Understanding Digital Innovation Processes and Outcomes

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“You don’t know, what you don’t know”

Michael Rosemann

Mit dieser Thesis blicke ich auf eine enorm lehrreiche und unvergessliche universitäre Laufbahn zurück. Dieser Weg wurde geprägt durch ein Umfeld, das mir Türen geöffnet hat und mir die Möglichkeiten geboten hat, mich stets weiterzuentwickeln und über mich hinauszuwachsen. Allen meinen WegbegleiterInnen möchte ich danken:

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Abstract

Digital technologies fundamentally drive socio-technical change for individuals and society as well as for organisations and the economy. With their unique characteristics, digital technologies change the nature of innovation and facilitate *digital innovation*. Digital innovation has transformative effects on products, services, processes, and business models, and enables organisations to reach new market opportunities, increase their efficiency, and contribute to a better society. Thus, digital innovation opens *opportunities* for organisations but also poses *disruptive threats*. Academics and practitioners agree that organisations need to capitalise on opportunities, anticipate disruptive threats, and develop digital innovation to maintain a competitive advantage and thrive in the digital economy. However, many organisations struggle in the different stages of the digital innovation process. Although research into digital innovation has matured considerably, it still lacks guidance on understanding and managing digital innovation *processes* and *outcomes*. Against this background, this cumulative doctoral thesis comprises six research articles that examine the *processes* and *outcomes* of digital innovation. Taking different conceptual lenses as well as applying qualitative and quantitative research designs, this thesis provides frameworks and methods that guide organisations in *initiating* and *developing* digital innovation and that structure digital social innovation as a specific innovation *outcome* type. The insights are relevant for academics and practitioners as they provide both a scientific perspective and practical guidance.

Concerning the *initiation* of digital innovation, research article #1 presents an opportunity-led ideation method that systematically guides organisations to capitalise on *opportunities* in the *initiation* stage of the digital innovation process. Incorporating different opportunity sources, the method reduces the uncertainty that organisations experience during the unstructured *initiation* stage. Complementing the opportunity-led perspective, research article #2 conceptualises the evolution of *disruptive threats* and provides a method that helps organisations to identify and assess disruptive threats.

This thesis goes on to provide descriptive and prescriptive insights into *developing* innovation in challenging organisational contexts. Some organisations face barriers that impede innovation, for instance, limited qualified personnel, limited financial resources, or a lack of capabilities. These barriers increase organisations' need to complement their set of resources and capabilities. For small and medium-sized enterprises (SMEs), for instance, cooperation is a way to complement resources as well as share the costs and risks of innovating with external partners. Research article #3 presents a taxonomy that structures characteristics of cooperation setups to foster SMEs' innovativeness and provides guidance on why, with whom, and how to cooperate. Since the taxonomy revealed a lack of actionable practices that support organisations in developing digital innovation, additional frameworks are presented. Research article #4 investigates the development of citizen-centric digital public services and presents success factors and a blueprint to guide this approach in the public sector. Research has revealed

that developing digital innovation requires an environment that is conducive for digital innovation. Thus, organisations must assess whether their internal organisational environment is ready for digital innovation adoption and whether and how they should adapt it. Focusing on artificial intelligence (AI) as a digital technology, research article #5 conceptualises AI readiness factors for AI adoption. The findings emphasise that AI readiness is an integral part of organisations' decisions across the entire AI adoption process to guide AI-related investments, prioritisation, and resource allocation.

The thesis concludes by investigating an emerging digital innovation *outcome* type, digital social innovation, which enables organisations to reach new markets, new customers, and new sources of profit by combining social and economic value creation. Connecting the research into digital innovation with the research into social innovation, research article #6 proposes a conceptualisation of digital social innovation, summarising relevant characteristics and combinations that commonly co-occur in industry.

Overall, this thesis contributes to the research into digital innovation *processes* and *outcomes*, applying qualitative and quantitative research methods, i.e. action design research, design science research, taxonomies, explorative case study research, and a qualitative interview study. Further, this thesis builds on and extends relevant research streams into digital innovation *initiation* and *development processes*, as well as digital innovation *outcomes*.

Table of Contents

I. Introduction[1]

Academics and practitioners agree that *digital innovation* is key for organisations to adapt and thrive in constantly changing environments (Ciriello et al. 2018; Fichman et al. 2014). While digital technologies fundamentally drive socio-technical change for individuals and society as well as for organisations and the economy, they are increasingly penetrating products, services, processes, and business models (Ciriello et al. 2018; Yoo et al. 2012). Thus, they are fundamentally changing the nature of innovation and facilitating digital innovation (Fichman et al. 2014). Digital innovation provides organisations with opportunities to reach new markets and increase their efficiency as well as to address customers' demands, contributing to a better society (Huang and Wang 2013; Walsham 2017). To this end, digital innovation concerns not only software companies: digital technologies are no longer just the way to streamline an organisation's internal processes and operations for productivity purposes (Ciriello et al. 2018; Nylén and Holmström 2015), but a key differentiating factor to enhance and expand existing offerings (Yoo et al. 2012). Thus, in dynamic business environments, digital innovation is a crucial strategic activity for organisations of all sizes in both the private and public sectors (Bertot et al. 2016; Nylén and Holmström 2015). Against this backdrop, it is unsurprising that the world's five most valuable companies stem from the digital sector (Ciriello et al. 2018).

Digital innovation opens *opportunities*, i.e. action possibilities to introduce innovative products, services, processes, or business models (Ciriello et al. 2018; Nambisan et al. 2017; Vega and Chiasson 2019), but also poses a multitude of potentially *disruptive threats* driven by the rapid development of new products and the dissolution of industry boundaries (Skog et al. 2018). Even market-leading companies with well-established and successful business models face digital innovation's impacts: For instance, in 2002, the video-rental company Blockbuster seemed unrivalled and had a market capitalisation of $5 billion (Downes and Nunes 2013). While Blockbuster's market capitalisation dropped to $62 million by 2009, the video-on-demand service provider Netflix capitalised to $3.9 billion that year (Chopra and Veeraiyan 2017). To date, Netflix is the streaming service with the most subscribers worldwide and a market capitalisation of more than $220 billion (Ponciano 2021). While Netflix capitalised on opportunities and became a competitive market player, Blockbuster did not anticipate the disruptive threats and did not respond with adequate measures. In contrast, Telecom New

[1] This section is partly comprised of content taken from the research articles in this thesis. To improve the readability of the text, I have omitted the standard labelling of these citations.

Zealand correctly assessed the availability of information via the internet as a significant threat and sold New Zealand Yellow Pages for $1.6 billion in 2007. And Telecom New Zealand was right: The Yellow Pages business lost more than $1 billion only three years later (Forbes 2007; Interest 2011). Against this background, organisations require capabilities to anticipate disruptive threats and to capitalise on opportunities to develop digital innovation.

Organisations of different sizes face different challenges regarding digital innovation. For instance, incumbents, i.e. organisations building on established business models, rather focus on becoming better at what they are already good at, instead of responding to digital trends and leverage digital opportunities (Crittenden et al. 2019). Further, small and medium-sized enterprises (SMEs) have resource constraints – for instance, qualified personnel and financial resources – which hinder innovation. Public sector organisations, for instance, have typically faced barriers among others in terms of risk avoidance, as innovation failures imply wasting public resources that could have been used elsewhere (Neumann et al. 2019; Pedersen 2020). Thus, organisations risk stagnating over time, missing opportunities to innovate, and losing customers and market share, i.e. being disrupted (Schmidt and Druehl 2008). In light of the various challenges, organisations need specific guidance to conduct digital innovation.

In essence, digital innovation describes new combinations of digital and physical components (Yoo et al. 2010) using digital technologies as a means or an end (Ciriello et al. 2018). Thus, research has conceptualised digital innovation regarding the use of digital technologies within digital innovation *processes* and *outcomes* (Fichman et al. 2014; Nambisan et al. 2017; Vega and Chiasson 2019). As outlined in Figure 1, Kohli and Melville (2019) structured the components of digital innovation, presenting a theoretical framework. Accordingly, digital innovation *processes* have four stages: *initiation, development, implementation,* and *exploitation*. Digital innovation processes are shaped through the *internal organisational environment* and the *external competitive environment* (Kohli and Melville 2019). This requires organisations to manage digital innovation in high interrelation with the internal organisational and external competitive environment (Kohli and Melville 2019). The first two stages, *initiation* and *development,* are typically time-consuming and subject to uncertainties, since the outcome's success is unclear in advance (Savino et al. 2017; Vasconcelos Gomes et al. 2018). Clarity in these stages can be increased with a shared understanding of digital innovation *outcome* types. Hence, this thesis seeks to provide guidance specifically for the *initiation* and *development* stages and to investigate digital innovation *outcome* types.

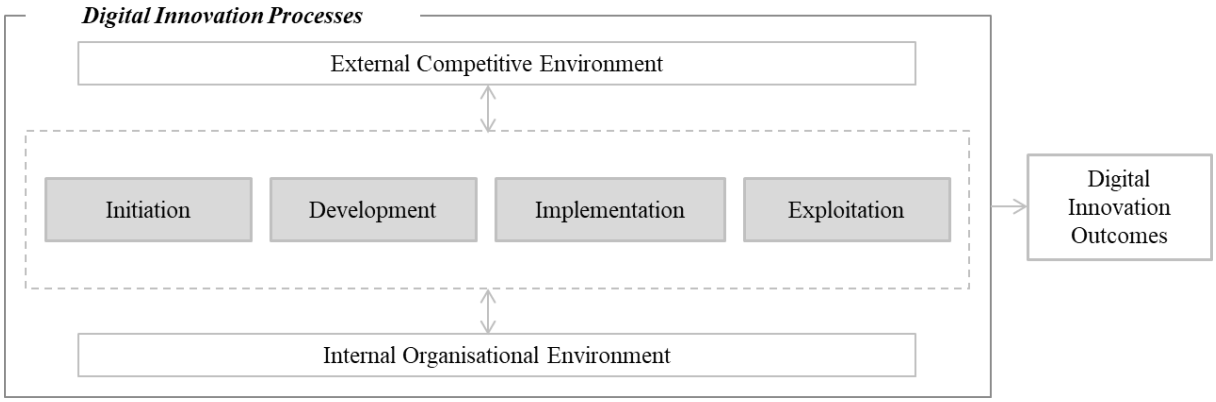

Figure 1. Theoretical Framework of Digital Innovation (based on Kohli and Melville 2019)

Research emphasises the importance of the first stage, *initiation*, as significantly influencing innovation success (Eling and Herstatt 2017). In this stage, innovative ideas are generated based on opportunities or disruptive threats. This stage requires one to identify and assess opportunities and disruptive threats to detect possible actions organisations may take to introduce an innovative outcome. Capabilities such as alertness and environmental scanning enable organisations to sense the environment and encourages digital innovation (Kohli and Melville 2019; Sambamurthy et al. 2003). Thus, organisations must monitor internal and external developments to determine subsequent innovation actions (Kohli and Melville 2019). Although the *initiation* stage is vital for innovation success, organisations still lack guidance and formalisation on how to successfully manage it, since it is creativity-intensive, informal, and lateral (Eling and Herstatt 2017).

In the second stage, *development*, organisations capitalise on opportunities or respond to threats concerning synchronising internal capabilities, and determine optimal actions to translate them into digital innovation outcomes (Kohli and Melville 2019; Mishra and Agarwal 2010). Research distinguishes two types of *development* activities: first, *designing and developing* of new digital innovation, and second, *adopting* pre-existing solutions (Kohli and Melville 2019). In line with Schumpeter (1934), who laid the foundation for innovation research, the development of digital innovation requires that one dynamically and substantially assembles and recombines resources and strategies so as to attain competitive advantage (Henfridsson et al. 2018; Yoo et al. 2010). Thus, an organisation's innovation capability demands that it recognises new resources, assimilates them, combines them with existing resources, and applys them (Cohen and Levinthal 1990; Prajogo and Ahmed 2006). However, organisations still struggle to tap digital innovation's full potential, since resource constraints or the need to align the internal organisational environment often hamper digital innovation.

Thus, organisations require guidance concerning actionable practices that foster their innovation *development* capabilities.

