Designing Industrial Companies' Procedural Backbone to Master Digital Service Innovation

– A Dynamic Capabilities Perspective –

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The President:

Prof. Dr. Bernhard Ehrenzeller

Vorwort des Autors

Diese Dissertation ist parallel zu meiner Tätigkeit als wissenschaftlicher Mitarbeiter am Institut für Technologiemanagement der Universität St.Gallen (ITEM-HSG) entstanden. In den drei Jahren meiner Zugehörigkeit habe ich durch zahlreiche Industrie- und Forschungsprojekte Einblick in viele führende Industrieunternehmen erhalten, wofür ich sehr dankbar bin.

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List of abbreviations

BM	Business model
DCV	Dynamic capabilities view
GTM	Go-to-market
GUI	Graphical user interface
IT	Information technology
ITEM-HSG	Institute of Technology Management at the University of St.Gallen
KPI	Key performance indicator
MVP	Minimum viable product
MVS	Minimum viable service
NPD	New product development
NPV	Net present value
NSD	New service development
PRQ	Primary research question
R&D	Research and development
RBV	Resource-based view
ROI	Return on investment
SRQ	Secondary research question
SSC	Services supporting the customers' actions
SSP	Services supporting the supplier's products
VRIN	Valuable, rare, imperfectly inimitable, and non-substitutable
VRIO	Valuable, rare, imperfectly inimitable, and organization

Abstract

At present, industrial companies face increasingly complex challenges. Shrinking product margins and changing customer needs form the core of these demands. A reliable service business offers an attractive option to industrial companies wanting to evade from the current conditions. In addition, ongoing digitalization is taking services to a new level. The resulting *digital services* combine the latest technological trends with their ability to meet individual customer needs. Therefore, industrial companies turn to digital services to protect and increase their competitive advantage. However, existing digital services miss the predefined targets of most industrial companies. This shortcoming is caused by firms developing digital services primarily based on product-driven innovation approaches. Also, academia remains silent on suitable digital service innovation practices. In response, this dissertation develops a new digital service innovation approach for industrial companies.

The *dynamic capabilities view* provides the conceptual framework to develop these new organizational capabilities. Organizational processes, comprising routines, artifacts, and actors, implement the required innovation (i.e., dynamic) capabilities in practice. Moreover, systematic literature analyses provide the foundation for the presented research. In addition, two empirical studies enhance the theoretical insights on digital service innovation. First, an in-depth interview study explores necessary routines in practice at 24 organizations. Second, focus group research involving eight industrial companies expands the previous understanding of digital service innovation to an implementable approach.

Finally, this dissertation presents a management framework of digital service innovation governance and process models built on routines, artifacts, and actors. The governance model transforms industrial companies' organizations. Thereby, organizational alignment and sufficient performance control enable digital service innovations. The process model directs the firms through these innovations by applying three innovation modes: identification, conceptualization, and implementation.

In sum, this dissertation makes a valuable contribution to digital service innovation research and practice. The findings close the gap in the literature between defined routines and high-level dynamic capabilities. In practice, the management framework established in this study constitutes a powerful tool that helps industrial companies build robust digital service businesses. Its application at industrial companies drives customer-centric, digital service innovations that overcome the increasing challenges in the markets.

Zusammenfassung

Sinkende Produktmargen und sich kontinuierlich ändernde Kundenbedürfnisse treiben zunehmend die Marktanforderungen für Industrieunternehmen in die Höhe. Neue Angebote, wie digitale Services, sind hingegen ein attraktives Mittel für Industrieunternehmen, um sich besser im Markt zu positionieren. Dabei ermöglicht die fortschreitende Digitalisierung immer individueller, Kundenbedürfnisse zu erfüllen und somit den Wettbewerbsvorteil gegenüber der Konkurrenz zu stärken. Viele Industrieunternehmen schaffen es jedoch nicht, die angestrebten Ziele mit ihren bereits existierenden digitalen Services zu erreichen. Ein wesentlicher Grund dafür ist, dass häufig produktgetriebene Innovationsansätze als digitale Serviceinnovation eingesetzt werden. Allerdings funktioniert diese Übertragung der Innovationsmethoden nicht. Gleichzeitig besteht auch in der Wissenschaft bisher noch kein passendes Modell zur Innovation von digitalen Services. Daher wird in dieser Dissertation ein neuer Ansatz für Industrieunternehmen aufgezeigt, der es diesen Unternehmen ermöglicht erfolgreich neue digitale Services zu entwickeln.

Diese Arbeit basiert auf der Theorie der dynamischen Fähigkeiten, die den Rahmen für den neuen Innovationsansatz setzt. Der Theorie nach werden Innovationen durch organisationale Prozesse, bestehend aus Routinen, Artefakten und Akteuren in den Unternehmen umgesetzt. Dieses konzeptionelle Verständnis von Innovation wird durch systematische Literaturanalysen und basierend auf empirischer Forschung mit Hilfe von Interviews und einer Fokusgruppe im Verlauf der Arbeit erweitert.

Als Kernergebnis präsentiert diese Dissertation ein System für die Steuerung und Umsetzung digitaler Serviceinnovationen mittels Routinen, Artefakten und Akteuren. Dabei übernimmt ein Governance-Modell die übergeordnete Steuerung zur notwendigen organisatorischen Transformation der Industrieunternehmen und die Lenkung der Entwicklung neuer digitaler Services. Die Umsetzung wird durch ein Prozessmodell gestaltet, das Industrieunternehmen durch die drei Innovationsmoden der Identifikation, Konzeptualisierung und Implementierung führt.

Insgesamt leistet diese Dissertation somit einen wertvollen Beitrag zur Forschung und Praxis im Bereich der digitalen Serviceinnovation. Einerseits schliessen die Ergebnisse die Lücke in der Literatur zwischen definierten Routinen und übergeordneten dynamischen Fähigkeiten. Für die Praxis stellt das in dieser Studie entwickelte Innovationssystem ein vielversprechendes Instrument dar. Mit dessen Hilfe können Industrieunternehmen kundenorientierte, digitale Serviceinnovationen vorantreiben, um die wachsenden Herausforderungen in den Märkten zu bewältigen.

