-to-conceptual taxonomy development (Nickerson et al., 2013). The resulting context taxonomy with its nine dimensions is depicted in Table 4.3.

Dimension	**Characteristic**			
Function	Awareness	Improvement		Integration
Focus	Problem	Strategy		Solution
Scope	Local	Domain	Global	Universal
Reference Field	Practice		Academic	
Perspective	Technical	Mix		Social
Fact-orientation	Factual		Counterfactual	
Historical-orientation	Past	Present	Future	Invariant
Time Awareness	Dynamic		Static	
Control	Naturalistic		Artificial	

Table 4.3: Context taxonomy for DSR (Herwix and zur Heiden, 2022)

Design researchers can use the taxonomy to improve their design effectiveness by better understanding the breadth of dimensions along with the construction of appropriate contexts. When viewing design from a temporal and procedural perspective, there are multiple contexts that are relevant for the successful design and application of artifacts. The key dimensions of the constructed context taxonomy—i.e., function, focus, and scope—were integrated into a three-dimensional framework and aligned with the general DSR cycle (Vaishnavi and Kuechler, 2015). The resulting framework can help design researchers identify and consider relevant contexts in the different stages of the design process. The framework shows that any combination of the key dimensions of the context taxonomy is worth investigating in certain situations, according to the problems that the designed artifacts aim to solve.

Combining the insights on the lack of consideration of context in design science publications and the conceptualization of context, we set out to foster a renaissance of context in DSR. Thus, we reestablished the understanding of design as ensembles of artifact and context (cf. Simon, 1996). We analyzed the most prominent frameworks and methods comprising DSR in IS and proposed adjustments to further understand and consider the influence of context on the design of artifacts (zur Heiden and Beverungen, 2022). The first result—an adapted framework of IS research, based on Hevner et al. (2004)—emphasizes the focus on the consideration of context (Figure 3.2). It accounts for three objectives identified in the literature. First, contextual requirements play an existential role in designing artifacts. Second, context and artifact are inextricably linked (Alexander, 1964; Simon, 1996). Thus, designing the context is also highly important and should be considered when designing artifacts, as otherwise artifacts will not fit into their intended contexts. Third, any generalization of DSR results should be achieved by evaluating artifacts in multiple contexts. As generalization of DSR results generally revolves around the context (van Aken, 2004), evaluation in multiple contexts provides a step towards enabling universal knowledge claims to be made (Cheng et al., 2016).

The adapted framework (Figure 3.2), these objectives (zur Heiden and Beverungen, 2022), and the three high-level guidelines for context consideration in DSR (zur Heiden, 2020) serve as general maxims. However, there was still a need for application-oriented methods to strengthen the influence of context in DSR. Thus, we reviewed methods for DSR, i.e., the nominal DSR process (Peffers et al., 2007), the components of a design theory (Jones and Gregor, 2007), and the DSR publication schema (Gregor and Hevner, 2013)—and proposed adjustments to accounting for context. For the nominal DSR process by Peffers et al. (2007), the description of the first five phases was extended to fulfill the three stated objectives. We adapted the components of a design theory by Gregor and Jones (2007) by extending the *purpose and scope* to include a context description, include design decisions stemming from the context in the *principles of form and function*, and renamed the fourth component to *artifact and context mutability* to also account for changes in the context. Finetuning the DSR publication schema by Gregor and Hevner (2013), we added a context description to the *introduction*, included existing theories of context change in the *literature review*, renamed the fourth section to *artifact-context description* to account for changes to the context, and recommended authors to show ways to evaluate their artifact in further contexts in the *evaluation*. We conclude with analyzing three recent DSR studies, each heavily relying upon one of the improved frameworks and methods (i.e., Chatterjee et al., 2018; Venkatesh et al., 2017; Klier et al., 2019). The papers already partly account for the proposed adjustments and identify room for improvement based on these adjustments to properly consider context in DSR. Design researchers can build on the proposed adjustments to increase rigor and relevance by considering the context of their design studies.

Answering the third research question of this dissertation provides omega knowledge, i.e., the extent to which context is considered in DSR in IS, and builds on this omega knowledge to generate lambda knowledge, i.e., guidelines for context consideration, an application-oriented definition and taxonomy, a framework for different contexts in DSR studies, an adapted framework for design-oriented research in IS, and adapted methods for DSR. Therefore, the contributions answer calls for in-depth investigation of context in IS (Avgerou, 2019) and allow to reinforce the inherent connection of artifacts and contexts as ensembles (Simon, 1996; Alexander, 1964). As platforms are extremely dependent upon their contexts (de Reuver et al., 2018), the knowledge contribution provides a methodological foundation for the design of digital platforms utilizing location information in different contexts.