Digital innovation *outcomes* can be products, services, processes, or business models (Ciriello et al. 2018; Fichman et al. 2014) enabled or supported by digital technologies (Suseno and Abbott 2021). Owing to the unique characteristics of digital technologies, digital innovation *outcomes* can appear in multiple forms and for various application areas. Both research and practice often use digital technologies as an umbrella term for a combination of computing, connectivity technologies, information, and communication (Bharadwaj et al. 2013; Pavlou and El Sawy 2010). Digital technologies enable one to connect people (Spagnoletti et al. 2015) and smart things, leverage efficient data collection and analysis (Xu et al. 2014), and facilitate digital services (Huber et al. 2019). Yoo et al. (2010) were the first to define digital technologies' characteristics as re-programmability, homogenisation of data, and self-referential nature. Digital technologies enable high scalability and facilitate low entry barriers and are accessible as a commodity leading to high diffusion and adoption rates (Huang and Wang 2013; Lokuge et al. 2018). As a specific digital innovation *outcome* type, *digital social innovation (DSI)* is a growing phenomenon, leveraging digital technologies for social value creation in a financially sustainable way (Bonina et al. 2020). DSI opens opportunities to reach new markets and customer segments, while increasing an organisation's reputation and brand value toward its customers (Fichman et al. 2014; Porter and Kramer 2006; Tracey and Stott 2017; Walsham 2012). Thus, DSI strongly contributes to competitive advantage and is gaining importance in organisations (Mirvis et al. 2016; Porter and Kramer 2006).

In sum, considering digital innovation's potential, organisations must leverage digital innovation if they are to maintain competitive advantage (Ciriello et al. 2018). Although organisations have recognised the need to constantly innovate, many organisations are still struggling in the different stages of the digital innovation process. Although the research into digital innovation has matured considerably, it lacks guidance on *understanding and managing digital innovation processes and outcomes*. Specifically, within *initiation*, organisations require systematic approaches for identifying *opportunities* and anticipating *disruptive threats*, so as to translate these into digital innovation initiatives (Nylén and Holmström 2015). Concerning the *development* stage, organisations with resource constraints and that are risk-averse still lack guidance on *developing* digital innovation. Further, research lacks knowledge on the prerequisites of successful *adoption* of digital innovation. Concerning digital innovation *outcomes*, little is known about digital innovation types that enable one to address pressing

social needs of customers and employees and to simultaneously generate economic returns (Bonina et al. 2020; Eichler and Schwarz 2019; Porter and Kramer 2006). Overall, research lacks a structured approach that guides organisations in *understanding initiation and development processes and outcomes* of digital innovation to thrive in dynamic business environments.

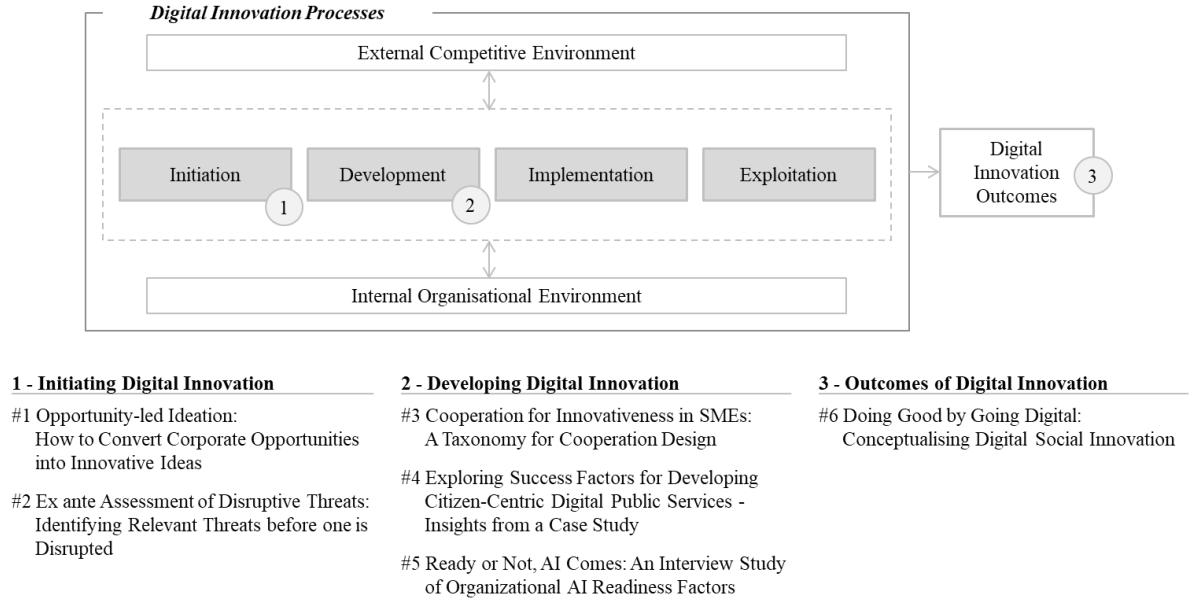

Figure 2. Assignment of the Research Articles to the Topics Structuring this Doctoral Thesis

This cumulative doctoral thesis consists of six research articles that investigate *initiation and development processes and outcomes* in the context of the internal organisational and external competitive environment. The research articles address the digital innovation *processes* and *outcomes* by applying different qualitative and quantitative methods, conceptual and theoretical lenses, empirical evidence types, and levels of granularity. This thesis presents models and methods for effective *initiation* based on opportunities and disruptive threats, successful *development* within constrained environments, and understanding of DSI *outcomes*. Covering theoretical and practical perspectives on digital innovation, this thesis is relevant for both researchers and practitioners.

As outlined in Figure 2, the research articles in this thesis are assigned to one section each, *initiating*, *developing*, and *outcomes* of digital innovation. First, the thesis addresses incumbents' need to identify opportunities and threats to *initiate* digital innovation. For each, the thesis provides a systematic method considering conceptual perspectives that supports the identification and assessment of innovation opportunities and disruptive threats, respectively (Section II.1, including research articles #1, #2). This enables to reduce the uncertainty that

organisations experience during the *initiation* stage. Second, the thesis presents frameworks to guide organisations in *developing* digital innovation. For one, the thesis provides two conceptual perspectives (a taxonomy and a case-study based framework) for organisations in innovation-constrained environments that support the successful creation of digital innovation (Section II.2, including research articles #3, and #4). To complement the *development* perspective, this thesis enhances the theoretical understanding of digital innovation *adoption* and highlights the importance of innovation-ready environments (Section II.2, including research article #5). Third, to address the question of digital innovation *outcome* types that foster dual value creation, i.e. creating social and economic value, this thesis presents a conceptualisation of DSI summarising dimensions and characteristics of DSI as well as combinations thereof (Section II.3, including research article #6).

Section III concludes this thesis by providing a summary of the key insights and directions for future research. Section IV includes the publication bibliography. The Appendix, Section V, comprises additional information on all research articles (V.1), my individual contributions (V.2), and the research articles themselves (V.3 to V.8).

II. Overview and Context of the Research Articles[2]

1 Initiating Digital Innovation

Dynamic business environments increase an incumbent's need for innovation (Vega and Chiasson 2019). Thus, the identification of ideas and their effective transformation into innovation is crucial for incumbents' performance (Nambisan 2017; Short et al. 2010; Teece 2007). The *initiation* stage is also known as the front end of innovation and involves the activities from the identification of an opportunity or disruptive threat to the development of a responding innovative idea (Kim and Wilemon 2002). As the first stage, it determines the ideas that proceed into the subsequent stages of the digital innovation process and is therefore crucial for innovation success (Eling and Herstatt 2017; Kock et al. 2015).

The initiation stage involves recognising opportunities such as the evolution of technologies and customer needs as well as anticipating competitive threats (Sambamurthy et al. 2003; Teece 2007). Against this background, the internal organisational environment and the external competitive environment significantly influence the initiation of digital innovation and have an ambivalent role (Kohli and Melville 2019; Nylén and Holmström 2015). For one, they provide *opportunities* that enable new innovation. For another, they provide multi-faceted *disruptive threats*, forcing incumbents to innovate if they are to remain competitive and provide new value for customers. Thus, opportunities and threats are two sides of the same coin – both provide starting points for digital innovation initiatives. To date, the initiation stage has been elusive, and little is known about how to identify opportunities for and threats to digital innovation. Decisions in the initiation stage strongly impact on the subsequent stages in the digital innovation process, yet are made under uncertainties (Reid and Brentani 2004).

A maturing body of literature has investigated insights into the initiation stage of the innovation process (Kohli and Melville 2019; Salerno et al. 2015). For instance, research has elaborated on relevant capabilities to detect opportunities, such as entrepreneurial alertness (Sambamurthy et al. 2003) and technological opportunism (Mishra and Agarwal 2010), and has emphasised knowledge capabilities that lead to the initiation of innovation (Carlo et al. 2012). However, the initiation stage still lacks guidance and is the least well-structured stage in the digital

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innovation process (Eling and Herstatt 2017). Thus, incumbents require tools and methods that guide them in this stage of uncertainty and risk (Eling and Herstatt 2017).

To address this need, Section II.1 presents models and methods for *initiating* digital innovation based on *opportunities* (research article #1) and *disruptive threats* (research article #2) in order to assist incumbents in the unstructured first stage of the digital innovation process.

Both research and practice highlight that opportunity management in innovation management is a key driver of long-term competitiveness (Ali et al. 2020; Teece 2007). Specifically, a focus on opportunities promises higher growth than a focus on innovation driven by problems (Verheul and van Mil 2008). Thus, while problem-centric ideation mainly enables incremental innovation (Visser and Faems 2015), opportunity-led ideation has the potential to yield radical innovation (George et al. 2016), i.e. new and transformative products, services, or business models that open new markets (Visser and Faems 2015). Thus, in the initiation stage, the opportunity identification is a key activity (Gurtner and Reinhardt 2016; Kohli and Melville 2019). Literature describes opportunity identification and idea generation as related concepts (Adams et al. 2006; Franke and Schreier 2002). Yet opportunity identification is often limited to being a precursor condition to idea generation. However, an interrelated view of the two concepts is missing, and researchers have called for systematic guidance on how to identify opportunities in the initiation stage (Eling and Herstatt 2017).

Research article #1 addresses this need and proposes the opportunity-led ideation method to structure the initial stage of the innovation process. The opportunity-led ideation method was co-developed and evaluated in a joint research project with one of Australia's leading financial service providers. The method development followed the action design research (ADR) paradigm (Sein et al. 2011) and used situational method engineering as research method (Henderson-Sellers and Ralyté 2010). ADR facilitates the creation of innovative artefacts, e.g. models or methods, that address practically relevant problem classes. To this end, researchers and practitioners jointly build, adapt, and evaluate the artefact in focus (Sein et al. 2011). The initial design specification of the opportunity-led ideation method was developed according to situational method engineering, building on extant knowledge on ideation and innovation methods. According to ADR, this method was shaped and evaluated in close collaboration with the case company and prospective users so as to ensure practical relevance (Sein et al. 2011): the method was applied, evaluated, and adapted in four iterations in close collaboration with the case company. Owing to this research design, the opportunity-led ideation method incorporates both theoretical knowledge and practical experience from the case company. In

addition to receiving feedback from the practitioners involved in the project team, this method was positively assessed by the case company's management and customers.

The opportunity-led ideation method is specified for the use in a pre-defined situation (Henderson-Sellers and Ralyté 2010). Thereby, a situation is composed by a context and a project type (Bucher et al. 2007). In terms of context, the method targets large and medium-size incumbents that strive for strategic innovation. Concerning for the project type, incumbents seek to identify opportunities that are translated into innovative ideas. The method's objective is to structure the creativity-intensive initiation stage so as to reduce incumbents' uncertainty in this stage. Thus, it supports structured idea generation based on established opportunity sources.

The opportunity-led ideation method builds on deductive knowledge on innovation management, idea generation, and opportunity identification, providing systematic step-by-step guidance by encompassing four activities: *initiation*, *immersion*, *investigation*, and *integration*. Each activity contains actionable techniques that are conducted by specific roles with related tools and provide defined outputs. Table 1 outlines the method's distinct elements. The first activity, *initiation*, is highly explorative. The ideation team specifies the innovation purpose against the backdrop of the organisational context, discovering opportunities from opportunity sources that are specified in advance. Typical opportunity sources discussed in the literature are corporate resources, competitors, customers, and science and technology (Teece 2007). The opportunities are then evolved into a strategic theme that serves as a roadmap for the incumbent and is named a "big idea". For each identified big idea, activities *immersion* to *integration* are conducted. In the *immersion* activity, the ideation team selects one big idea and creates an idea concept for it. An idea concept reflects the skeleton of the idea and outlines its scope with the most important content areas. In subsequent activities, the ideation team details the big idea according to the idea concept. In the *investigation* activity, the ideation team identifies opportunities using the opportunity sources, detailing the big idea. To do so, the ideation team investigates the opportunity sources simultaneously and independently, structuring opportunities per source. Finally, the *integration* activity merges the outputs of both prior activities. The opportunities of the *investigation* activity are developed into so-called "small ideas" in an evolutionary process. A small idea is a combination of small features that could be a stand-alone product or service. The ideation team enriches and refines the idea concept with generated small ideas. The small ideas fit the strategic theme of the big idea. After this activity, the selected big idea will have emerged in full.