1 Introduction

Almost a century ago, Schumpeter (1934) realized the importance of a firm's innovation activities to gain and retain a competitive advantage in the market. Following Schumpeter, industrial companies have, for decades, transformed their traditional offerings to uphold or develop their market position (Cusumano, Kahl, & Suarez, 2015). Today, this transformation mainly focuses on service-oriented offerings that are constantly advanced by digital technologies (Oliva & Kallenberg, 2003; Savastano, Amendola, Bellini, & D'Ascenzo, 2019). Industrial companies expect these *digital services* to improve their position in the global markets (Kindström & Kowalkowski, 2014).

This study supports industrial companies' digital service innovation. From the companies' point of view, external and internal drivers motivate this research. Externally, the ongoing digitalization and aggravating market conditions continuously challenge the firms' competitive advantage. Internally, the current organizational capabilities of industrial companies are no longer sufficient to drive digital service innovation. Also, academia scarcely assists with a viable digital service innovation approach. Against this background, the subsequent sections elaborate on this study's motivation, theoretical foundation, contribution, and direction.

1.1 Managerial relevance

Industrial companies based in western economies face increasing competition in their markets. Asian manufacturers increase their appeal to customers by offering lower prices and catching up with the application of advanced technologies (Burgelman, 1996). Moreover, large technology firms such as Amazon, Apple, or Google are taking the competition in industrial markets to the next level (Sebastian et al., 2020; Teece & Linden, 2017). Their digital technologies provide customers with more convenient solutions, thereby sparking new customer demands. As a result, market conditions have become more complex, volatile, and uncertain (Loonam, Eaves, Kumar, & Parry, 2018; Matt, Hess, & Benlian, 2015). A possible exit from these conditions is the reinforcement of industrial companies' current competitive advantage, enabling them to remain attractive to customers (Berman, 2012; Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014; Gray, El Sawy, Asper, & Thordarson, 2013; Hess, Benlian, Matt, & Wiesböck, 2016; Sebastian et al., 2020; Svahn, Mathiassen, & Lindgren, 2017).

The release of new services is a promising avenue to gain competitive advantages. Witell, Gustafsson, & Johnson (2014) highlight services' capacity to strengthen competitive advantage by leveraging the installed base as a platform to sell services. Contrarily, most service offerings miss their performance targets (Bakås, Powell, Resta, & Gaiardelli, 2012).

Underperforming services are related to industrial companies' historical lack of the required capabilities (Kindström & Kowalkowski, 2014; Spring & Araujo, 2009; Tukker, 2015). Industrial companies have crafted leading approaches to product development in order to thrive in their core business and are still shaped by their focus on traditional products and their technology-driven development. Service innovation, however, calls for a different skill set (Kindström & Kowalkowski, 2009). For example, it demands iterative approaches involving interdisciplinary teams (Troilo, De Luca, & Guenzi, 2017).

Service innovation also embodies new management practices to purposefully steer this unique and complex innovation process (Meier, Roy, & Seliger, 2010). Nevertheless, managers often neglect to build the organizational capabilities necessary for service innovation (Szwejczewski, Goffin, & Anagnostopoulos, 2015). The rise of digital technologies intensifies the consequences of this neglect, while service innovation gravitates toward developing digital services (e.g., remote monitoring or diagnostics) (Allmendinger & Lombreglia, 2005; Wünderlich, Wangenheim, & Bitner, 2013). These more advanced services utilize rising data streams sourced from the installed base or third-party devices (Opresnik & Taisch, 2015).

The new realm of services and their digital enhancement call for further support as they challenge firms' capabilities. In this regard, more and more managers are seeking guidance to improve their digital service innovation (Biemans, Griffin, & Moenaert, 2016). A dedicated and formalized digital service innovation approach, comparable to existing product development approaches, would increase the success of digital services and support managers throughout their innovation endeavors (De Brentani, 2001; Gebauer, Fleisch, & Friedli, 2005; Meier et al., 2010).

1.2 Theoretical relevance

Initially, Vandermerwe & Rada (1988) coined the term *servitization* to describe the extension of a traditional product business with services. Currently, academia extensively addresses this transition of industrial businesses toward digital service offerings (Witell,

Snyder, Gustafsson, Fombelle, & Kristensson, 2016). In the process, servitization researchers developed a shared understanding of digital service innovation as a firm's dynamic capability. Subsequently, the *dynamic capabilities view* (DCV) has emerged as the dominant perspective in this field. (Rabetino, Harmsen, Kohtamäki, & Sihvonen, 2018).

Academia typically concentrates on studying the dynamic capabilities at firms' routine levels (Gebauer, Saul, Haldimann, & Gustafsson, 2017). As such, the literature identifies extensive sets of routines executed by firms (Stähle, 2020). This primary focus on routines relates to a narrow interpretation of dynamic capabilities. The general construct of dynamic capabilities is operationalized through organizational processes that, in turn, comprise routines, artifacts, and actors (Feldman & Pentland, 2003; Helfat et al., 2007). Therefore, the routines only represent a building block that constitutes an organizational process and, eventually, a dynamic capability (Teece, 2007).

The literature has a limited capacity to link the existing sets of routines to an overarching organizational process of digital service innovation (Den Hertog, van der Aa, & de Jong, 2010; Kindström, Kowalkowski, & Sandberg, 2013; Pettus, Kor, & Mahoney, 2009). Furthermore, related artifacts and actors – with an ability to enhance the current understanding of digital service innovation – are missing in this field as a dynamic capability. In response, this study addresses the current shortcomings by developing a new governance and process framework based on the DCV.

1.3 Scientific perspective

A relativistic view drives the ontological perspective of this research. "Realities are apprehendable in the form of multiple, intangible mental constructions […] and dependent for their form and content on the individual persons or groups holding the constructions" (Guba, Lincoln, & others, 1994, pp. 110-111). Furthermore, this research is enhanced by a constructivist epistemology. Knowledge comes "into existence in and out of our engagement with the realities of our world. There is no meaning without a mind. Meaning is not discovered, but constructed" (Crotty, 1998, pp. 8-9). Thus, in accordance with the presented descriptions, the relativistic and constructive attitude contributes to the investigation's character.

Digital service innovation is still an emergent research topic in academia and practice. Therefore, its construction can benefit from inductive case study research (Yin, 2018). Accordingly, this study's key findings are derived from empirical data, which introduce multiple realities. Each data source, ranging from personal or company-wide insights to

the formation of a focus group, acts in a unique environment and builds its own reality. A focus group, in particular, contains two reality levels. First, each participant introduces an own view to the group. Second, the group itself builds a mutual understanding through a series of joint meetings. The peculiarities of these realities and their construction are factors that influence the research process.