After reviewing the literature on digital platforms in IS by constructing a conceptual model and dictionary (Bartelheimer, zur Heiden, Lüttenberg, et al., 2022), conceptualizing LBS and LCS as two distinct ways of co-creating value utilizing location information on digital platforms (zur Heiden et al., 2023), and providing a methodological foundation for contextual design (Herwix and zur Heiden, 2022; zur Heiden and Beverungen, 2022; zur Heiden, 2020), I design two digital platforms (de Reuver et al., 2018; Pauli et al., 2021), in answer to the fourth research question (*How ought digital platforms to be designed to co-create value based on location information?*). I investigate two contexts—local high street retail and maintenance on the distribution grid—to design, instantiate, and evaluate two different types of digital platforms that co-create value through an LBS and an LCS.

High street retail in European cities is declining due to competition with online retail platforms, retailers lacking capabilities and resources for digital technologies (Hänninen et al., 2018), and the COVID-19 pandemic. We started with a qualitative study to assess the context, i.e., high street retail in a German mid-sized city with approximately 150,000 inhabitants. We interviewed 19 different actors located on the city's high street, comprising retailers, service businesses, and restaurants (termed SMEs) to assess their usage of digital platforms and tools, and their intention to extend it (Berendes et al., 2020). Thus far, most SMEs use global digital platforms, e.g., Facebook and Instagram, to communicate with customers, showing that SMEs in high streets are willing to use digital platforms. A majority of the interviewees were familiar with locally restricted digital platforms, i.e., local online platforms (LOPs), and generally prefer them to global digital platforms. However, SMEs want entry barriers of LOPs to be lower than those of global digital platforms. SMEs stated the importance of LOPs allowing them to generate knowledge about customers (acquiring new customers and promoting customer loyalty), promote advantages over online competitors, and strengthen the local cooperation on the high street (Berendes et al., 2020).

Based on these insights, the digital platform *DigiStreet* for local high street in the form of a digital actor engagement platform was designed, implemented, and evaluated (Bartelheimer, zur Heiden, Berendes, et al., 2022). A digital actor engagement platform aims to complement existing interactions—in the case of high street retail these interactions comprise customers visiting or passing local stores—with digital touchpoints (Breidbach et al., 2014; Frow et al., 2015; Ramaswamy, 2009). The designed platform utilizes LBA via Bluetooth beacons to foster engagement between customers and SMEs in high streets, enabling hybrid online-offline customer journeys. The insights are based upon up-to-date location information on potential customers moving along the high street. Using action design research (Sein et al., 2011), the platform was developed in cooperation with the local town center management and evaluated in three stages, with a total of 150 participating SMEs and over 2,300 citizens. The data generated from the third evaluation—a naturalistic field study—was further used in publications outside of this dissertation to investigate the influence of centrality in high streets (zur Heiden and Winter, 2021) and design a system for area recommendations for retail stores in high streets (zur Heiden et al., 2020).

We formalized the learning (Sein et al., 2011) gained from designing, implementing, and evaluating the digital actor engagement platform by formulating four design principles (Gregor et al., 2020): First, the different roles on a digital actor engagement platform have to be distinguished, as they reflect the different engagement dispositions of actors. Thus, customers and SMEs engaging in local high streets have to have different functionality on the platform. Second, a digital actor engagement platform has to provide functionality that is able to nudge customers toward a desired behavior that will increase actor engagement (Ghose et al., 2019). Thus, SMEs can create digital touchpoints—special offers, events, new information—and customers can interact with these touchpoints remotely and at the SME location via LBA on the digital platform. This functionality integrates the dynamic position of users with the static location of SMEs—characterized as an LBS. Third, engagement connectedness has to be prioritized to achieve network effects and to foster engagement in local high streets. Thus, the digital actor engagement platform has to enable customers and SMEs to use different channels to engage (offline, mobile, website) and provide the freedom to regulate the usage of personal data for customization. Fourth, the value-in-use of actors has to be prioritized over platform profitability to foster long-term actor engagement. Thus, learning and feedback mechanisms for both customers and SMEs have to be initiated and both actor groups have to be engaged locally.