Table 1. Overview of the Method's Activities and Elements

Activity (E.1)	**Activity 1: Initiation**	**Activity 2: Immersion**	**Activity 3: Investigation**	**Activity 4: Integration**
Techniques (E.2)	- Generate big ideas that capitalise on the opportunity sources	- Select one big idea - Choose a structure for the big idea - Create an idea concept based on that structure	- Identify opportunities originating from each source - A structured search using a need-driven and feature-driven approach	- Use sources to generate small ideas - Populate small ideas around the idea concept - Elaborate the big idea to produce a detailed, comprehensive theme
Tools (E.3)	- Opportunity sources: Corporate resources, Customer, Competitor, Science and Technology - Formal and informal ideation tools for general idea generation (e.g. envisioning of mega trends, scenario thinking, ad-hoc discussions) - Narratives that provide a first outline of the big idea	- Idea selection voting - A framework that serves as the foundation for the idea concept (e.g. three horizons, 2x2 matrix, logic tree)	- Opportunity sources: Corporate resources, Customer, Competitor, Science and Technology - Identify specific sources of opportunities - Identify specific methods for opportunity discovery and recognition (recombination of assets, customer segmentation, market analysis, sensing of state-of-the-art technologies) - Structure sources using a need-driven and feature-driven perspective - *Need-driven approach* according to the jobs to be done and the benefactors - *Feature-driven approach* according to the features and the jobs that could be done	- Idea concept - Populated opportunity sources - Established ideation tools for specifying ideas (e.g. Scenario, Storyboards, Roleplaying)
Roles (E.4)	- Sources experts - Moderator - External experts (e.g. consultants, researchers)	- Source experts - Moderator - Experts with knowledge about the used frameworks	- Source experts	- Source experts - Moderator
Output (E.5)	- Big ideas - Short narratives per big ideas	- An idea concept as the structure of the chosen big idea	- Populated opportunity sources that serve as the foundation for the further development of an idea concept	- A big idea enriched with small ideas structured based on the idea concept
Justificatory Knowledge	- Opportunity Sources, e.g. (Chesbrough 2003; Zhou et al. 2009) - Opportunity identification and analysis (Khurana and Rosenthal 1998; Kim and Wilemon 2002; Koen et al. 2002) - Design Thinking (Johansson-Sköldberg et al. 2013; Kumar 2012; Osterwalder et al. 2014)	- Idea selection (Koen et al. 2001) - Concept structuring (Goel and Pirolli 1992)	- Opportunity discovery and recognition (George et al. 2016) - Need-driven approach (Slater et al. 2010) - Feature-driven approach (Bower and Christensen 1995) - Design Thinking (Johansson-Sköldberg et al. 2013; Kumar 2012; Osterwalder et al. 2014)	- Established methods as stimuli in ideation (Koen et al. 2001) - Integration of knowledge into the innovation activities (Prajogo and Ahmed 2006; Savino et al. 2017)

In sum, article #1 increases the understanding of the transformation of opportunities into innovative ideas and supports practitioners by providing a systematic, step-by-step procedure. The method contributes to innovation management by representing an effective approach to opportunity-led ideation. It specifically contributes to opportunity management, a research

stream related to identifying and assessing opportunities as well as converting them into digital innovation initiatives (Short et al. 2010).

Although *opportunities* provide action possibilities for digital innovation, incumbents that do not effectively manage *disruptive threats* will lose existing business faster than they create new business (Christensen et al. 2015). Dynamic business environments confront incumbents with multiple disruptive threats that may lead to disruption: From a product perspective, digital technologies facilitate the rapid development and diffusion of new products accompanied by the shortening of product lifecycles (Ciriello et al. 2018). From a market perspective, common industry boundaries are dissolving and markets are increasingly globally connected. Further, digitally empowered customers compete against incumbents (Ritzer 2015). These examples provide indications of multiple potential disruptive threats (Ciriello et al. 2018). Whether incumbents are able to survive these disruptive threats depends on their capability to effectively anticipate disruptive threats to react to or prepare for their impacts. Owing to its complexity, most incumbents are still struggling to anticipate disruption (Skog et al. 2018). Anticipating disruption requires incumbents to assess either the threat of a new and potentially disruptive offering or the possible disruptive impacts of an already introduced offering (Paap and Katz 2004).

Research into the context of disruption provides insights into origins (Bughin and van Zeebroeck 2017), impact trajectories (Chen et al. 2016; Palacios Fenech and Tellis 2016), and response strategies to anticipate disruption (Hopp et al. 2018; Skog et al. 2018). However, research into disruption has no common conceptual foundation (Hopp et al. 2018). For instance, there are various conceptual foundations regarding the evolution of disruptive threats, which makes it hard for organisations to identify a concept that suits their situation (Hopp et al. 2018).

Research article #2 addresses this need and proposes the Disruption Evolution Framework (DEF), which describes the course of disruptive threats with three phases (i.e. threat possible, threat apparent, and threat materialised) and distinguishes four interrelated signal categories (i.e. context, catalyst, capability, and company signals) and threats (i.e. customer, competitor, product, and policy threats). Building on the DEF, article #2 also presents the Disruptability Assessment Method (DAM), which enables incumbents to systematically assess disruptive threats via a step-by-step procedure (Figure 3). The DEF and the DAM are especially developed for incumbents that draw on long-established business models. With extensive decision-making processes, these organisations typically lag concerning reacting to new trends and disruptive threats, and feel secure based on seemingly stable revenues (Wessel and Christensen 2012).

Thus, early anticipation of disruption and effective prioritisation, which is necessary to counteract or prepare for its impacts, is crucial for them (Hopp et al. 2018).

The DEF reflects both deductively and inductively derived insights. First, conducting a literature review, the DEF was deductively derived, reflecting key concepts related to disruption, i.e. the evolutionary process, the concepts of threats and signals, and the relationship among the concepts. Second, the DEF was validated inductively based on real-world cases of disruption. Further, a sound set of disruptive threats and signals was compiled based on the literature and a comprehensive set of real-world cases. Following the design science research (DSR) paradigm, the DEF served as the analytical lens for building the DAM, using situational method engineering (Henderson-Sellers and Ralyté 2010). In line with situational method engineering, the DAM is composed of existing method fragments from disruption identification methods that were derived in the literature review. The DAM's applicability and usefulness were demonstrated and evaluated with an insurance incumbent. The evaluator conducted a complete iteration of the DAM and assessed it based on established evaluation metrics, i.e. efficiency, ease-of-use, generality, and operationality. Both the demonstration and the evaluation confirmed that the DAM is applicable in practice and that it generates valuable insights for practitioners to be used in further strategic activities.

To shed light on various disruptive threat types, the DEF distinguishes disruptive threats according to four categories: customer, competitor, product, and policy. *Customer threats* are threats that arise through changes in customer preferences or behaviours that influence their purchase decisions (Christensen et al. 2018). *Competitor threats* are threats that relate to the changing competitive dynamics in the environment, for instance, the number of competitors or customers that become competitors (MacGill and Smith 2017). *Product threats* are the pressures induced by technological advances on incumbents' product portfolios and capabilities (Christensen et al. 2015). *Policy threats* describe fundamental changes in the market, for instance, legal, political, or economic forces (Biber et al. 2017).

The DEF is based on the notion that disruption cannot be directly observed ex ante (Christensen et al. 2018; Sainio and Puumalainen 2007). The evolution of a disruptive threat describes the transition from a disruptive threat to a concrete offering having a disruptive impact on an individual organisation (Myers et al. 2002). Thus, both research and practice use signals as indicators to assess the probability of being disrupted (Klenner et al. 2013). The accumulation of observable signals determines the extent of susceptibility (Hang et al. 2011; Keller and Hüsig 2009; Klenner et al. 2013). As outlined in Figure 3, the DEF conceptualises disruption

distinguishing between three evolutionary phases, i.e. threat possible, threat apparent, and threat materialised, considering four categories of internal and external signals: context, catalyst, capability, and company.

Before a threat materialises, favourable market conditions determine its intensity (Hang et al. 2011). In the early phase, *threat possible*, context signals indicate a market environment that favours a threat to enter or to spread rapidly. The signal *internationally connected markets*, for instance, increases the likelihood of disruptive products immediately spreading within markets (Deloitte 2017). In the subsequent phase, *threat apparent*, catalyst signals reveal market gaps that can be exploited by a disruptive offering. The signal *outperforming technology*, for example, indicates that products based on new technologies are likely to replace existing offerings (Chen et al. 2016). The third phase, *threat materialised*, describes an offering or an external development following a disruptive path (Christensen et al. 2015; Klenner et al. 2013; Myers et al. 2002). Capability signals relate to a specific threat and indicate its possible impact on market participants. The impacts are assessed higher with more observable capability signals (Klenner et al. 2013). In contrast to the aforementioned categories of signals that refer to the external environment, company signals describe an incumbent's proneness to disruption along with the complete evolution of disruption. For instance, the signal *no strategic alliances*, indicates a risk of a higher disruptive impact, since an isolated incumbent can be more vulnerable to market dynamics (Yu and Hang 2010).

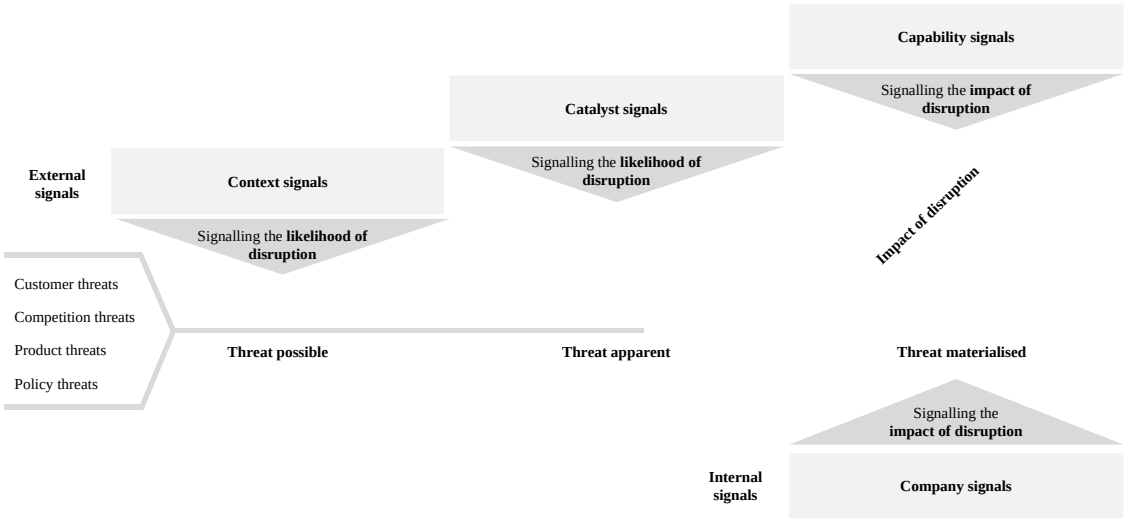

Figure 3. The Disruption Evolution Framework (DEF) with Related Signals

Building on the DEF as a conceptual lens, the DAM supports incumbents in the assessment and prioritisation of threats regarding their possible impacts and the likelihoods of their materialising in the form of newly introduced products, services, or business models. The DAM

comprises four activities: *select threats*, *evaluate signals*, *assess materialisations,* and *review results*. The activities are specified with various techniques that are conducted with tools from distinct roles and provide certain outputs (Table 2).

Table 2. Overview of the Disruptability Assessment Method's Activities and Related Elements

Activity	**Technique**	**Tool**	**Role**	**Output**
Activity 1 (A1) Select threats	(1) Review disruptive threats and potentially add, remove, or adapt individual threats according to recent trends (2) *(Optional)* Choose the selection of focal threats for the current iteration (3) Understand the focal threats in detail and discuss necessary prerequisites as well as possible instantiations for the selected market	- Initial compilation of threats based on expert discussions, the literature, and historical cases	- Senior executive, project leader, and team members (core team) - *(Optional)* External market experts	- A compilation of threats and selection of the focal threats - An overview of individual threats
Activity 2 (A2) Evaluate signals	(1) Find additional signals relating to the focal threats (e.g. by using the provided catalogue of questions as support) (2) Establish signal-threat relationships (3) Draw on publicly available information to assess each signal's observable strength	- Initial compilation of signals based on expert discussions, the literature, and historical cases - Catalogue of guiding questions to support finding different signal types	- Core team to identify signals - Expert panel consisting of the project team and external experts to evaluate the signals	- An updated compilation of signals evaluated regarding their publicly observable strengths
Activity 3 (A3) Assess materialisations	(1) Conduct market research to find materialisations of the focal threats (2) Assess the identified materialised threats regarding their possible impacts using capability signals	- Initial compilation of capability signals based on expert discussions, the literature, and historical cases	- Core team - External experts for market research	- The focal threats with their materialisation status and an assessment of the materialisations
Activity 4 (A4) Review results	(1) Combine all inputs from previous activities in the provided calculation scheme (2) (Optional) Weigh the context, catalyst, and capability dimensions against one another (3) Revise the threats performing high on one or several dimensions	- Disruptive threat assessment scheme - Disruptive threat summary on one page	- Core team	- The prioritised threats and individual summaries of the focal threats

In the first activity, *select threats*, organisations identify, select, and understand disruptive threats as the foundation for all following activities. In the second activity, organisations *evaluate signals* based on their relationships to threats and consider them based on their observable magnitude. In the third activity, *assess materialisations*, organisations identify materialised threats and assess their impact. Finally, in the fourth activity, organisations *review results* and compile the most relevant threats to be used in further strategic discussions.