1.4 Research objectives

Academia typically stresses the importance of building organizational capabilities to achieve the firms' overarching goal of competitive advantage (Fischer, Gebauer, Gregory, Ren, & Fleisch, 2010). Therefore, this dissertation adopts an organizational capability perspective to support industrial companies in their transformation toward a strong competitive advantage through a successful digital service business. In this sense, as a theoretical lens, the dynamic capabilities view supports this study (Section 2.2).

In particular, the research aim is to enhance the current state of the literature about the definition of digital service innovation's organizational approach (Chapter 2). Thereby, regarding their organizational capability development, industrial companies are provided with further guidance to overcome their reluctance to build suitable capabilities for digital service innovation (Warner & Wäger, 2019). Table 1 presents two core research gaps that motivate the present research. They are derived from a systematic literature review (Blum, Budde, & Friedli, 2019) and from additional forward and backward analyses of the relevant literature.

Table 1: Research gaps

#	Research gap	Indicative sources
1	Digital service innovation needs new management mechanisms to steer the innovation process sufficiently	Bessant, Lehmann, & Möslein (2014); Herrera González & Hidalgo Nuchera (2019); Meier et al. (2010); Pal & Zimmerie (2005); Panesar & Markeset (2008); Tjørnehøj & Nicolajsen (2018)
2	Digital service innovation needs a defined organizational process to leverage its full potential as a dynamic capability	Biemans & Griffin (2018); D'Alvano & Hidalgo (2012); De Brentani (2001); Dörner, Gassmann, & Gebauer (2011); Lusch & Nambisan, (2015); Nambisan, Lyytinen, Majchrzak, & Song (2017); Song, Song, & Di Benedetto (2009)

Five research questions, which drive this study, are distilled from the research gaps. Table 2 presents the primary research question (PRQ), supported by four secondary research questions (SRQ).

Table 2: Research questions

ID	Research questions
PRQ	How should industrial companies pursue digital service innovation?
SRQ-1	*What organizational routines constitute digital service innovation?*
SRQ-2	*What artifacts support digital service innovation?*
SRQ-3	*What actors manage the operationalization of digital service innovation, and what are their role profiles?*
SRQ-4	*How should a management framework be designed to guide practitioners through digital service innovation?*

The research framework, depicted in Figure 1, guides the operationalization of the dissertation. It connects the three clusters of dynamic capabilities (sensing, seizing, and transforming) and organizational processes in the context of digital service innovation. Sensing and seizing are the clusters that refer to the innovation process. Transforming relates to the required management mechanism as governance. Combined, they lead to the desired outcomes.

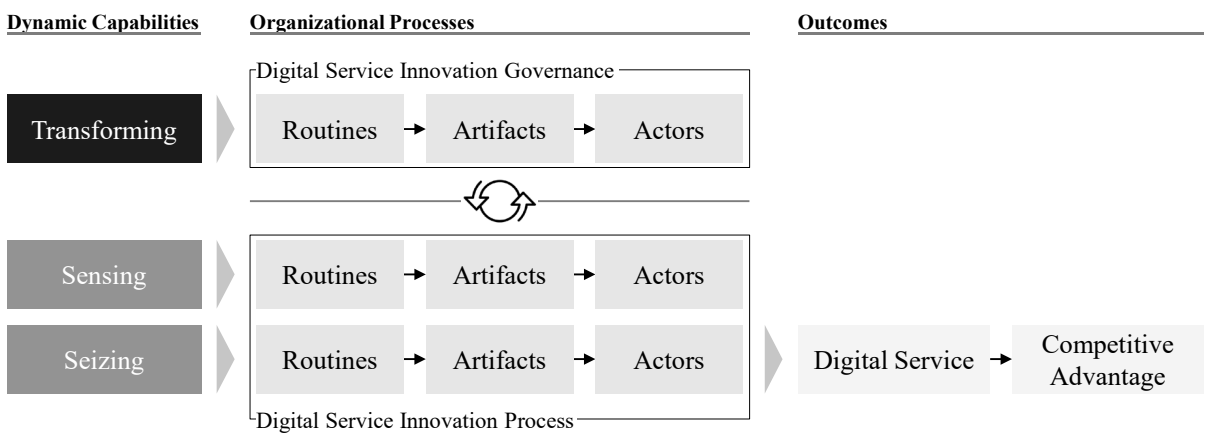

Figure 1: Research framework. Own illustration (based on Feldman & Pentland, 2003; Teece, 2007)

1.5 Research design

This dissertation follows an iterative research approach (Figure 2 and Figure 3). A systematic literature review (Blum et al., 2019) and previous research on service innovation routines (Stähle, 2020) serve as its foundation. The theoretical understanding of digital service innovation is enhanced by case study research (i.e., a multiple case study and a single embedded case study). This research method suits the emergent topic of digital service innovation (*cf.* Eisenhardt, 1989; Voss, Tsikriktsis, & Frohlich, 2002). Furthermore, the explorative character of the research questions and objectives contributes to the case studies' application (Yin, 2009).