The results from this study show that the design of digital actor engagement platforms not only aligns with the design of digital platforms—concerning the layered architecture and the social interaction structures—but also differs due to the value-in-use experienced by different actor groups on the platform. Types of digital platforms differ from another and have to be designed in their specific context to function properly (cf. de Reuver et al., 2018; Pauli et al., 2021). Further, the study shows that information systems are effective in strengthening the dynamic process of actor engagement, as they enable to add digital touchpoints to physical service ecosystems. Additionally, the field evidence of the naturalistic field study shows that the effectiveness of LBA to engage customers and SMEs is not as high in situ as it is in controlled settings (e.g., Fang et al., 2015; Ghose et al., 2019; Molitor et al., 2018; Molitor et al., 2020). Nevertheless, it shows an LBS co-creating value on a digital platform.

The second context considered to generate lambda knowledge on digital platforms is the distribution grid. Critical challenges from the energy turnaround and mobility revolution increase the stress on critical assets of the distribution grid (Smith et al., 2022; Biener et al., 2016), which requires a change from traditional to predictive maintenance strategies. To design a digital platform in the context of the distribution grid, the current state-of-the-art for maintenance strategies, distribution grid assets, sensors, machine learning, and business models were reviewed (Hoffmann et al., 2020). This context analysis shows the complexity of the distribution grid and proposes service as a promising lens to investigate how predictive maintenance can be successfully applied.

After investigating the context, distribution grid operators were identified as the main customers of a predictive maintenance solution for their critical assets. Thus, in a qualitative study, we assessed the current situation of distribution grid operators (zur Heiden and Priefer, 2021). The interviews provided insights into the mature and well-defined processes and IT systems, but also showed a lack of knowledge about the current status of assets of the distribution grid. The pressure to lower costs is high while recruiting is hard in the energy sector, and changing legal frameworks make the distribution grid operators face uncertainties about the future. We derived five preliminary design principles for an information system, i.e., a digital platform, for predictive maintenance on the distribution grid: (1) Predicting upcoming maintenance activities to prevent failures, (2) integrating information systems to avoid redundancies and gather knowledge, (3) permanently monitor the status of the assets, (4) incident and knowledge management for documentation of asset histories, and (5) automated workforce management to plan upcoming maintenance activities.

To prepare the design of a digital platform that co-creates value through an LCS on the distribution grid, we specifically investigated the use of location information and its use in GIS (zur Heiden et al., 2022c). Since critical assets of the distribution grid are wide spread but stationary, an LCS was used to enable distribution grid operators to apply predictive maintenance. Based on our preliminary design principles, we designed an information system for predictive maintenance on the distribution grid, which combines an ERP system to manage master data and transactions, a machine learning system to analyze the sensor data from the assets, and a GIS to visualize the results in a geographic representation. Following a prototype implementation, three hypothesis that guide an evaluation of the information system were derived. First, an implemented information system for predictive maintenance of critical assets of the distribution grid will prevent failures and lead to fewer downtimes of critical assets. Second, regular and time-based maintenance intervals can be extended due to information on the condition of the assets—ultimately saving costs for distribution grid operators. Third, any causes for failures will be easier to identify based on the condition data, saving both time and costs in the event of failure.

We built on the preliminary design principles and the design of the information system for predictive maintenance to design an ensemble artifact comprising a digital platform and a smart service system (zur Heiden et al., 2022a). Digital industrial platforms enable to collect and integrate data from heterogeneous industrial assets and devices—e.g., switchgears and transformers—and provide functionality to asset manufacturers to provide machine learning models (Pauli et al., 2021). The designed smart service system places different assets of the distribution grid as smart products at the interface between manufacturers and distribution grid operators (cf. Beverungen et al., 2017). The combination of smart service system and digital industrial platform provides both a technical and an economic perspective on co-creating value with predictive maintenance. We instantiated the digital industrial platform and evaluate the ensemble artifact using a willingness-to-pay analysis.