In sum, Section II.1 presents models and methods that guide organisations in the unstructured *initiation* stage. Specifically, research article #1 provides knowledge about how to systematically identify *opportunities*, while research article #2 provides knowledge on how to identify and assess potential *disruptive threats*. The artefacts seek to address relevant problem classes with useful solutions. The methods provide incumbents with guidance and serve as decision support to reduce the uncertainty level in the initiation stage. Both presented methods complement each other, and incumbents need to master both identifying and managing *opportunities* and *disruptive threats* if they are to successfully compete in turbulent environments.

2 Developing Digital Innovation

Organisations of all sizes have a strong interest in using innovation as a tool if they are to foster long-term competitive advantage (Sedera et al. 2016). After the *initiation* stage, ideas are *developed* into innovative products, services, processes, or business models (Yoo et al. 2012). Innovation *development* builds on the recombination of available internal and external resources, e.g. from other organisations (Helfat and Raubitschek 2018; Zahra and George 2002). Thus, developing innovation requires that one acquires internal resources and utilises external resources (Fabrizio 2009). Thus, innovation development is enhanced by a heterogeneous set of available resources (Amit and Schoemaker 1993; Brunswicker and van de Vrande 2014; Teece 2007). Especially organisations with resource constraints face challenges concerning limited resources and capabilities that hinder innovation activities (Forsman 2011). Developing innovation distinguishes between *designing and developing* completely new innovation as well as *adopting* a pre-existing solution, such as an existing digital technology (Kohli and Melville 2019). Against this background, the thesis distinguishes the two perspectives on innovation development, and Section II.2 presents frameworks to guide organisations in *developing* and *adopting* digital innovation.

For instance, SMEs are pushed to the limits of their innovation capabilities by globalised markets' increased interconnectedness. For one, SMEs face resource constraints, for instance, limited size and scalability, qualified personnel, and financial resources (Bouncken et al. 2014; Diez 2002; Lee et al. 2010). For another, developing digital innovation bears risk concerning unknown success (Häckel et al. 2018). Both factors hinder SMEs from innovating and increases their need to complement their internal set of resources and capabilities (Becker and Dietz 2004). Cooperation is a way to complement resources and share the costs and risks of innovating with external partners (Galende 2006; Wolff and Nuseibah 2017). SMEs engaging in cooperation by sharing and combining resources can foster their innovativeness (Scaringella and Radziwon 2018). Thus, cooperation offers possibilities to overcome barriers that hinder SMEs' pursuits of innovation. To leverage cooperation best, both research and practice require guidance on what cooperation setup best suits the individual innovation purpose.

Research article #3 addresses this need and presents a taxonomy that provides a comprehensive overview over the characteristics of cooperation to foster SMEs' innovativeness. To structure cooperation setups for SMEs, Nickerson et al.'s (2013) taxonomy development method was followed. Taxonomies represent a theory for analysing (Gregor 2006) and serve as foundation for design research and sense-making (Gregor and Hevner 2013). The taxonomy was derived in four iterations, combining deductive and inductive approaches. The first two iterations incorporate deductively derived knowledge on elements of cooperation for innovation from the general and the information systems-specific literature. To this end, a literature review was conducted to derive dimensions and characteristics of cooperation for innovation. The taxonomy's robustness and maturity were validated by mapping 17 real-world objects. To validate the taxonomy's practical usefulness, it was evaluated with ten experts, who assessed it according to the five evaluation criteria: comprehensibility, understandability, ease-of-use, fidelity with real-world phenomena, and applicability. Further, the experts demonstrated the taxonomy's applicability by classifying their own cooperation projects.

The taxonomy comprises 25 characteristics according to 11 dimensions: purpose, value-added, composition, partner source, direction, network range, timeframe, organisation structure, governance, information management, and communication. The dimensions are presented in Table 3. The dimension *purpose* characterises the cooperation's objective, which can either be defined or undefined (Mahnke et al. 2008; Olsen et al. 2012). A defined purpose relates to a cooperation partner that has specified requirements prior to a cooperation. In contrast, in undefined cooperation setups, the purpose is developed during cooperative work. The

dimension *value-added* defines which resources the cooperation strives for (Bengtsson and Johansson 2014; Iturrioz et al. 2015; Li et al. 2016). Organisations that strive for supplementary resources aim to, for instance, pool quantities to purchase in more beneficial conditions, while organisations that strive for complementary resources have no or only a few of the resources available. The dimension *composition* refers to the various resources an SME strives for in cooperation (Gardet and Fraiha 2012; Wolff and Nuseibah 2017). These resources can either be material (e.g. production site, research equipment) or immaterial (e.g. knowledge, competencies, status) (Ambrosini and Bowman 2009; Barney 1991, 1995).

Table 3. Taxonomy on Cooperation for Innovation among SMEs

Dimension	Characteristics	Description	ME / NE[1]
Purpose	Defined | Undefined	Is a goal specified?	ME
Value-added	Supplementary | Complementary	Are the assessed resources supportive or additional?	NE
Composition	Material | Immaterial	Which resource type is sought?	NE
Partner source	Internal | External	What is the origin of cooperation?	NE
Direction	Horizontal | Vertical | Lateral	Links with partner/s?	NE
Network range	Bilateral | Multilateral	How many partners are involved?	ME
Timeframe	Short-term | Mid-term | Long-term	How long is the cooperation supposed to last?	ME
Organisation structure	Hierarchy | Heterarchy	How is cooperation organised?	ME
Governance	Formal | Informal | Agent	What is the applied regulatory framework?	ME
Information management	Manual | Automatic	How is information shared?	NE
Communication	Real | Virtual	Which interaction type is used?	NE

[1] ME = Mutually exclusive dimension (one characteristic observable at a time); NE = Non-exclusive dimension (potentially multiple characteristics observable at a time).

The dimension *partner source* defines whether the cooperation includes partners from outside the organisation, i.e. external, or from inside the organisation, i.e. internal (Brink 2017; McAdam et al. 2014; Swaminathan and Moorman 2009). The dimension *direction* relates to the sources where cooperation partners are acquired. Organisations should choose their partners strategically depending on the pursued goal and expectation. The direction can be vertical, horizontal, or lateral (Hadjimanolis 1999). The dimension *network* relates to the numbers of partners involved in the cooperation, i.e. bilateral or multilateral (Gnyawali and Park 2009; Iturrioz et al. 2015). The dimension *timeframe* refers to the length of a cooperation agreement

and distinguishes between short-term, mid-term, and long-term (Das 2006). The dimension *organisation structure* defines the internal decision-making structure and distinguishes between a heterarchical or a hierarchical approach (Golonka 2015; Thorgren et al. 2009). The dimension *governance* contributes to how different governance modes impact the roles, relationships, and competitive positions of partners in a cooperation (Gancarczyk and Gancarczyk 2016). Governance in cooperation setups has three characteristics: formal, informal, and agent. The dimension *information management* defines the way the information is exchanged between the participating organisations (Scholz-Reiter and Krause 2001). The exchange can be conducted either manually or automatically (Damsgaard and Lyytinen 1998). The dimension *communication* characterises a cooperation's network structure, which can be real, i.e. direct social interaction without physical distance, or virtual (Howard et al. 2003; Wildemann et al. 2005).

In sum, the presented taxonomy serves as a structuring tool for researchers in the investigated field and as a cooperation map for practitioners. It enables one to classify cooperation for innovation, illustrating a design space to purposefully set up cooperation projects, and provides guidance on future decision-making on the most suitable options. The evaluation of the taxonomy showed that cooperation enhances an organisation's resources for innovation purposes.

Our findings reveal that, to date, both research and practice lack actionable practices during the development process to guide organisations that have limited innovation capabilities. Similar to SMEs, public sector organisations face constraints, e.g. political influences, legal dependencies, contradictory incentives, vertical structures, that hinder them from acting autonomously and flexibly (Bertot et al. 2016). Also, public sector organisations face barriers in terms of risk avoidance, lack of resources, lack of suitable capabilities, and small innovation budget, which impede innovation (Neumann et al. 2019; Pedersen 2020). Moreover, failures in the public sector imply public sector organisations wasting public resources that could have been used elsewhere (Neumann et al. 2019). Although digital technologies provide governments with opportunities to increase the public value and serve citizens through personalised and context-aware forms (Lindgren et al. 2019; Matheus et al. 2020), to date, public sector organisations use digital technologies primarily to increase internal productivity and efficiency (Magnusson et al. 2020; Vries et al. 2016). Thus, research and practice require guidance on how to develop successful citizen-centric digital public services (CCDPS) (Benbunan-Fich et al. 2020).

Intensive research has been conducted on how to provide more efficient support for managing innovation (Balachandra and Friar 1997; Cooper and Kleinschmidt 1995; Kuester et al. 2013; Spivey et al. 1997). Against this backdrop, success factors (SFs) present organisations with areas where good results will ensure successful competitive performance (Rockart 1979). Research has elaborated SFs in the innovation field as a key management instrument (Storey et al. 2016) and has proposed SFs that guide organisations in managing the development of innovation to mitigate typical risks such as high investments or high failure rates (Evanschitzky et al. 2012; Kuester et al. 2013). SFs provide a relevant option to guide organisations in developing activities, increasing the likelihood of innovation success. However, to date, SFs guiding public sector organisations in developing CCDPS are missing.

Research article #4 addresses this need and proposes guidance for public sector organisations on developing CCPDS presenting a CCDPS development framework comprising 21 SFs according to six categories that outline actionable practices in digital innovation development for public sector organisations.

The development of the CCDPS development framework followed a multi-step approach. The research was embedded in the IT project domain, since CCDPS development was considered an IT project in broader terms. In preparation for the case study, a conceptual lens was derived from the literature, representing 39 SFs in six SF categories for IT project development in the public sector. Using the six deductively derived SF categories as a conceptual lens, a single exploratory case study in a medium-sized German region was conducted to explore SFs that are specific to CCDPS development. The project team investigated the development of a digital platform that facilitates citizens' participation in regional life. The digital platform was developed by the region's city council and county administrations and involved more than 30 stakeholders and more than 800 citizens. The case study lasted more than 16-months and included more than 500 hours of fieldwork, fifteen workshops with citizens and stakeholders, and nine semi-structured interviews. Based on data collected during the case study, the CCDPS development framework was compiled comprising 21 SFs in six categories. Complementing the descriptive insights, prescriptive insights into an empathic approach in terms of a blueprint for future CCDPS development is presented.

As outlined in Table 4, the CCDPS development framework comprises 21 SFs in the six categories: strategy and objectives, citizen and stakeholder integration, development activities, project management, people, as well as culture and collaboration.

The category *strategy and objectives* contains four SFs that relate to the clear statement of goals and objectives and authorities' commitment to the project. Because CCDPS development requires multiple stakeholders and implies high interoperability, the project parties must agree on the project's overall strategy with aligned objectives (Anthopoulos et al. 2016; Edwita et al. 2017). The category *citizen and stakeholder integration* contains four SFs relating to the active integration and involvement of citizens and stakeholders in order to understand their needs. With the CCDPS creating personalised experiences for a broad range of citizens, the service's fit with citizens' requirements is critical (Chen 2010; van Velsen et al. 2009). The category *development activities* contains four SFs relating to activities of requirement elicitation, analysis, and validation (van Velsen et al. 2009). During CCDPS development, the project team should deliberately conduct activities that help them understand citizens and their needs, and should structure the resulting analysis of the requirements for the service's development. The category *project management* contains three SFs relating to activities of a proactive project management so as to ensure stable progress of the CCDPS development. Proactive and anticipatory project management are required to adapt swiftly to changing internal and external conditions, such as changes in the project plan and long decision-making processes (Javani and Rwelamila 2016). The category *people* contains three SFs relating to personnel's capabilities and roles that facilitate the project's success. The management of an interdisciplinary and complex CCDPS development project requires various skills and clear responsibilities – the foundation for a trusting collaboration within the project team (Lappi et al. 2019). Finally, the category *culture and collaboration* contains three SFs relating to the overall working environment and the organisation's attitude. Culture is key to support the overall project's objective, i.e. innovative mindset and a best-for-citizens culture (Ziemba and Kolasa 2016).