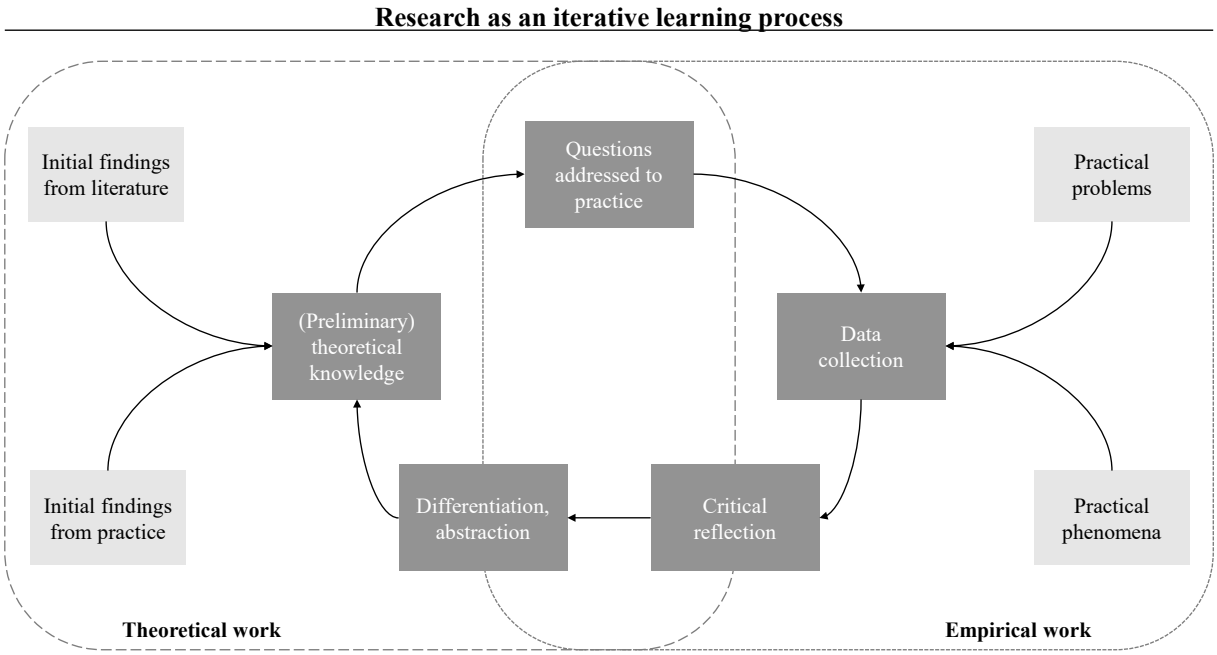

Figure 2: Iterative research process
(adapted from Baumbach, 1998; Gassmann, 1997; Kubicek, 1977; Tomczak, 1992)

The multiple case study is implemented through an interview study involving 24 organizations. This broad investigation makes provision for sufficient inductive research to deepen academic insights. Thereby, the theoretical knowledge is enriched with findings on the application of digital service innovation in practice. Accordingly, the routines suggested by the literature are mapped with real-life activities and adjusted to an implementable level. Finally, the resulting framework consolidates the insights within five dimensions that specify digital service innovation (Chapter 3).

The framework is augmented by a single embedded case study, operationalized through a focus group. The focus group's topic is digital service innovation in the industrial sector. The focus group consists of experts from eight different industrial companies. These eight companies share a common interest in advancing digital service innovation, and each one of them serves as an embedded case. A purposeful case selection builds the foundation that leads to investigating widespread maturities regarding digital service innovation.

The focus group's results support the overarching case (i.e., industrials' digital service innovation) with generalizable results. In this regard, they contribute to industrial companies pursuing digital service innovation in general. Two levels of analysis within the focus group advance the digital service innovation. First, the company representatives share individual insights with the group. Second, the individual insights generate discussions on the best approaches to pursue.

This leads to a mutual understanding of the most promising practices. The representatives' openness to present their experiences and their ability, for the most, to find a mutual understanding across the individual insights, refer to the profound embeddedness of the case companies in the overarching case of digital service innovation. Eventually, the experts' consensus and the guidance of the dynamic capabilities define what this study ultimately describes as digital service innovation.

Finally, a resulting management framework consolidates all the findings. It comprises overarching governance and process models based on defined routines, artifacts, and actors (Chapters 3, 4, and 5). This management framework guides managers comprehensively and is most satisfying through digital service innovation. It also enhances the dynamic capabilities view in digital service innovation by providing the missing organizational process to fill the gap between routines and the clusters of dynamic capabilities (sensing, seizing, and transforming). Figure 3 summarizes the applied research process of the dissertation by illustrating the three exploration stages and their syntheses.

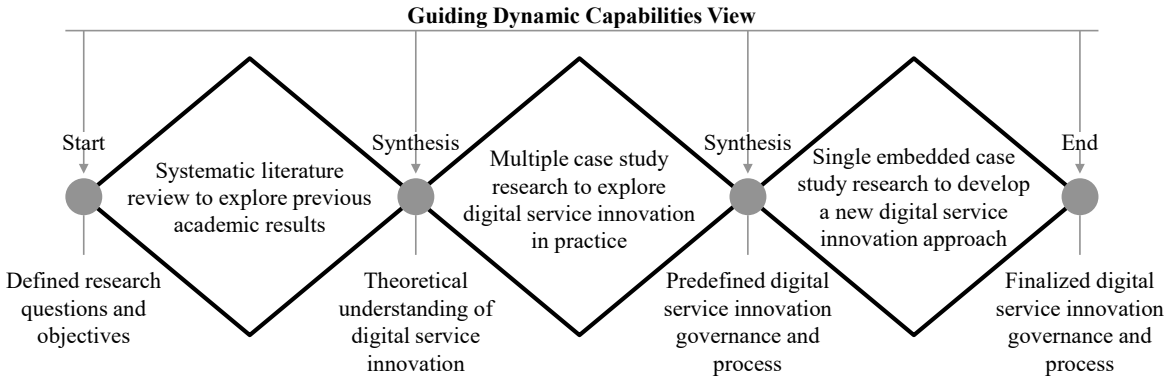

Figure 3: Implemented research design. Own illustration, design adapted from Plattner et al. (2011)

1.6 Thesis outline

Whereas the aforesaid introduction provides a basic overview of the study's motivation and objectives, the next chapter presents the theoretical foundation. This theoretical background starts with a description of the dynamic capabilities view as the applied theoretical lens. Thereafter, it presents the current state of the literature concerning the innovation outcome, process, and governance and specifies these aspects in digital service innovation.

Chapter 3 presents practical insights into the identified theoretical routines. Based on an interview study, it describes the underlying methodology, findings, and synthesis of the interviews. The resulting framework provides the foundation for Chapter 4. In this chapter, the focus group research method, findings, and synthesis pave the way for the definition of a new digital service innovation approach. Subsequently, Chapter 5 proposes new digital service innovation governance and process models by navigating through its details. In addition, the chapter discusses the findings based on the applied theoretical lens and existing literature. Finally, Chapter 6 summarizes and critically reflects on the contributions of the study. In conclusion, it presents new avenues for future research.