Following the design and evaluation of this platform and service system, we formalized the knowledge by deriving a set of five design principles (Gregor et al., 2020) for predictive maintenance of critical assets from an IS perspective. First, a digital platform has to be established to enable both sides of the market to co-create value within a value-creation network for mutual benefit. Thus, different systems from individual asset manufacturers can be avoided (Pauli et al., 2021) and actors can be connected through their assets as smart products (Beverungen et al., 2019), utilizing indirect network effects (Beverungen et al., 2021; Hagiu and Wright, 2015). Second, the business relationships in the value-creation network should be modeled in a smart service system to enable actor groups to interact via their smart products. We identified that distribution grid operators are willing to pay for such a smart service in our willingness-to-pay analysis and, thus, utilized smart service systems as useful frameworks for value co-creation (Beverungen et al., 2019). Third, the data should be provided on the digital platform in three different time intervals, i.e., historical data for reporting, current data for condition monitoring, and predictions of the future asset status to enable predictive maintenance decisions. The differentiation of data by time interval is already recognized in the literature (Nadj et al., 2016; Lüttenberg et al., 2018). Additionally, our willingness-to-pay analysis showed that all three time-dependent applications—reporting, condition monitoring, and predictive maintenance—will be accepted by the market. Fourth, multiple information systems and data types have to be integrated to allow the smooth transition of the business processes of asset operators. In the case of our digital industrial platform, this included an ERP system for master and transaction data, a GIS for location information, and a machine learning system for data analysis and prediction. For data types, we included sensor data, master and transaction data from the ERP system, location information, and relevant external data, e.g., weather data. While this integration of systems and data is described in the literature (Nadj et al., 2016; Farhangi, 2009), our willingness-to-pay analysis also highlighted the integration of data and systems. Fifth, the data has to be presented in different degrees of complexity so that multiple user groups can derive implications for asset operation and planning. While raw data has to be accessed for the specific analysis of individual assets, GIS dashboards can visualize high-level overviews of the assets.

The ensemble artifact of digital industrial platform and smart service utilizes location information of critical assets of the distribution grid—i.e., immovable entities. Therefore, the service classifies as an LCS (zur Heiden et al., 2023). The location information is used for improving the analysis results, e.g., through the integration of weather data and nearby industries (to determine soot levels), and for visualizing the data and analysis results. The prediction of maintenance needs would also be possible without location information, but the results would not be as accurate (zur Heiden et al., 2023). Visualization would also be possible without location information. However, distribution grid operators nowadays utilize GIS for visualization (zur Heiden and Priefer, 2021), and location information increase the appeal of the result visualization. Thus, utilizing location information of static assets in digital platforms via an LCS allows to co-create superior value-in-use.

The design and evaluation of the ensemble artifact of digital industrial platform and smart service system provides lambda knowledge on both artifact types in the form of design principles (Gregor et al., 2020). Through the integration of a technical perspective (digital industrial platform) and a service perspective (smart service system), we are able to extend the understanding of predictive maintenance in IS research, as previous IS research on predictive maintenance either focused on the design of technical artifacts (e.g., Nadj et al., 2016; Lüttenberg et al., 2018) or on improving prediction algorithms (e.g., Fabri et al., 2019; Rudolph et al., 2020). Additionally, we are the first to apply a willingness-to-pay analysis for evaluating a DSR result—thus, taking a service perspective for an iterative artifact evaluation.

A comparison of the two digital platform artifacts designed and evaluated in different contexts shows that, while they share similarities, they also show considerable differences due to contexts, their use of location information, and their digital platform characteristics. For contexts, the digital actor engagement platform was designed in a local high street context with B2C relations, whereas the digital industrial platform was designed in a distribution grid context with B2B relations. Thus, the local high street context allowed for a real-world evaluation in a public field study, whereas the digital industrial platform could only be evaluated by measuring the willingness-to-pay rather than through a full implementation.

Concerning the utilization of location information, the digital actor engagement platform co-creates value through an LBS system. It combines the static location information of SMEs with the dynamic positions of customers in high streets. The LBS provides a form of localized service provision, i.e., LBA (Molitor et al., 2018) and specific information for static location in cities (Lehrer et al., 2011), as categorized by answering the second research question (zur Heiden et al., 2023). Without the dynamic location information of customers, value cannot be co-created. We identified multiple customers who were not willing to share their data—including location information—which extended the gap between the short head of active and engaged users, and the long tail of passive users (Bartelheimer, zur Heiden, Berendes, et al., 2022). The digital industrial platform, however, utilizes static location information of assets on the distribution grid. It reflects an LCS that is able to co-create value even without the location information (zur Heiden et al., 2023). Integrating the location information, however, yields the benefit of improved predictions for upcoming maintenance needs due to, e.g., weather, animal populations, and soot from nearby industries. Although the location information on assets of the distribution grid is not available to asset manufacturers, distribution grid operators advocated the integration of location information in their systems, mainly due to their representation of assets in GIS (zur Heiden et al., 2022a; zur Heiden and Priefer, 2021).