In sum, the six SF categories abstract from the influence of individual SFs and enable a higher-order analysis of the CCDPS development process (Gregor 2006). Further, the individual SFs guide organisations with their detailed descriptions in successful CCDPS development. With the framework, the article reports on an empathic approach that focuses on citizens as prospective users of the CCDPS. The CCDPS development framework serves as foundation for the conceptualisation of the CCDPS process, contributes to theoretical knowledge on innovation development in the public sector, and stimulates future research into the vital topic of CCDPS development.

Table 4. CCDPS Development Framework

Dimension	Success Factor	Description
Strategy and Objectives	Innovation Ambition	The project's objective is to develop an innovative service beyond statutory duties
Strategy and Objectives	Aligned Objectives	All project parties are involved in the definition of the project's strategy and objective
Strategy and Objectives	Continuous Commitment and Resource Availability	Project resources (e.g. funding) are constant even with a change of government
Strategy and Objectives	Agreement on External Partners	Agreement of project team on external partners and tasks that are sourced to them
Citizen and Stakeholder Integration	Diverse Integration Levels	Stakeholders are integrated at various levels: Informative, Deciding, Operative collaboration
Citizen and Stakeholder Integration	Access to Citizens	Stakeholders provide access to relevant citizen groups
Citizen and Stakeholder Integration	Purpose-driven Integration	Integrate relevant citizen groups purposefully at specific points in the project
Citizen and Stakeholder Integration	Empathic Approach	Understand citizens' contexts and perspectives, pains, and wishes; interact with citizens in the natural environment
Development Activities	Citizen Modelling	Characterisation of citizens via appropriate methods (e.g. persona design, customer journey design)
Development Activities	Need-centred Requirements Elicitation	Querying citizen about their needs, not specific software functions
Development Activities	Feasibility Check	Select and prioritise requirements regarding feasibility; resolve contrary requirements and dependencies
Development Activities	Modular Requirements	Structure requirements in distinct modules for modular implementation
Project Management	Dedicated Project Management	Choose a responsible team member for project management activities who is the single point of contact
Project Management	Anticipatory Project Management	Proactive project management adapts to changing internal and external conditions (e.g. early risk mitigation, project plan changes)
Project Management	Continuous Evaluation	Conduct continuous project reviews with main stakeholders to evaluate the project's progress
Culture and Collaboration	Innovation Mindset	Establish an innovative mindset toward generating something new and unknown
Culture and Collaboration	Best-for-citizen Culture	Culture facilitates to create the best value for citizens
Culture and Collaboration	Transparency and Comprehensibility	Culture of sharing opinions, expectations, and objectives, and room for communication and discussions
People	Clear Roles and Responsibilities	Transparency in the team about roles and responsibilities
People	Skill Diversity	The operating team has skills (e.g. domain knowledge, method knowledge) that are relevant to CCDPS development
People	Outside-in Perspective	An external party provides an outside-in perspective to break through old barriers

While research articles #3 and #4 presented guidance for the *design and development* of digital innovation, research article #5 relates to the *adoption* of digital innovation.

In line with the closely interlinked role of the internal environment, organisations must prepare the organisational conditions and managerial practices to leverage the full potential of innovation adoption, i.e. the expectation of improved organisational performance (Hameed et al. 2012). Artificial intelligence (AI), for instance, poses various technical and organisational challenges that must be considered in adoption intentions (Baier et al. 2019; Bughin et al. 2017). Thus, successful AI adoption requires coordinated activities across the organisation by fostering AI readiness first. The literature has contributed insights into the adoption process (Hameed et al. 2012), different adoption factors (Frambach and Schillewaert 2002), related effects on organisational performance (Lokuge et al. 2018), or the application of adoption models to a specific innovation or technology (Oliveira and Martins 2011). To date, antecedents of successful innovation adoption at the organisational level have remained unspecific (Damanpour and Schneider 2006). Organisational readiness for change theory postulates that a higher organisational readiness increases the innovation adoption success and decreases the risk of failure (Snyder-Halpern 2001; Weiner 2009). Thus, organisations require readiness models that help to assess the organisational state of preparation to exploit the potential of an innovation (Molla and Licker 2005). Research highlights that adoption models must account for the specific technology in focus and its respective context (Molla and Licker 2005). Thus, readiness models require context-specific consideration and should to be tailored to the related domain, i.e. a specific technology (Molla and Licker 2005).

Owing to AI's inherent complexity, companies encounter pitfalls when adopting AI (Baier et al. 2019). An informed decision regarding an organisation's readiness increases the likelihood of successful AI adoption and is important to successfully leverage AI's business value. Thus, successful AI adoption requires coordinated activities across the organisation by first fostering AI readiness (Alsheibani et al. 2019; Baier et al. 2019; Gallivan 2001). Researchers and practitioners currently lack guidance on AI readiness factors, which are a prerequisite for successful AI adoption.

To address this need, research article #5 conceptualises AI readiness with its 18 factors, as a foundation and integral element throughout the entire AI adoption process and not as a mere precursor condition. AI readiness and AI adoption foster and necessitate each other, which leads to mutual reinforcement and high intertwinedness. Thus, AI readiness requires continual consideration owing to changing adoption purposes.

Conducting an in-depth interview study, data from 25 AI experts was collected to derive AI readiness factors and conceptualise the organisational AI readiness assessment. Following Corbin and Strauss (1990), 18 AI readiness factors in five categories were deduced from the interview data using open and axial coding. Further, these factors were operationalised with 58 illustrative indicators. The results were then triangulated with the literature on digital innovation readiness and adoption as well as insights from practitioner studies (Flick et al. 2004). Finally, the findings were evaluated via a card-sorting approach with a focus group of AI-related researchers. The 18 AI readiness factors are structured into five categories that specify action fields and necessary conditions for successful AI adoption (see Table 5). The five categories are presented in the following and comprise strategic alignment, resources, knowledge, culture, and data.

AI adoption should be aligned with the organisation's overall strategy. The category *strategic alignment* is defined as the tight link between organisational priorities and the processes that enable and support this adoption process (Hofmann et al. 2020; Shahrasbi and Paré 2014). Considering AI's inherent complexity, organisations need dedicated resources to steer the development of related assets, capabilities, and commitment (Bawack et al. 2019; Pumplun et al. 2019). Thus, the category *resources* considers AI-related financial, personnel, and infrastructural resources. Since AI raises questions regarding the applicability and explainability of underlying intelligent techniques, the category *knowledge* relates to the employees' adequate understanding and expectations of AI (Davenport 2018; Hofmann et al. 2020). The category *culture* considers creating an environment that facilitates openness toward innovation and change for AI adoption at the organisational and individual levels (Pumplun et al. 2019). Finally, the category *data* comprises assets and capabilities to ensure high data availability, quality, accessibility, and flow (Groopman 2018; Kruse et al. 2019).

In light of the results, conceptualising AI readiness is twofold (Figure 3). First, AI readiness includes 18 readiness factors in five categories that constitute the organisational chassis for developing AI readiness. Second, AI readiness encompasses the understanding of purposeful AI adoption beyond the specific factors. Organisations select AI readiness factors in light of the specific context of AI adoption and specify action fields and appropriate measures to attain the necessary AI readiness factors. Thus, AI readiness and AI adoption demand continual assessment as well as a context-specific and purpose-specific understanding.

Table 5. Organisational AI Readiness Factors

	Factor	AI characteristics	Organisational necessity
Strategic alignment	AI-business potentials	AI functions are highly versatile and broadly applicable.	AI-business potentials ensure that AI adoption is beneficial and suitable for the organisation.
	Customer AI readiness	AI use requires an understanding of the complexity and lack of transparency of learning algorithms.	Customer AI readiness enables internal or external customers to appropriately use AI-integrated offerings.
	Top management support	AI's inherent complexity poses change not only within but across organisational levels, which requires top management commitment.	Top management support signals AI's strategic relevance to the organisation and fosters AI initiatives.
	AI-process fit	AI-based systems are more precise if processes are structured and provide standardised data input.	AI-process fit through standardisation, reengineering, and implementation of new processes facilitates AI adoption.
	Data-driven decision-making	AI-based systems are fundamentally data-driven and require openness to incorporate such insights.	Data-driven decision-making fosters AI adoption because both utilise data and statistical methods to gain insights.
Resources	Financial budget	AI-based systems require high investments to tailor assets and capabilities to the unique context and data.	Strategic allocation of the financial budget for AI adoption supports the overcoming of initial obstacles and uncertainty.
	Personnel	AI adoption requires a broader spectrum of different roles and know-how for core business use.	AI specialists and business analysts with AI know-how facilitate AI adoption.
	IT infrastructure	Deploying AI poses high workloads and data storage requirements.	IT infrastructure enables AI-related activities and AI integration.
Knowledge	AI awareness	AI's underlying concepts, e.g., machine learning or the autonomy of data-based decision support, are hard to grasp.	AI awareness ensures that employees have adequate understanding and expectations toward AI.
	Upskilling	AI-based systems in core business require every employee to have a basic understanding of AI.	Upskilling enables employees to learn and develop AI or AI-related skills.
	AI ethics	AI-based systems are at risk for biased learning and unethical outcomes.	AI ethics comprise measures to prevent bias, safety violations, or discrimination in AI outcomes.
Culture	Innovativeness	Employees' fear of AI-induced job loss threatens proactive innovativeness.	Innovativeness increases employees' willingness to change the status quo through the application of AI.
	Collaborative work	AI deployment relies on integrating different perspectives, i.e. domain, data, and IT.	Collaborative work enables employees to work in teams and combine different skills.
	Change management	Employees' lack of understanding and fear of AI threaten the acceptance of AI-based systems.	Change management helps employees to understand and cope with AI-induced organisational change.
Data	Data availability	AI-based systems learn through different data types and large data amounts.	Data availability within the organisation fuels AI solutions.
	Data quality	AI-based systems achieve better results the higher the quality of the data they learn with.	Data quality ensures accurate AI outcomes.
	Data accessibility	AI personnel require access to relevant data sources for deployment.	Data accessibility facilitates AI experts to easily prototype and develop AI solutions.
	Data flow	Initial and continuous training of AI-based systems requires smooth and automated data flow.	Data flow between its source and its use ensures high data accessibility to AI experts.

The findings contribute to theory on readiness and adoption. Although AI adoption and AI readiness are distinct concepts, they are highly interdependent. Owing to AI's unique characteristics and various application areas, organisations must integrate AI readiness throughout the entire adoption process so as to purposefully guide investments, prioritisation, and resource allocation (Baier et al. 2019). Second, AI readiness and AI adoption foster and necessitate each other. Organisations adopt AI in cycles of continually piloting use cases that expand gradually across departments (Hofmann et al. 2020). Thus, AI readiness and AI adoption demand continual consideration instead of a one-time assessment, since requirements change with experience from adoption.

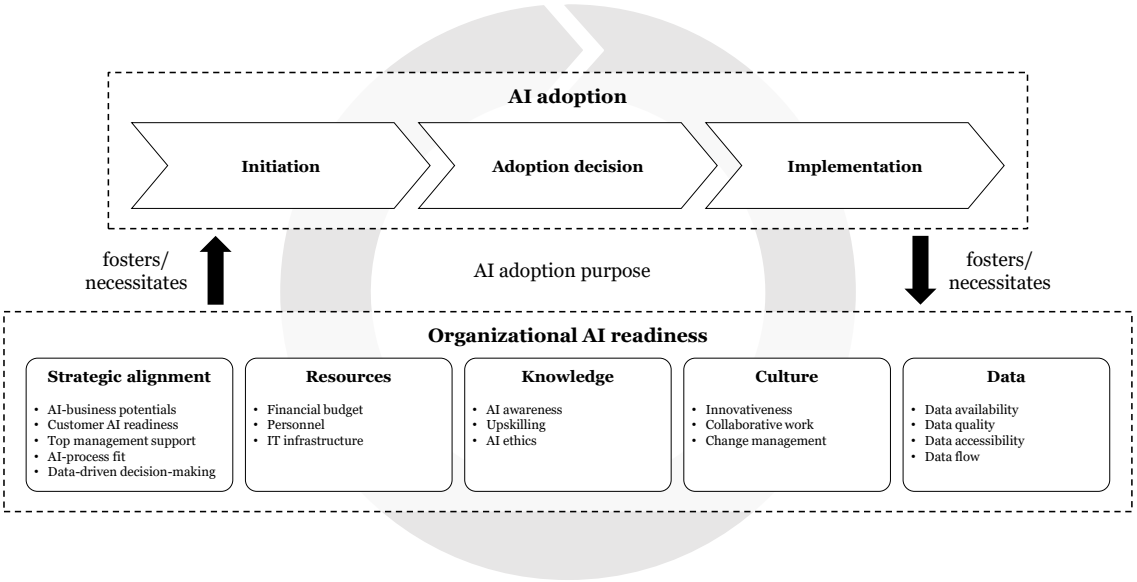

Figure 3. Integrating AI Readiness in the AI Adoption Process

In sum, research article #5 comprehensively conceptualises and operationalises organisational AI readiness. The results encompass organisational AI readiness factors, corresponding indicators for AI readiness assessments, and general implications for AI adoption. Hence, the findings serve as prerequisites that guide purposeful decisions in the entire AI adoption process for both research and practice. In sum, research article #5 extends the body of descriptive knowledge on innovation adoption and provides a foundation for prescriptive knowledge toward successful innovation adoption in the context of AI.