2 Theoretical background

Traditionally, three generic pathways exist to retain and develop competitive advantages (Teece, Pisano, & Shuen, 1997). First, Porter (1980) suggests focusing on a firm's position in the face of market forces. Following this logic, managers should analyze their current position and then initiate measures to protect their firms against existing market forces. Second, Shapiro (1989) contends that firms can influence market conditions by manipulating competitors' actions. Third, Teece et al. (1997) propose enhancing the capability base and underlying resources of firms. Focusing on the firms' organizational perspective can help to achieve a sustainable competitive advantage (Penrose, 1959; Wernerfelt, 1984). This study follows the third pathway as it makes allowance for the definition of a universal approach that positively impacts firms' competitiveness.

Organizational capabilities are defined as "a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end" (Amit & Schoemaker, 1993, p. 35). Beyond the regular organizational capabilities, *dynamic capabilities* enable companies to remain competitive at a specific point in time since they contribute to sustaining competitiveness in continuously changing market conditions (Teece, 2018).

Considering its importance to industrial companies, this dissertation applies the dynamic capabilities view as a theoretical perspective. The relevance of dynamic capabilities to industrial companies pursuing digital service innovation is based on several considerations: First, digital service innovation is relatively new to industrial companies. The related organizational transformation is ongoing and its advancement requires further guidance (*cf.* Sjödin, Parida, Kohtamäki, & Wincent, 2020). Second, the underlying digital technologies are rapidly developing (Brynjolfsson & McAfee, 2011), as are the prevailing market conditions. Third, customers expect their suppliers to leverage new technologies to enhance the value of their offerings (Ross, Beath, & Mocker, 2019). Consequently, the firms' capability base is constantly challenged, and managers need to continuously transform the existing capabilities to satisfy market needs (Helfat & Peteraf, 2003).

Following the dynamic capabilities view, the research questions address the firms' capability base in general (see Section 1.4). Therefore, the next sections elaborate on the concepts relating to firms' organizational capabilities. In sequence, they introduce the overarching construct of organizational capabilities (Section 2.1); expand the notion of organizational capabilities by presenting the dynamic capabilities view (Section 2.2); clarify the operationalization of these conceptualizations in organizational processes by

adding the underlying subdimensions of routines, artifacts, and actors (Section 2.3); and, finally, translate the theoretical concept of dynamic capabilities into innovation and digital service innovation (Sections 2.4 and 2.5).

2.1 Organizational capabilities

Academia approaches organizational capabilities in terms of the *resource-based view* (RBV) (Barney, 1991; Wernerfelt, 1984). Firms' resources and capabilities are at the core of this theoretical approach. Resources are tradable assets available on factor markets (Makadok, 2001). Therefore, a firm's resources are all the factors that it possesses or manages (Amit & Schoemaker, 1993). Capabilities, as previously indicated, are a firm's organizational capacity to deploy and increase the productivity of its resources throughout their utilization (Amit & Schoemaker, 1993; Teece et al., 1997). Capabilities are firm-specific and hardly tradeable. Accordingly, they can only be transferred by selling the entire firm or its units (Makadok, 2001; Teece et al., 1997). Collectively, resources and capabilities form the basis of firms' competitive advantage. To attain competitiveness, their configuration must be valuable, rare, imperfectly inimitable, and non-substitutable (VRIN) (Barney, 1991; Conner & Prahalad, 1996). Research has advanced this perspective to VRIO (valuable, rare, imperfectly inimitable resources and organization) in order to place more emphasis on the organizational part of the firm's resources (Barney, 1996).

Although capabilities and resources can support the competitive advantage of firms, academia regards their configuration as static and ignoring market trends (Eisenhardt & Martin, 2000; Priem & Butler, 2001). Accordingly, the firms' ability to build a competitive advantage is limited to specific time periods as market conditions fluctuate. This criticism of the RBV arose at the onset of its introduction, based on the argument that firms lack the required skills to renew their resources and capabilities in line with changing market conditions (Dierickx & Cool, 1989).

The static character of the organizational capabilities is defined by the firms' mechanisms to manage and develop capabilities. Firms build capabilities by utilizing existing resources (Winter, 2003). Managers identify resource utilization's high-performing patterns and promote these at an organization-wide level (Schreyögg & Kliesch-Eberl, 2007). Simultaneously, they appreciate the value of these existing capabilities that guarantee their firms' operations. (Garbuio, King, & Lovallo, 2011). By only supporting the

application of the known high-performing ways of resource utilization, managers ultimately prevent the development and operationalization of new ways of utilization (Burgelman, 2002; Leonard-Barton, 1992; Westphal & Bednar, 2005).

The described procedure only incentivizes the application of familiar and tested resource configurations, thereby limiting firms' possible future actions (Bercovitz, de Figueiredo, & Teece, 1996). However, to maintain their active position in the market, firms must master the tension between exploiting existing capabilities and exploring new business opportunities (Velu, 2017). Subsequently, to help firms adapt to changing conditions, the next section introduces the concept of *dynamic capabilities* (Barney, Wright, & Ketchen, 2001).

2.2 Dynamic capabilities

In order to accommodate the changing resource base, Teece et al. (1997) enhance the RBV with the dynamic capabilities view (DCV). They support statements on resources' *stickiness* to a firm, which is difficult to overcome. Because of this, companies should classify their capabilities as dynamic rather than static.

Based on this perspective, various definitions of dynamic capabilities have evolved (Arend & Bromiley, 2009). This research follows the definition of Teece et al. (1997). They define dynamic capabilities "as the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of a competitive advantage given path dependencies and market positions" (Teece et al., 1997, p. 516).

More specifically, dynamic capabilities differ from ordinary capabilities by intentionally changing the resource base (Ambrosini & Bowman, 2009; Helfat & Winter, 2011). In this sense, ordinary capabilities enable the basic operations of firms. They are more pageable and have a limited impact on firms' competitiveness (Teece, 2014). Kump, Engelmann, Kessler, & Schweiger (2019), on the contrary, support the implications of dynamic capabilities by indicating the positive relationship between strong dynamic capabilities and firms' innovation performance.

The key characteristics of the dynamic capabilities follow a hierarchical model (Teece, 2018). Although the literature seems to approach the DCV from different angles (*cf.* Eisenhardt & Martin, 2000; Helfat et al., 2007; Teece, 2007; Teece et al., 1997; Zollo & Winter, 2002), the different perspectives are strongly aligned in synthesizing research (e.g., Di Stefano, Peteraf, & Verona, 2014; Peteraf, Di Stefano, & Verona,

2013). In this sense, researchers who define the DCV, locate their approaches in a three-layered hierarchical model (*high-order capabilities*, *microfoundations*, and *ordinary capabilities*). The two layers of *high-order capabilities* and *microfoundations* are defined as dynamic capabilities (Teece, 2007).