Although both artifacts are instantiations of digital platforms, the general characteristics of digital platforms differ between the actor engagement platform and the digital industrial platforms. First, the digital actor engagement platform features direct and indirect network effects (Hagiu and Wright, 2015; Beverungen et al., 2021)—e.g., SMEs are attracted by large numbers of customers and other SMEs on the platform. For the digital industrial platform, however, neither different asset manufacturers engage with one another, nor for asset operators. Therefore, the digital industrial platform mostly utilizes indirect network effects. Second, the digital actor engagement platform features a high degree of openness (Ondrus et al., 2015; Benlian et al., 2015), characterized by low entry and exit barriers in the form of a publicly available and free-to-use platform. The digital industrial platform is inherently designed to be less open and raises higher entry barriers. Asset manufacturers need to provide machine learning models to predict maintenance needs, whereas asset operators need to integrate their information systems and business processes to co-create value. Third, the different degrees of openness and the entry and exit barriers correlate with the affiliation of each participant (Hagiu and Wright, 2015). While the affiliation of customers in a high street might be low for our digital actor engagement platform—especially for non-resident customers—asset operators have a high affiliation to the digital industrial platform once they commit to using it (zur Heiden et al., 2022a). For these two examples of digital platforms, this dissertation confirms the influence that context has on their design (de Reuver et al., 2018; Poniatowski et al., 2021).

4.2 Contribution to Research and Management

This dissertation is set out to develop *lambda knowledge* for research, businesses, and society on how to design digital platforms that utilize location information. To be able to create lambda knowledge, however, the first contributions of this dissertation especially focus on investigating and generating *omega knowledge*, i.e., knowledge about phenomena and sense-making (Mokyr, 2002). The combination of both types of knowledge thus allows to make a holistic and comprehensive contribution for research and management.

The first research question was answered by omega knowledge on which digital platform concepts are used in IS research and how these can be integrated. Thus, the knowledge in form of a decomposed model and lexicon enables researchers to position their research on digital platforms, including design studies, in the corpus of platform research in IS. While the lexicon of platform terms in IS aims to describe the current state of platform research in a Type One theory for analyzing (Gregor, 2006), the decomposed model extends this knowledge by relating different concepts, thus providing a Type Two theory for explaining (Gregor, 2006). The results from answering the second research question also provide omega knowledge. The different types of LBS comprise a Type One theory for analyzing, whereas the distinction between LBS and LCS as different classes of service utilizing location information contributes a Type Two theory for explaining (Gregor, 2006).

Answering the third research question provides both omega and lambda knowledge. The analysis of DSR publications with regards to their context provides descriptive knowledge on the extent to which context is (or is not) considered in DSR. The designed artifacts in the form of the context taxonomy, the context framework[9], and the updated methods and guidelines for DSR to consider the context of the research provide lambda knowledge, i.e., theories for design and action (Gregor, 2006). The contributions to answering the fourth research questions are also split between omega and lambda knowledge. The analyses of the contexts contribute omega knowledge, whereas the results of designing and evaluating digital platforms in these contexts contribute lambda knowledge. Again, the reason for also providing omega knowledge is the analysis and investigation of the context in which the digital platforms are designed in. Thereby, this dissertation does not only prescribe how to strengthen context involvement in design research—cf. the answers to the third research question—but also serves as a working example by thoroughly analyzing contexts and their appertaining problems.

In sum, this dissertation revolves around three different contexts to generate lambda knowledge: Design science research in IS research, high street retail, and maintenance on the distribution grid. These contexts resemble the three relevance cycles visualized for the research approach of this dissertation (cf. Figure 3.5). Thus, the different contributions as lambda knowledge in the form of artifacts (March and Smith, 1995) for each context are visualized in Figure 4.2, combined with the theory types by Gregor (2006) for the omega knowledge contributions. In total, I contribute Type One, Two, and Five theories to the IS knowledge base. This dissertation does not provide Type Three and Four theories—i.e., theories for predicting or explaining and predicting (Gregor, 2006), because it takes a design-oriented perspective (Österle et al., 2011).