Regarding digital innovation *development*, research articles #3 and #4 address organisational environments that face challenges that hinder innovation, such as limited resources or risk-aversion. Thus, research article #3 structures cooperation setups that foster innovation development in the context of SMEs. In the context of public sector organisations, research article #4 presents success factors for CCDPS development and provides prescriptive insights with a blueprint that guides successful innovation development projects. Concerning innovation *adoption*, research article #5 presents a conceptualisation of the interrelationships between organisational readiness and innovation adoption for the specific context of AI and provides AI readiness factors that serve as prerequisite for successful AI adoption.

3 Outcomes of Digital Innovation

As outlined in Section I, this doctoral thesis investigates *processes* and *outcomes* of digital innovation. While Section II.1 and II.2 deal with the *process* perspective, i.e. the *initiation* and *development* of digital innovation, Section II.3 elaborates the *outcome* perspective and presents DSI as an emerging digital innovation *outcome* type that enables incumbents to address social topics. DSI is gaining importance as an emerging phenomenon in research and practice (Drechsler et al. 2020). Drawing on knowledge of both social innovation and digital innovation (Bonina et al. 2020; Dong and Götz 2020), DSI enables incumbents to address the increasing expectations of customers and employees regarding social topics, for instance fair working conditions or sustainable resource consumption (Bonina et al. 2020; Eichler and Schwarz 2019; Porter and Kramer 2006). Thus, DSI leverages the opportunities of digital technologies to address solutions for pressing social needs (Bonina et al. 2020; Dong and Götz 2020; Tim et al. 2021). DSI's distinct relevance is demonstrated by research that elaborates on reducing high infant mortality through digital technology intervention (Venkatesh et al. 2016), relieving hunger and promoting environmental sustainability using social media (Tim et al. 2017; Zheng and Yu 2016) as well as alleviating poverty through e-commerce (Tim et al. 2021).

Despite DSI's undeniable relevance, research into DSI is still in its infancy (Bonina et al. 2020; Rodrigo and Palacios 2021). To realise DSI's full transformative potential, researchers and practitioners require a conceptualisation of DSI regarding its characteristics and implementation possibilities (Bonina et al. 2020). Research article #6 conceptualises DSI to provide a way to address future social topics with the help of digital technologies (Nickerson et al. 2013). Thus, the DSI phenomenon is investigated on two different levels of detail, providing a taxonomy to clarify dimensions with corresponding characteristics and clusters to clarify typical combinations of them.

Taxonomies serve as theory for analysing (Gregor 2006) and are the basis for design research and sense-making (Gregor and Hevner 2013). Following Nickerson et al.'s (2013) taxonomy development method, the taxonomy was iteratively developed, combining both deductive and inductive approaches. The dimensions and characteristics reflect literature-backed knowledge on social innovation, digital innovation, and DSI. The taxonomy was evaluated by classifying 296 DSI initiatives from U.S.-based and Germany-based incumbents, which were compiled from the years 2018 and 2019. To enrich the specific insights into DSI initiatives' dimensions and characteristics, 12 clusters of DSI initiatives are inductively developed, describing DSI at

a more abstract and stable level by grouping characteristics that commonly co-occur in the real world (Field 2013; Hair et al. 2010). The clusters are derived with hierarchical clustering, i.e. a statistical technique that groups objects with similar characteristics (Rokach 2010).

The taxonomy (Figure 4) conceptualises DSI with six dimensions and 18 characteristics. The first dimension, *agent*, defines the cooperation setting in which a DSI initiative is being developed, i.e. isolated, with partners, or through partners (Caroli et al. 2018; Phillips et al. 2019; Sanzo et al. 2015). The dimension *objective* disinguishes between a DSI initiative's explorative or exploitative objective (Benner and Tushman 2003; Park et al. 2020). The dimension *payoff* describes that the payoff type being generated with the DSI initiative can be direct or indirect (Baptista et al. 2019; Dawson and Daniel 2010). The dimension *target* describes which social topic the DSI initiative is addressing, i.e. people, planet, peace, prosperity, or partnerships (Eichler and Schwarz 2019; United Nations 2015; Wu et al. 2018). The dimension *role of digital technology* describes whether the digital technology in question is a key component of the DSI initiative or has a supportive role (Benbasat and Zmud 2003; Suseno and Abbott 2021). Finally, the dimension *outcome* illustrates the DSI initiative's layer of digital technologies, i.e. device, network, service, or content (Henfridsson et al. 2018; Yoo et al. 2010).

DIMENSION	CHARACTERISTICS					GUIDING QUESTION
Agent	Isolated	With Partners	Through Partners			In what cooperation setting is the DSI initiative being developed?
Objective	Exploration	Exploitation				What is the objective of the DSI initiative?
Payoff	Direct	Indirect				What is the payoff of the DSI initiative?
Target	People	Planet	Peace	Prosperity	Partnerships	What social topic is being addressed by the DSI initiative?
Role of Digital Technology	Enabler	Supporter				What is the role of DT in the DSI initiative's outcome?
Outcome	Device	Network	Service	Content		What is the key DT layer of the DSI initiatve?

Figure 4. Taxonomy of Digital Social Innovation Initiatives

This taxonomy enables the systematic classification of DSI initiatives and therefore increases the current understanding of DSI, for instance, in terms of similarities and dissimilarities generally. Beyond this contribution, the taxonomy allowed to cluster DSI initiatives on the basis of shared characteristics (Nickerson et al. 2013), leading to the inductive inference of 12 clusters. Table 6 depicts the 12 clusters, highlights their significant taxonomy characteristics, and provides a brief description. Representing the clusters according to their discriminating dimensions' characteristics, the clusters' names follow the scheme *agent-objective-payoff-role of digital technology*. In case one of the dimensions was not ambiguous regarding its

characteristics' distribution, the dimension's name was replaced with an *X*. The clusters are shortly described in the following.

Six clusters describe DSI initiative types that are developed from an incumbent in isolation. The cluster *Isolated-Exploitation-Indirect-Supporter* comprises DSI initiatives that address the incumbent's internal perspective, for instance, enhance employees' experiences of work, i.e. exploitation as objective. In this cluster, DSI initiatives are supported by digital technologies. The DSI initiatives in the cluster *Isolated-Exploitation-Direct-Enabler* represent an exploitative innovation in existing business structures with the goal of generating direct revenues. DSI initiatives are enabled by digital technologies that are smart and operate autonomously, such as sensors or AI. The cluster *Isolated-Exploration-Indirect-Supporter* comprises DSI initiatives that address the people perspective and mainly educational matters beyond the incumbent's proprietary business model – these usually seek to create indirect revenues. Related DSI initiatives are supported by digital technologies. In contrast to the previous cluster, the cluster *Isolated-Exploration-Direct-Enabler* comprises DSI initiatives that are enabled through digital technologies and create direct financial returns by exploring new markets and customers. The cluster *Isolated-X-Indirect-Enabler* comprises DSI initiatives that address social topics without expecting direct financial returns through, for instance, reducing inequalities, targeting ecological sustainability, or enhancing people's health. Digital technologies have a key part in the DSI initiative. The cluster *Isolated-X-Direct-Supporter* comprises DSI initiatives that focus on the environmental sustainability of society and organisations seeking for direct payoff. Digital technologies have a supportive role in the DSI initiatives.

Four clusters describe types of DSI initiatives that are developed in partnership with, e.g. incumbents or start-ups. The cluster *With Partners-X-Indirect-Supporter* contains DSI initiatives that generate indirect revenues while mainly focusing on exploiting existing markets. Digital technologies have a supportive role in the DSI initiatives. In contrast to the previous cluster, DSI initiatives in the cluster *With Partners-X-Indirect-Enabler* focus on using digital technologies as an enabler to generate indirect returns with partners. The DSI initiatives in the cluster *With Partners-X-Direct-Supporter* focus on generating direct revenues focusing on exploiting existing markets and exploring new markets to similar extents. While the DSI initiatives are supported by digital technologies, the DSI initiatives in the cluster *With Partners-X-Direct-Enabler* are enabled by digital technologies and aim for direct financial returns.

Finally, two clusters characterise DSI initiatives that are created through partners by, e.g. conducting competitions for start-ups, sponsoring DSI initiatives of start-ups, or making

donations to NGOs. Within the cluster *Through Partners-X-Indirect-Supporter* DSI initiatives are supported by digital technologies and lead to an indirect positive payoff in terms of, e.g. a positive image. The cluster *Through Partners-X-X-Enabler* comprises DSI initiatives that are mostly enabled by digital technologies. The DSI initiatives in this cluster both create direct revenue through, for instance, strategically investing in other companies, as well as indirect revenue through, for instance, sponsoring DSI initiatives or conducting competitions.

While the DSI taxonomy provides the in-depth classification of DSI initiatives, the 12 clusters abstract from individual DSI initiatives and enable to investigate and understand DSI on a more abstract level. Thus, the taxonomy serves as operational support in detailed discussions, whereas the clusters represent a high-level classification and especially serve as a means for strategic decision-making. The clusters therefore represent common combinations of DSI initiatives' characteristics that serve as a tool for systematically developing future DSI initiatives according to the corporate strategy and for best addressing the various objectives.

In sum, research article #6 contributes to the growing body of knowledge on DSI. The findings expand emerging knowledge about DSI (Bonina et al. 2020; Rodrigo and Palacios 2021), since the taxonomy and clusters specify the DSI design space and provide an overview of different DSI initiative types. Conceptualising the DSI phenomenon provides a way to address future social topics with the help of digital technologies. The taxonomy and the clusters are an indispensable precursor for further descriptive and prescriptive research (McKelvey 1982; Posey et al. 2013). In sum, the taxonomy and clusters challenge and support future sense-making and design research into the DSI phenomenon. Overall, the findings are the foundation to better manage the integration of social topics into digital innovation efforts by leveraging digital technologies for social purposes.

Table 6. Clusters of Digital Social Innovation Initiatives

Cluster	n*	Agent	Objective	Payoff	Target	Role of DT	Outcome**	Brief description
Isolated-Exploitation-Indirect-Supporter	62 (21%)	isolated (100%)	exploitation (100%)	indirect (100%)	people (85%)	supporter (100%)	D / C (85% / 61%)	Related DSI initiatives are developed in **isolation**, **exploiting** existing markets and customers while generating **an indirect** payoff and using digital technology as a **supporter**.
Isolated-Exploitation-Direct-Enabler	43 (15%)	isolated (100%)	exploitation (100%)	direct (100%)	planet (63%)	enabler (100%)	D / N / S / C (49% / 65% / 56% / 51%)	Related DSI initiatives are developed in **isolation**, **exploiting** existing markets and customers while generating a **direct** payoff and using digital technology as **an enabler**.
Isolated-Exploration-Indirect-Supporter	15 (5%)	isolated (100%)	exploration (100%)	indirect (100%)	people (87%)	supporter (100%)	S / C (73% / 73%)	Related DSI initiatives are developed in **isolation**, **exploring** new markets and customers while generating an **indirect** payoff and using digital technology as a **supporter**.
Isolated-Exploration-Direct-Enabler	11 (4%)	isolated (100%)	exploration (100%)	direct (100%)	planet (82%)	enabler (100%)	D / N / S / C (45% / 100% / 73% / 91%)	Related DSI initiatives are developed in **isolation**, **exploring** new markets and customers while generating a **direct** payoff and using digital technology as an **enabler**.
Isolated-X-Indirect-Enabler	20 (7%)	isolated (100%)	exploitation (65%)	indirect (100%)	people / planet (50% / 50%)	enabler (100%)	S / C (80% / 60%)	Related DSI initiatives are developed in **isolation** while generating an **indirect** payoff and using digital technology as an **enabler**.
Isolated-X-Direct-Supporter	28 (9%)	isolated (100%)	exploitation (71%)	direct (100%)	planet (71%)	supporter (100%)	S / C (89% / 64%)	Related DSI initiatives are developed in **isolation** while generating a **direct** payoff and using digital technology as a **supporter**.
With Partners-X-Indirect-Supporter	30 (10%)	with partners (100%)	exploitation (70%)	indirect (100%)	people / partnerships (87% / 100%)	supporter (100%)	S / C (87% / 83%)	Related DSI initiatives are developed **with partners** while generating an **indirect** payoff and using digital technology as a **supporter**.
With Partners-X-Indirect-Enabler	11 (4%)	with partners (100%)	exploration / exploitation (55% / 45%)	indirect (100%)	people / partnerships (73% / 100%)	enabler (100%)	D / N / S / C (18% / 45% / 91% / 91%)	Related DSI initiatives are developed **with partners** while generating an **indirect** payoff and using digital technology as an **enabler**.
With Partners-X-Direct-Supporter	11 (4%)	with partners (100%)	exploration / exploitation (45% / 55%)	direct (100%)	people / partnerships (82% / 100%)	supporter (100%)	S / C (64% / 91%)	Related DSI initiatives are developed **with partners** while generating a **direct** payoff and using digital technology as a **supporter**.
With Partners-X-Direct-Enabler	33 (11%)	with partners (100%)	exploration (73%)	direct (100%)	partnerships (100%)	enabler (100%)	D / N / S / C (30% / 58% / 79% / 73%)	Related DSI initiatives are developed **with partners** while generating a **direct** payoff and using digital technology as an **enabler**.
Through-Partners-X-Indirect-Supporter	13 (4%)	through partners (100%)	exploitation (69%)	indirect (100%)	people (92%)	supporter (100%)	S / C (92% / 85%)	Related DSI initiatives are developed **through partners** while generating an **indirect** payoff and using digital technology as a **supporter**.
Through Partners-X-X-Enabler	19 (6%)	through partners (100%)	exploration / exploitation (53% / 47%)	direct / indirect (37% / 63%)	people (84%)	enabler (100%)	D / N / S / C (32% / 32% / 95% / 68%)	Related DSI initiatives are developed **through partners** while using digital technology as an **enabler**.