Teece et al. (1997) define three clusters of dynamic capabilities as high-order capabilities. These clusters relate to the strategic decisions of upper management to best allocate the available resources. They furthermore provide the theoretical framework for the subsequent layers. Teece (2007) conceptualizes the three high-order dynamic capabilities as supporting companies in their continuous resource transformation: *sensing, seizing,* and *transforming*. Microfoundations or second-order capabilities support the execution of these high-order clusters. They relate to firms' decision-making routines and portfolio innovations. The microfoundations are eventually supported by ordinary capabilities that guide the basic operations of firms.

The three dimensions of dynamic capabilities that guide capability implementation are subsequently explained in greater depth. The next subsections shed light on the three high-order dynamic capabilities of *sensing, seizing,* and *transforming*, followed by an analysis of the microfoundations (Sections 2.4 and 2.5).

2.2.1 Sensing

Firms must stay informed about new developments in their business environment. Therefore, they must gain relevant information through sensing activities. "Sensing (and shaping) new opportunities is very much a scanning, creation, learning, and interpretive activity. Investment in research and related activities is usually a necessary complement to this activity" (Teece, 2007, p. 1322). Apart from sensing new opportunities, firms should also keep track of emerging threats (Helfat & Peteraf, 2015). The adjacent and remote environments are both relevant sources of information on the market forces of opportunities and threats (March & Simon, 1958). To support comprehensive knowledge building, firms should include third parties when gathering market intelligence (Giudici, Reinmoeller, & Ravasi, 2018).

While Teece (2007) focuses on the external perspective of sensing, firms are best informed if they also assess available information within their organizations (Babelytė-Labanauskė & Nedzinskas, 2017). Notably, the entire organization should pursue sensing activities and report the results upstream to management (Teece & Linden, 2017). This allows staff to perform both formal and informal sensing activities (Helfat & Peteraf, 2015).

2.2.2 Seizing

Seizing is about realizing future opportunities or defending firms against market threats. Furthermore, it is intricately linked to management's need to convert the market information into new offerings (Teece, 2007). These decisions are intertwined with strategy development and financial investments. Firms with high seizing capabilities can advance their respective business models according to their possible scope of actions (Kump et al., 2019).

However, reacting to changing market conditions is also affected by firms' path-dependency. The more decisions management makes to implement new solutions, the more biased and limited their options and possible maneuvers become (Abernathy, Utterback, & others, 1978). Hence, managers should be aware of these biases in order not to block the efficacy of the dynamic seizing capability (Teece, 2007).

Moreover, implementing the seizing capability as an iterative procedure creates a supportive relationship between sensing and seizing (Day & Schoemaker, 2016), and helps to overcome the previously mentioned dependencies. Firms build additional knowledge through the implementation of new business solutions. This mechanism creates a loop of constant knowledge creation and utilization, thereby increasing the total knowledge available to the firms (Cohen & Levinthal, 1990).

2.2.3 Transforming

Transforming represents the required organizational adaptations of firms to changing conditions in an optimal way (O'Reilly & Tushman, 2008). Teece (2007) refers to transforming activities as "enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets" (p. 1319). This process includes the entire organization and is related to two application fields. First, transformation is necessary when firms have sensed and seized new offerings and want to implement them (Li & Liu, 2014; Weerawardena & O'Cass, 2004). The new offerings often require new resource configurations from firms. As a result, management needs to initiate the updating of ordinary capabilities to comply with the new requirements of the surrounding conditions (Noble, 1999; Teece, 2014). Second, management must constantly review their approaches to applying dynamic capabilities in order to ensure their impact (Teece, 2007). In other words, to successfully steer firms, managers must continuously question the suitability of their capabilities under current conditions. The implementation and advancement of governance structures to manage the transformation

enhance the appropriateness of management practices (Augier & Teece, 2009; Nickerson, Yen, & Mahoney, 2012; Schilke, Hu, & Helfat, 2018; Teece, 2007).

The three dynamic capabilities of sensing, seizing, and transforming were mainly introduced as a sequence of activities that firms should pursue (Teece, 2007, 2018; Teece et al., 1997). Nonetheless, the three high-order dynamic capabilities are rather individual building blocks that firms have to configure (Wilden, Devinney, & Dowling, 2016). Their specific composition relies on their unique design for the firms' purposes (Danny Miller & Mintzberg, 1984). Since the aim of this research is to construct dynamic capabilities in the context of digital service innovation, it adopts the perspective of Wilden et al. (2016). Accordingly, sensing, seizing, and transforming are individual core elements that must be operationalized to suit digital service innovation.

In line with the dynamic capabilities view, the aforesaid, overarching concept of dynamic capabilities is implemented through organizational processes. The subsequent introduction of the concept of organizational processes complements the understanding of possible pathways to firms' operationalization of dynamic capabilities (Section 2.3) and is followed by an elaboration of dynamic capabilities in innovation and its subset of digital service innovation (Sections 2.4 and 2.5).

2.3 Organizational processes

Firms implement organizational and dynamic capabilities by applying organizational processes (Eisenhardt & Martin, 2000). Based on Nelson & Winter's (1982) definition of organizational routines, Howard-Grenville & Rerup (2016) define organizational processes as "regular and predictable business behavior" (p. 15). Accordingly, the organizational processes are aggregated sets of activities that convert inputs into outputs to satisfy the needs of involved stakeholders (Palmberg, 2009). Furthermore, by extending this concept in the context of dynamic capabilities, these processes represent the microfoundations of the dynamic capabilities, e.g., new product development or exploring new markets (Teece, 2018).

Feldman & Pentland (2003), in their seminal work, originally identified three constituting elements of organizational processes. These elements help to analyze the underlying organizational mechanisms. First, *routines* refer to "units or 'chunks' of organized activity with a repetitive character" (Dosi, Nelson, Winter, & others, 2000, p. 4). Second, *artifacts* support the execution of routines as they guide their operations (D'Adderio, 2008). Third, *actors* (human and non-human) realize the routines and apply the artifacts to achieve the organizational process's aspired output (Feldman, Pentland,

D'Adderio, & Lazaric, 2016). All three dimensions (routines, artifacts, and actors) are of prime importance when implementing the firm's dynamic capabilities. The understanding of these dimensions is subsequently refined.