From an IS perspective on digital platforms, the knowledge generated throughout this dissertation aligns with the research agenda for digital platform research in IS by de Reuver et al. (2018). For conceptual issues of digital platform research, de Reuver et al. (2018) recommend to provide clear definitions of digital platform concepts, to identify units of analysis and their boundaries (i.e., relevant contex-

[9] The literature on taxonomies in IS is indifferent about the knowledge classification of taxonomies. While it is seen as omega knowledge in the form of Type One theories (Gregor, 2006; Muntermann et al., 2015), others see it as lambda knowledge or a combination of prescriptive and descriptive knowledge (Iivari, 2007; Nickerson et al., 2013). This dissertation posits the developed taxonomy as a model resulting from a design process (Kundisch et al., 2022), i.e., lambda knowledge.

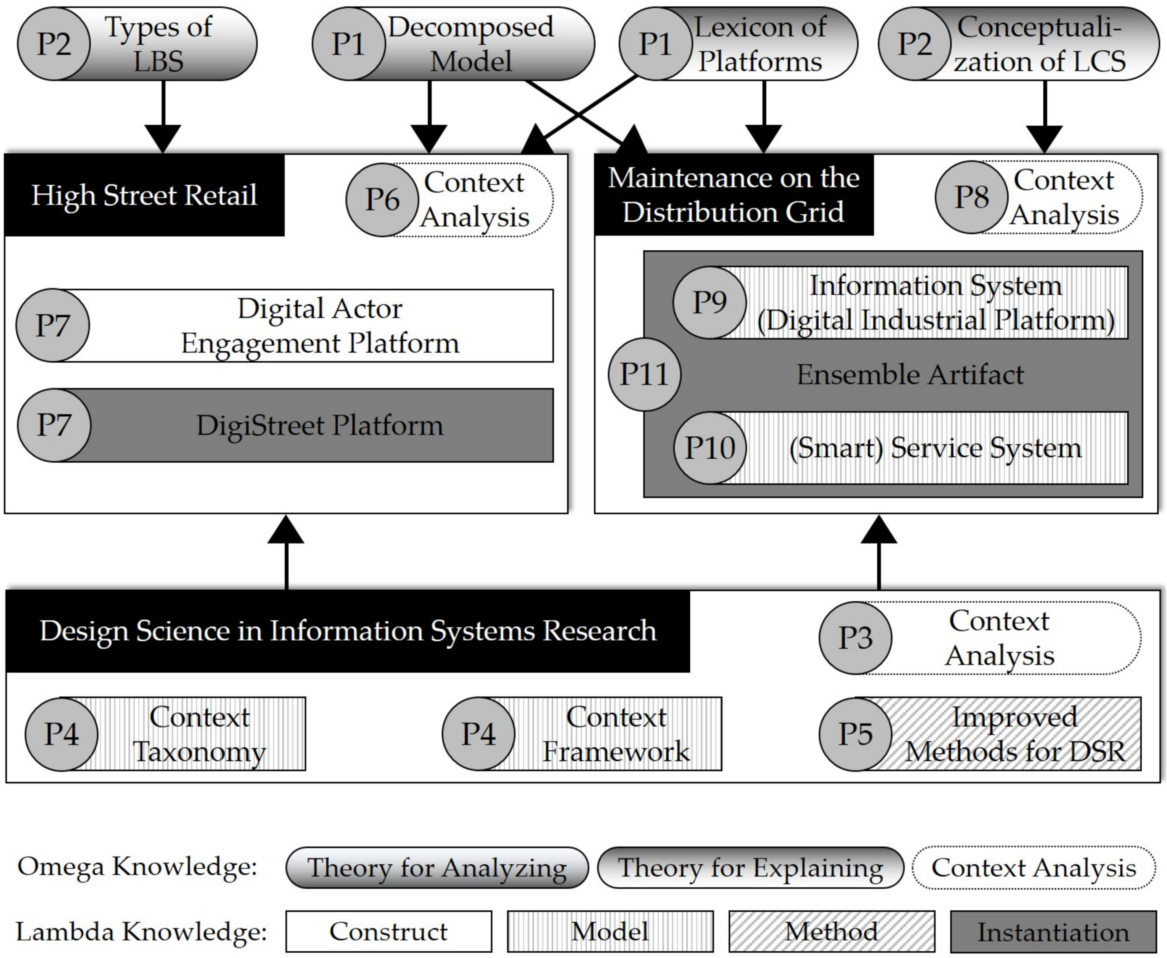

Figure 4.2: Knowledge contributions of this dissertation

tual factors), and to specify the perspective on the digital platform. These issues are answered by providing a conceptual model and lexicon on digital platforms (Bartelheimer, zur Heiden, Lüttenberg, et al., 2022), the extensive analysis of the different contexts before designing digital platforms (Hoffmann et al., 2020; Berendes et al., 2020; zur Heiden, 2020), and in-depth definitions of a digital actor engagement platform (Bartelheimer, zur Heiden, Berendes, et al., 2022) and a digital industrial platform (Pauli et al., 2021; zur Heiden et al., 2022a). Thus, this dissertation takes an integrated perspective of economic, social, and technical views on digital platforms. For scoping issues, de Reuver et al. (2018) recommend to first widen the scope of research on digital platforms and, second, to develop a contextualized theory on digital platforms. This dissertation spans multiple contexts while still designing digital platforms for specific contexts, i.e., high street retail in European cities and European energy distribution grids. Finally, for methodological issues, de Reuver et al. (2018)

recommend to conduct embedded case studies, longitudinal studies, design research, and data-driven approaches. This dissertation undertakes a design approach, utilizing different research methodologies for each of the steps involved in designing and analyzing digital platforms.

This dissertation also provides managerial implications based on the developed results. First and foremost, it provides knowledge on how to design and apply digital platforms in different contexts. Thereby, it emphasizes the importance of thoroughly analyzing relevant contexts before designing and applying such digital platforms. For local town center management, the results imply that engaging with SMEs in high streets should be prioritized, as SMEs generally lack digital capabilities, and that SMEs should be aware of a long tail distribution of participating actor groups on digital retail platforms. Concerning the energy distribution grid context, distribution grid operators should actively transform to condition monitoring and predictive maintenance by investing in the digitalization of technology and strategy. Otherwise, assets and parts of the distribution grid would have to be reactively maintained, increasing the external pressure due to a highly dynamic environment.