Notes: *n = number of DSI initiatives; grey fields = distribution unambiguous; **D = device, N = network, S = service, C = content.

III. Summary and Future Research[3]

1 Summary

To thrive in today's extremely dynamic business environments, digital innovation is indispensable for organisations of all sizes and industry branches. Although knowledge of digital innovation *processes* and *outcomes* has considerably matured, organisations face challenges in creating innovation. Innovation *processes* tend to be time-consuming and risky owing to unpredictable *outcomes*. In particular, both research and practice demand descriptive and prescriptive knowledge on supporting digital innovation *processes* and specifying digital innovation *outcomes*. In light of the presented research articles, this thesis contributes to *understanding and managing digital innovation initiation and development processes and outcomes*. First, this thesis investigates ways to identify *opportunities* and *disruptive threats* in the internal organisational environment and external competitive environment to *initiate* digital innovation. Second, this thesis highlights the potential of structured guidance to overcome challenges in digital innovation *development*. Third, this thesis sheds light on the new phenomenon DSI and provides a design space for future research on digital innovation *outcomes* for social purposes.

Concerning the first topic of guiding the *initiation* of digital innovation, Section II.1 presents two methods that build on various conceptual lenses that support incumbents in identifying and managing opportunities and disruptive threats, clarifying activities within the important initiation stage. Research article #1 examines how incumbents can identify *opportunities* and transform them into innovative ideas. To this end, the opportunity-led ideation method is developed that structures the creativity-intensive and lateral initiation stage with the activities initiation, immersion, investigation, and integration to reduce the uncertainty that organisations experience during this stage. The method builds on justificatory knowledge on opportunity identification and ideation (George et al. 2016; Johansson-Sköldberg et al. 2013; Zhou et al. 2009), and incorporates opportunity sources that allow to systematically leverage opportunities in the internal and external environment. The method contributes to descriptive knowledge on the nexus between opportunity identification and idea generation. Further, the findings add to prescriptive knowledge offering a structured process that guides the transformation into ideas.

[3] This section is partly comprised of content taken from the research articles in this thesis. To improve the readability of the text, I have omitted the standard labelling of these citations.

Research article #2 complements the opportunity-focused approach by providing descriptive and prescriptive knowledge on identifying and assessing *disruptive threats*. The findings comprise the DEF that conceptualises the evolution of disruptive threats and distinguishes four interrelated categories of signals and threats. The DEF extends the theoretical core of disruption by providing a well-founded conceptualisation of the evolution of disruptive threats, which connects disruptive threats and market signals depending on a threat's evolutional phase. Building on the DEF, the DAM reflects a step-by-step procedure that guides incumbents in assessing their susceptibility to being disrupted. While the DEF adds to descriptive knowledge on disruption evolution, the DAM adds to prescriptive knowledge and enables researchers and practitioners to create an overview over disruptive threats regarding their likelihood of successful materialisation and their possible impacts.

Regarding the need for guidance on *developing* digital innovation, Section II.2 provides detailed perspectives to support organisations in developing digital innovation in constrained environments. Further, it sheds light on the highly intertwined nature of the concepts digital innovation readiness and digital innovation adoption. Regarding guidance for the development process, research article #3 presents a taxonomy for SMEs to increase their innovation potential through cooperation. Building on the concepts of dynamic capabilities (Helfat and Raubitschek 2018) and absorptive capacity (Cohen and Levinthal 1990), cooperation enhances SMEs' scope of action, since they enable them to complement their own resources and overcome resource barriers. The taxonomy outlines a structure to analyse current cooperation setups and advises the design options to set up new cooperation according to context-aware and purpose-aware parameters. The taxonomy adds to the descriptive knowledge on cooperation for innovation and provides the foundation for higher-order theories (Gregor 2006).

Complementing the theory-focused approach, research article #4 provides actionable practices in terms of distinct SFs for the development of CCDPS using an exploratory case study. In focus is the case of a medium-sized German region that aims to develop a digital platform that facilitates citizens' participation in regional life beyond what statutes demand. Building on SF categories of IT projects as a theoretical lens, 21 SFs for the development of CCDPS are derived. The six SF categories abstract from the influence of individual SFs and provides research with a higher-order analysis of the CCDPS development process. Further, the case adds to prescriptive knowledge by providing a blueprint that guides public sector organisations in successful CCDPS development.

Concerning organisational readiness for digital innovation, research article #5 highlights the importance of digital readiness as a foundation for successful digital innovation adoption. It examines digital readiness in the specific context of AI serving as a general-purpose technology. Based on empirically derived insights, the article presents a conceptualisation of organisational AI readiness and introduces a comprehensive set of 18 AI readiness factors structured into five categories. Further, AI readiness is investigated as an integral element throughout the entire AI adoption process. By conceptualising and operationalising organisational AI readiness, this contribution reflects empirical groundwork for theorising on digital innovation adoption and digital innovation readiness in general.

Addressing the need for understanding digital innovation *outcomes* for social purposes, Section II.3 presents a conceptualisation of the emerging phenomenon of DSI. To do so, research article #6 proposes a taxonomy of DSI initiatives consisting of six dimensions and 18 characteristics. Describing typical DSI initiative types, it presents 12 clusters of typical combinations of DSI initiatives' characteristics, representing DSI at a more general level. The clusters distinguish between 12 typical DSI types that allow one to classify DSI as a prerequisite of DSI development. The taxonomy and clusters add to the descriptive knowledge on DSI, providing new perspectives on dual value creation types. The taxonomy and the clusters contribute to theory-building and are a key prerequisite for further descriptive and prescriptive research.

2 Limitations and Future Research

Like any research endeavour, this doctoral thesis is beset with limitations that stimulate further research. This section provides an aggregated overview over the thesis' limitations, while detailed limitations of the individual research articles are addressed in the individual research articles (see Appendix V.3 to V.8). This section also provides ideas for further research into digital innovation *processes* and *outcomes*.

First, for *initiating* digital innovation, the thesis takes a view on the interplay between the initiation stage and the influence of the internal organisational environment and external competitive environment. Research articles #1 and #2 present methods that each provide actionable guidance in the initiation stage. According to the ADR and DSR paradigms, both methods incorporate existing knowledge to develop a useful artefact for research and practice. To evaluate their usefulness, the method development processes incorporated demonstration and evaluation cycles with practitioners during the research process. However, both methods were evaluated regarding their applicability and usefulness in one organisation. Future research should continue to validate the methods' usefulness and should gather evidence from other organisations to complement the promising feedback from the initial applications. For instance, further case studies should be conducted to evaluate the opportunity-led ideation method and the DAM in other contexts and markets and for other digital innovation types.

Second, relating to *developing* digital innovation, this thesis presents descriptive and prescriptive insights into developing innovation in challenging organisational contexts. The insights are the foundation for further theory development endeavours. To validate the results, quantitative research approaches seem promising. Regarding research article #3, cluster analysis can be used to empirically evaluate typical combinations of cooperations' characteristics. This provides comprehensive insights into cooperation beyond specific real-world objects on a more general level. Research article #4 provides 21 SFs that guide CCDPS development, and research article #5 presents 18 AI readiness factors. In light of the exploratory nature of both studies, both articles do not elucidate the factors' prioritisation and weighting with respect to organisational contingencies. Future quantitative research may validate the individual factors, elaborate on interactions among factors, and investigate their influences concerning the overarching development purpose.

Third, for understanding digital innovation *outcomes* for social purposes, the thesis conceptualises and contributes to descriptive knowledge on DSI. As DSI is still a new

phenomenon in both research and practice, this thesis does not provide explanations or hypotheses on the importance and relevance of clusters of DSI initiatives. On this foundation, further research should investigate prescriptive knowledge on the DSI outcomes and should provide a holistic view on the development of DSI. Since DSI will likely change with evolving digital technologies, researchers should conduct longitudinal studies to re-evaluate the descriptive insights and elaborate on prescriptive insights. Further, confirmatory research should extend the descriptive and prescriptive insights of this thesis.

In sum, this thesis contributes to the existing body of knowledge of digital innovation, particularly to its highly interrelated components. Although digital technologies will advance at high speed in the future, the fundamental concept of digital innovation will remain the same. Organisations in all contexts will have to advance with the ever-changing environment if they are to remain competitive in market, and – more importantly – if they want to deliver value to their customers. I trust that the ideas and results of this thesis shed light on digital innovation, particularly on the *processes* and *outcomes* of digital innovation, contributing to the vital and tough challenge of continually transforming through innovation.

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V. Appendix

1 Index of Research Articles

Research Article #1: Opportunity-led Innovation: How to convert Corporate Opportunities into Innovative Ideas

Wyrtki K, Röglinger M, Rosemann M (2021) Opportunity-led Innovation: How to convert Corporate Opportunities into Innovative Ideas. In: *Creativity and Innovation Management,* pp. 1-19.

Research Article #2: Ex ante Assessment of Disruptive Threats: Identifying Relevant Threats before one is Disrupted

Blume K, Oberländer AM, Röglinger M, Rosemann M, Wyrtki K (2020) Ex ante Assessment of Disruptive Threats: Identifying Relevant Threats before one is Disrupted. In: *Technological Forecasting and Social Change*. 158.

Research Article #3: Cooperation for Innovativeness in SMEs: A Taxonomy for Cooperation Design

Buck C, Watkowski L, Wyrtki K (2021) Cooperation for Innovativeness in SMEs: A Taxonomy for Cooperation Design. In: *International Journal of Entrepreneurial Venturing*.

Research Article #4: Exploring Success Factors for Developing Citizen-Centric Digital Public Services – Insights from a Case Study

Wyrtki K, Krombacher A, Buck C, Röglinger M (2021) Exploring Success Factors for Developing Citizen-Centric Digital Public Services – Insights from a Case Study. *Working paper*.

Research Article #5: Ready or Not, AI Comes – An Interview Study of Organizational AI Readiness Factors

Jöhnk J, Weißert M, Wyrtki K (2021) Ready or Not, AI Comes – An Interview Study of Organizational AI Readiness Factors. In: *Business & Information Systems Engineering*. 63, pp. 5-20.

Research Article #6: Doing Good by Going Digital: Conceptualising Digital Social Innovation

Buck C, Krombacher A, Röglinger M, Wyrtki K (2021) Doing Good by Going Digital: Conceptualising Digital Social Innovation. *Working paper*. Earlier version published in *Proceedings of the 28th Conference on European Conference on Information Systems (ECIS), An Online AIS Conference, 2020.*

2 Individual Contribution to the Included Research Articles

In this cumulative thesis, six research articles build the main body of this work. All research articles were developed in teams with multiple co-authors. Thus, this section details the respective research settings and highlights my individual contribution to each research article.

Research article #1 (Wyrtki et al. 2021) was developed together with two co-authors, with all authors jointly developing the opportunity-led ideation method. Together with one co-author, I took a key role in conducting the research project and collecting research data in Brisbane, Australia. Moreover, I was primarily responsible for the underlying literature work, the data collection and analysis, and the application and evaluation of the method. I also took a key role in revising the article for re-submission. In sum, I was involved in each part of the project.