2.3.1 Routines

According to Feldman & Pentland (2003), organizational routines are defined "as repetitive, recognizable patterns of interdependent actions, carried out by multiple actors" (p. 95). This definitional perspective includes decision-making practices that shape the firms' actions (Cohen, 1991; Cyert, March, & others, 1963). It furthermore applies to all capability hierarchy levels, ranging from high-order dynamic capabilities to low-level ordinary capabilities.

Academia approaches organizational routines from two perspectives. First, the *granularity* of the routines, which ranges from the discussion of specific activities of the performing actors (e.g., Feldman, 2000) to the embeddedness of aggregated activities in the organizational process landscape (e.g., Howard-Grenville & Rerup, 2016). Second, the *dynamism* of the routines, which examines the stability or evolution of organizational routines over time (e.g., Wenzel, Danner-Schröder, & Spee, 2020).

The *granularity* of the routines is related to their specific characterization. Over the years, researchers have conceptualized multiple approaches to describe the routines' attributes (Parmigiani & Howard-Grenville, 2011). The most dominant version stems from Feldman & Pentland (2003). They distinguish between and define ostensive and performative routines. Ostensive routines describe the required activities actors should perform on a meta-level. Thus, ostensive routines guide actors throughout the enactment of the envisaged tasks. In this sense, researchers also describe the ostensive perspective as rules set by the organization's management (Burns & Scapens, 2000; Quinn, 2011). Actors, however, through their operationalization, transform the ostensive routines into daily activities and behavior. Through their application, ostensive routines become performative routines. Bourdieu (1977, 1990), as cited by Feldman & Pentland (2003), note that "practices are carried out against a background of rules and expectations, but the particular courses of action we choose are always, to some extent, novel" (p. 102).

The dichotomy of ostensive and performative routines makes allowance for an analysis of the routines' *dynamism* (Farjoun, 2010; Parmigiani & Howard-Grenville, 2011). The assumption that actors always apply routines slightly differently serves as the foundation of constant change (Feldman & Pentland, 2003). In this context, Dougherty & Dunne (2004) refer to the concepts of mutual adjustment (Mintzberg & McHugh, 1985;

Thompson, 1967) and mutual adaptation (Leonard, 1998). Routines evolve over time as actors within the organization incrementally adapt to new conditions. Thereby, multiple actors change their routines independently. As part of their daily cooperation, the involved actors must agree on new routines and the interfaces among them. In these cases, the joint adjustments help to align all involved actors with – again – suitable routines. This ongoing mechanism allows organizations to transform their dynamic and ordinary capabilities continuously. However, to maintain the firms' competitive advantage, the strategic application of dynamic capabilities accelerates the transformation speed of ordinary capabilities to an appropriate level.

2.3.2 Artifacts

Artifacts comprise the relevant knowledge that guides the execution of routines (D'Adderio, 2003) and represent rules or standard operating procedures put into action by the actors (Hales & Tidd, 2009). Templates, software, or process descriptions are typical artifacts that support routines. The artifacts also embody the routines, enabling them to obtain objects to interact with (Feldman & Pentland, 2003). Their appearance can be physical or non-physical (Ethiraj, Kale, Krishnan, & Singh, 2005).

During routine execution, actors perceive artifacts both as enablers and constraints (Howard-Grenville, 2005). Artifacts enable routines as they contain the required knowledge to steer the actions to achieve the desired outputs. However, restrictions surface when routines are executed, as actors must follow the artifact's instructions. As a result, artifacts can become barriers to their own implementation if the actors are not capable or willing to follow the instructions. However, academia has been unable to decode the influencing factors of artifacts' ambiguous impact on performance (Parmigiani & Howard-Grenville, 2011).

2.3.3 Actors

The actors' main responsibility is to implement routines. The actors embody human and non-human entities (Feldman, 2003; Feldman et al., 2016). Typical examples of human actors are the employees or the managers of organizations (Buyl, Boone, & Matthyssens, 2011; Feldman, 2003). Non-human actors refer to technical devices or information technology (Oliveira & Quinn, 2015).

In general, actors are deemed to be skilled and reflective in their actions (Feldman et al., 2016). Even if some fail to operationalize routines, their statistical reliability supports the emergence and application of routines (Nelson & Winter, 1982). Moreover,

they execute, contextualize, and build connections between certain routines (Howard-Grenville, 2005). Eventually, actors transform ostensive routines into performative routines as they follow the instructions of the former by combining them with the application of artifacts.

Finally, the dynamic capabilities view and the underlying organizational process provide the foundation for this dissertation. The interplay between the three clusters of sensing, seizing, and transforming, along with the process elements of routines, artifacts, and actors, delineate the boundaries of this study. However, the implementation of each dynamic capability cluster and process element requires a context; a context that is provided by the realm of digital service innovation.

The next sections introduce the basic views on innovation (Section 2.4) that are essential to understand the existing body of knowledge before specifying the literature's status quo in digital service innovation (Section 2.5). The literature discusses innovation and digital service innovation at an aggregated level, comparable to the primary research question. Therefore, the subsequent introduction does not always differentiate between the dynamic capabilities (sensing, seizing, and transforming) and organizational process elements (routines, artifacts, and actors).

2.4 Innovation as a microfoundation

The introduced concept of dynamic capabilities and its underlying subdimensions can be operationalized in various realms. Innovation approaches, however, constitute the most prominent field of application (*cf.* Teece, 2007). The implementation of innovation refers to the dynamic capabilities' microfoundations.

Innovation approaches comprise all necessary activities to pursue innovation and to classify the aspired outcomes (Schumpeter, 1934). Through their eventual outcome, innovation approaches expand the dynamic capabilities' perspective. In other words, the innovation outcome serves as the intermediary between the organizational (innovation) process and the subsequent competitive advantage (Figure 4).