4.3 Conclusion and Outlook

This dissertation set out to generate lambda knowledge on digital platforms that utilize location information in different contexts. Through clarifying the lexical structures in digital platform research, distinguishing types of service utilizing location information, and refining methods for the design of digital platforms, knowledge about the contexts of high street retail and maintenance on the distribution grid was combined to design two digital platforms.

Although the research results of single papers corroborate the results of the other papers in this dissertation, the insights open up new questions to be answered by upcoming research in IS. First, the first research question should be applied to neighboring disciplines, e.g., engineering and marketing, to compare the results with the IS discipline, and the model and lexicon should be adapted to future trends and research on digital platforms. Second, although this dissertation features two contexts with different approaches to utilizing location information—i.e., an LBS in local high streets and an LCS on the distribution grid—there might be other ways to co-create value with location information. Future research should identify other relevant contexts and investigate ways to utilize location information. Third, the artifacts designed to help researchers to effectively and efficiently design artifacts in full consideration of the context of their research (third research question) could only be evaluated with a naturalistic ex-ante evaluation, entailing the risk of identifying false positives (Venable et al., 2012). Future research should investigate the use of the methods after conducting design studies aligning with the frameworks and methods.

Fourth, although the digital platforms were designed and evaluated, follow up studies should be conducted (vom Brocke et al., 2020) to control for value-co-creating implementations and long-term success. Visible in established platforms, winner-takes-all dynamics benefit monopolies and hinder the growth of different platforms of the same type (Eisenmann et al., 2006). The growing interest in data spaces and ways to transition from digital platforms to data spaces (Beverungen et al., 2022) might also change the way in which digital platforms are viewed and designed in the future. Thus, future research should investigate the value of the generated design knowledge, because the temporal dimension leads to a change in context (Herwix and zur Heiden, 2022), and therefore requires further design knowledge and efforts.

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List of Publications[10]

Journal Publications

C. Bartelheimer, P. zur Heiden, H. Lüttenberg, and D. Beverungen 2022. "Systematizing the Lexicon of Platforms in Information Systems: A Data-Driven Study," *Electronic Markets* (32:1), pp. 375–396. (doi: 10.1007/s12525-022-00530-6).

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