Research article #2 (Blume et al. 2020) was developed together with four co-authors. All co-authors jointly developed the analytical lens and the method building on that foundation. I was particularly involved in the design of the research method, the data coding and interpretation, the presentation of the research results as well as textual elaboration. I also took a key role in revising the article for re-submission. Throughout, I had a main role in each part of the project.

Research article #3 (Buck et al. 2021) was developed with two co-authors. I contributed to this article by co-initiating and co-developing the entire research project. Moreover, I participated in research discussions and provided feedback on the paper's content and structure. In particular, I engaged in the further development of the research idea, the synthesis and presentation of the research results as well as textual elaboration. I also took a key role in revising the article for re-submission. Throughout, I had a key role in all parts of the research project.

Research article #4 (Wyrtki et al. 2021) was developed in a team of four co-authors. Being the leading author, I had the main role in initiating the research project and contributing by co-developing and driving the entire research project. I was primarily responsible for the underlying literature work, for compiling the framework of candidate success factors, and for conducting the evaluation. Although the research article represents to a large extent my work, the three co-authors were involved in all parts of the project and helped to advance our contribution.

Research article #5 (Jöhnk et al. 2021) was developed together with two co-authors. All authors jointly compiled the AI readiness factors and derived respective categories. Moreover, I was primarily responsible for the underlying literature work, contributed to the synthesis and presentation of the research results as well as to textual elaboration. I also took a key role in revising the article for re-submission. Thus, my co-authorship is reflected in the entire research project.

Research article #6 (Buck et al. 2021) was developed with three co-authors. A former version has been presented at the 28th European Conference on Information Systems, 2020 after which we incorporated the reviewers' feedback to significantly advance our work. I took a key role in the taxonomy development, the evaluation of the taxonomy, and the development of corresponding clusters. Additionally, I engaged in the further development of the research idea and textual elaboration of the entire manuscript. Thus, my co-authorship is reflected in the entire research project.

3 Research Article #1:
Opportunity-led Ideation:
How to Convert Corporate Opportunities into Innovative Ideas

Authors: Wyrtki K, Röglinger M, Rosemann M

Published in: Creativity and Innovation Management, 2021

Abstract: Opportunities, i.e. action possibilities for innovative business models, goods, services, and processes, particularly affect idea generation, which is vital for innovation success. Capitalizing on opportunities requires complementing predominating problem-centred innovation approaches. Despite mature knowledge on idea generation, there is still a limited understanding on how to leverage opportunities. Hence, there is a limited set of methods available that provide formalized guidance. To address this gap, we co-developed an opportunity-led ideation method in an action design research project with one of Australia's leading financial service providers. Thanks to this immersive collaboration, our method not only reflects the intent of researchers and existing knowledge, but also the influence and needs of practitioners. Building on established opportunity sources from the literature, this method structures the idea generation stage of the innovation process into the activities initiation, immersion, investigation, integration. The method provides guidance on how to transform opportunities into ideas and presents activities, techniques, tools, and roles that are important within the idea generation stage. Our research theoretically extends the understanding of opportunity identification within the front end of innovation. Moreover, it provides insights on balancing formalization and creativity within idea generation. Organizations can use the method as a blueprint to systematically and proactive sense, assess, and translate opportunities into ideas.

Keywords: Innovation, Ideation, Opportunity Discovery, Action Design Research, Situational Method Engineering

4 Research Article #2:
Ex ante Assessment of Disruptive Threats:
Identifying Relevant Threats before one is Disrupted

Authors: Blume M, Oberländer AM, Röglinger M, Wyrtki K

Published in: Technological Forecasting and Social Change, 2020

Abstract: The shortening of product life-cycles accompanied by the rapid development of new products and dissolving industry boundaries are indicative of a multitude of potentially disruptive threats. The survival of incumbents depends on their capability to effectively anticipate and manage such threats. Thus, the early anticipation of disruptive threats to react or prepare for their impacts is a crucial topic in practice and academia. Although the current body of knowledge provides numerous approaches to disruption anticipation, a comprehensive conceptualisation of the evolution of disruptive threats is missing. Moreover, incumbents lack guidance on how to effectively anticipate disruptive threats. To address this gap, we propose the Disruption Evolution Framework (DEF), which conceptualises the course of disruptive threats along three phases (i.e. threat possible, apparent, and materialised) as well as distinguishes four interrelated categories of signals (i.e. context, catalyst, capability, and company signals) and threats (i.e. customer, competitor, product, and policy threats). Building on the DEF, we also propose the Disruptability Assessment Method (DAM), which enables incumbents to systematically assess disruptive threats via a step-by-step procedure. We evaluated the DAM in the Corporate Development and the Global Digital Partnerships departments of an insurance company. Overall, our work contributes to the descriptive and prescriptive knowledge on disruption anticipation.

Keywords: Disruptive Threats, Disruptive Signals, Anticipating Disruption, Disruptability Assessment, Disruption Evolution, Situational Method Engineering

5 Research Article #3: Cooperation for Innovativeness in SMEs: A Taxonomy for Cooperation Design

Authors: Buck C, Watkowski L, Wyrtki K

Published in: International Journal of Entrepreneurial Venturing, 2021

Abstract: Various resource constraints of small and medium-sized enterprises (SMEs) highlight the strategy of cooperation for innovation as it enhances organizations' options and breadth of knowledge sources. Nevertheless, research lacks guidance on why, with whom, and how to cooperate and has so far not provided a comprehensive overview of the characteristics of cooperation to foster SMEs' innovativeness. We build a taxonomy based on deductive and inductive iterations. The taxonomy incorporates insights from literature including information science, innovation management, and organizational science. Further it represents insights from practitioners on cooperation for innovation. Our taxonomy delineates the design options for practitioners and advises that one select organization-specific parameters. With this taxonomy, we conceptually structure existing research and empower practitioners to analyze their current cooperation projects, reconsider them, and gain knowledge to design new ways of cooperation that best suit their aims.

Keywords: Small and medium-sized enterprises, SMEs, Taxonomy, Innovation, Cooperation

6 Research Article #4: Exploring Success Factors for Developing Citizen-Centric Digital Public Services – Insights from a Case Study

Authors: Wyrtki K, Buck C, Krombacher A, Röglinger M

Working Paper

Extended Abstract:

Digital technologies open opportunities to use e-government to increase service quality beyond the performance of statutory duties. However, most digital public services are not designed to be citizen-centred, that is, personalised to the heterogeneous range of citizens' needs. As a result, public sector organisations do not tap the full potential public value in terms of service quality. Public sector organisations lack guidance in how to develop successful digital public services (CCDPS) and, therefore, often fail to do so. Using success factors (SFs) to provide public sector organisations with insights on how to develop successful CCDPS may increase service quality and adoption by meeting citizens' needs (Holgersson et al., 2018), which increases public value (Bertot et al., 2016; Neumann et al., 2019). Hence, our research seeks to answer the research question, *What are the SFs for the development of CCDPS?*

This article addresses this need and provides SFs for CCDPS development using an exploratory case study. Although academics and practitioners have agreed that CCDPS development is key to creating public value (Bertot et al., 2016; Lindgren et al., 2019), theoretical and conceptual guidance on CCDPS development is scarce. Against this background, we first derived a conceptual foundation on SFs for IT projects in the public sector from the literature. Building on this conceptual foundation, we conducted a 16-month case study investigating a German region's CCDPS development project. The project was conducted jointly by the region's city council and the county administrations. Following an inclusive approach, the project involved more than 30 (institutional) stakeholders and the participation of more than 800 citizens.

In analysing the revelatory case, our findings make three major contributions to research and practice: First, we deduced six SF categories and related SFs from the literature for public sector IT projects. The six SF categories represent a high-level analysis facilitating to understand the key areas for public sector IT projects. Considering the specific

characteristics of CCDPS, e.g. being developed with a new value objective in the risk-averse context of public sector, CCDPS require a conceptualisation to the specific challenges posed by CCDPS development for public sector organisations. Second, using these SF categories as a conceptual lens, we investigated a 16-month CCDPS development case from which we inductively inferred a CCDPS development framework that comprises 21 SFs in the six SF categories. Third, we provide first-hand, in-depth insights into an empathic approach to CCDPS development as a blueprint for future CCDPS development.

The CCDPS development framework provides a basis for understanding the activities in the requirements engineering process of CCDPS development and the measures required for successful CCDPS development. The CCDPS development framework is a guide for achieving the service ideal of public value. Given the public sector's specific challenges, our framework can help to guide practitioners systematically in the process of CCDPS development. Our work sets the foundation for revolutionising commonly known digital public services toward a more citizen-centric design that can achieve the service ideal of public value in the future.

Keywords: Citizen-Centric Digital Public Service, Digital Service, E-Government, Requirements Engineering, Service Innovation, Success Factors, IT Project

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7 Research Article #5: Ready or Not, AI Comes – An Interview Study of Organizational AI Readiness Factors

Authors: Jöhnk J, Weißert M, Wyrtki K

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Abstract: Artificial intelligence (AI) offers organizations much potential. Considering the manifold application areas, AI's inherent complexity, and new organizational necessities, companies encounter pitfalls when adopting AI. An informed decision regarding an organization's readiness increases the probability of successful AI adoption and is important to successfully leverage AI's business value. Thus, companies need to assess whether their assets, capabilities, and commitment are ready for the individual AI adoption purpose. Research on AI readiness and AI adoption is still in its infancy. Consequently, researchers and practitioners lack guidance on the adoption of AI. The paper presents five categories of AI readiness factors and their illustrative actionable indicators. The AI readiness factors are deduced from an in-depth interview study with 25 AI experts and triangulated with both scientific and practitioner literature. Thus, the paper provides a sound set of organizational AI readiness factors, derives corresponding indicators for AI readiness assessments, and discusses the general implications for AI adoption. This is a first step toward conceptualizing relevant organizational AI readiness factors and guiding purposeful decisions in the entire AI adoption process for both research and practice.

Keywords: Artificial Intelligence, AI Adoption, AI Readiness, Organizational Readiness Assessment, Interview Study

8 Research Article #6: Doing Good by Going Digital: Conceptualising Digital Social Innovation

Authors: Buck C, Krombacher A, Röglinger M, Wyrtki K

Working Paper

Extended Abstract:

Digital social innovation (DSI) is an emerging phenomenon that allows incumbents to identify new business opportunities and respond to challenges in turbulent environments. It leverages digital technologies (DTs) to address the increasing expectations of customers and employees regarding social topics, for instance, sustainable resource consumption or fair working conditions (Bonina et al., 2020). DSI represents an emerging type of innovation that uses the opportunities opened by DTs to address pressing social needs (Bonina et al., 2020; Dong & Götz, 2020; Tim et al., 2021). Thus, DSI enables incumbents to reach new markets and new customers as well as new sources of profit by combining social and economic value creation. For instance, DSI can increase an incumbent's reputation and brand value toward its customers. Further, through DSI, incumbents can foster employee satisfaction through adopting socially responsible behaviour. DSI, therefore, represents a source of competitive advantage and is becoming increasingly important in practice.

Despite DSI's increasing importance in practice, research into DSI is still in its infancy (Bonina et al., 2020). There is yet no shared understanding of DSI, which leads incumbents to miss value potentials, making them less attractive to customers and employees, and leading them to lose competitive advantage. Thus, DSI needs conceptualisation regarding its characteristics and implementation possibilities to provide practitioners and academics with a thorough understanding to leverage its opportunities (Bonina et al., 2020). To address this need, we seek to answer the following research question: *What are characteristics of DSI initiatives in the context of incumbents?*

To answer our research question, we develop a taxonomy for DSI initiatives based on Nickerson et al.'s (2013) taxonomy development method. We combined deductive and inductive approaches in four iterations to develop our taxonomy. Our taxonomy structures DSI initiatives according to six dimensions and 18 characteristics and provides

a foundational understanding of their diverse manifestations. With the taxonomy, we structure the DSI phenomenon and provide a means for addressing future social topics with the help of DTs (Nickerson et al., 2013). Further, we inductively developed 12 clusters of DSI initiatives on this foundation, describing DSI at a more abstract and stable level by grouping characteristics that commonly co-occur in the real world. To develop the taxonomy and the clusters, we used 296 DSI initiatives from U.S.- and Germany-based incumbents.

Our work comprehensively conceptualises DSI, resulting in implications for research and practice, laying a foundation for researchers to shape and proactively develop DSI in the future. Further, we provide support for incumbents in structuring the DSI process and assessing DSI types according to their purposes. Our study contributes to descriptive knowledge and delivers insights relevant to both DSI practice and theory. The taxonomy and clusters provide the IS discipline with a first building block to guide incumbents toward successful DSI, laying a foundation for further sense-making and design-led research.

Keywords: Digital Innovation, Social Innovation, Digital Social Innovation, DSI, Taxonomy, Cluster Analysis

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