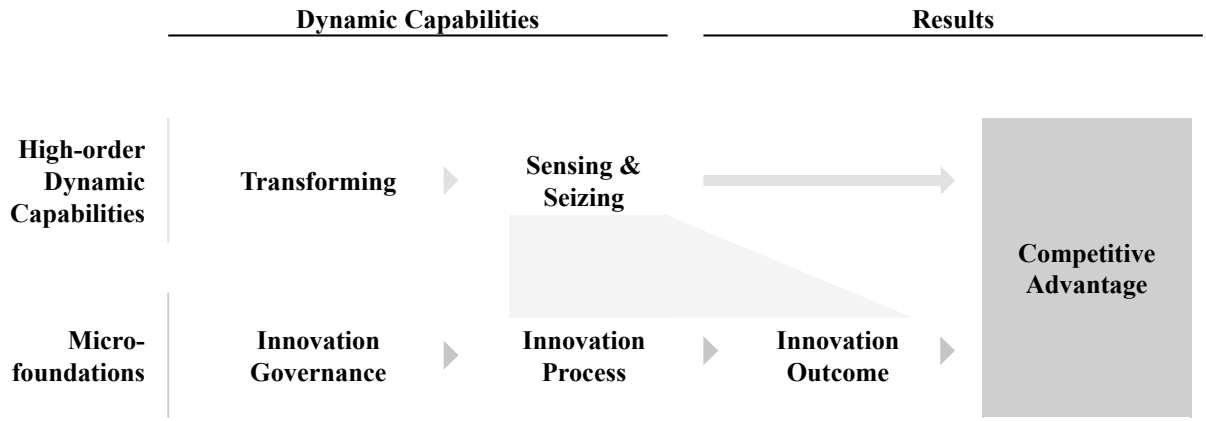

Figure 4: Combining dynamic capabilities and innovation. Own illustration

Accordingly, this study applies the following perspective to the implementation of dynamic capabilities through innovation. In general, the required innovation activities refer to the related innovation process in which the dynamic capabilities of sensing and seizing are implemented. More specifically, following the definition of Feldman & Pentland (2003), the underlying routines that constitute the innovation process are defined as ostensive routines. Furthermore, the dynamic capability of transforming refers to the innovations' governance, guided by a separate framework that exists beyond the innovation process (*cf.* Schilke et al., 2018; Teece, 2007; Wilden et al., 2016).

The next subsections clarify the foundations of the innovation approaches. The literature discusses these approaches based on their outcome, the related process on an aggregated level, and the overarching governance model that steers the innovation process. Moreover, the three dimensions serve as the basis for discussing the theoretical fundamentals of digital service innovation (Section 2.5). The outcome, process, and governance dimensions of digital service innovation also provide additional background information that supports the empirical findings of Chapter 3 and Chapter 4 and, finally, the development of a management framework in Chapter 5.

2.4.1 Innovation outcome

Firms that seek to improve their competitive advantage need to assess their possible courses of action. Different typologies of innovation outcomes set the boundary conditions under which firms can innovate. Utterback (1971) defines innovation outcomes as "an invention which has reached market introduction in the case of a new product, or first use in a production process, in the case of a process innovation" (p. 77).

Academia proposes many different typologies to classify innovation outcomes (Damanpour & Aravind, 2011). Based on Damanpour's (1991) typology, Edquist, Hommen, & McKelvey (2001) and Meeus & Edquist (2006) consolidate the understanding of innovation outcomes in two categories, namely *product innovations* and *process innovations*. This specification of innovation outcomes best suits the purposes of this research.

Product innovations entail new offers for existing or new markets. Typical examples are the hardware products of industrial companies or related services that address customer needs. These innovations are mainly associated with technology development by firms' research and development (R&D) departments (*cf.* Johnson, Christensen, & Kagermann, 2008; Wheelwright & Clark, 1992).

Process innovations, instead, drive internal efficiency. These innovations refer to improvements in the firms' organization or administration. Thereby, firms identify new approaches to serve customers with products or services. Restructured internal procedures (e.g., production processes) are other outcomes of process innovations. Although these internal procedures focus on the architecture of the firms' practices, they also encompass the required technology that supports the execution of the new processes (Edquist et al., 2001).

Based on the core concepts of product and process innovation, a more comprehensive perspective on innovation outcomes has evolved in academia (Kahn, 2018). Business model innovation stems from these two categories, but expands innovation outcomes in the direction of a new form (Massa, Tucci, & Afuah, 2014). Winterhalter, Weiblen, Wecht, & Gassmann (2017) define business model innovation as innovating in the five dimensions of value creation logic, product and service logic, marketing and sales logic, profit formula, and positioning. According to Matzler, Bailom, von den Eichen, & Kohler (2013), they specify it as "new ways to structure […] value creation processes and capture that value with great returns" (p. 30). In practice, the interplay of product and process innovations and business model innovation is characterized by iteration cycles. Therein, business model innovation builds the business model around the evolving product or process innovation (Winterhalter et al., 2017).

Finally, the degree of novelty complements the innovation outcome profile as a general degree of freedom. A spectrum ranging from incremental to radical outcomes defines the possible range. Subramaniam & Youndt (2005) refer to incremental innovations as the refinement of existing products and services, while radical innovations "significantly transform existing products and services" (p. 452).

The presented innovation outcomes set the boundaries for firms to build their competitive advantage and lay the foundation for the related innovation processes.

2.4.2 Innovation process

The foundation of innovation activities was laid in Schumpeter's (1934) seminal work. In his view, firms can only achieve economic prosperity through continual change. Based on this logic, researchers defined processes to institutionalize this change. According to Pavitt (2006), "innovation processes involve the exploration and exploitation of opportunities for new or improved products, processes or services, based either on an advance in technical practice ("know-how"), or a change in market demand, or a combination of the two. Innovation is therefore essentially a matching process" (p. 3) (Mowery & Rosenberg, 1979). This exploration and exploitation encompass the three core dimensions of innovation: invention, development, and implementation (Raghu Garud, Tuertscher, & de Ven, 2013).

Early research on innovation processes concentrated on developing new tangible goods through R&D activities (Alam & Perry, 2002; Parthasarthy & Hammond, 2002). In this respect, Booz & Hamilton (1982) defined eight linear steps of new product development (NPD), namely new product strategy, idea generation, screening, evaluation, business analysis, development, testing, and commercialization. Their seminal work served as a role model for many researchers who improved the original process model (Alam & Perry, 2002; Eveleens, 2010).

Further studies proposed additional processes emphasizing different aspects of the development process (Cooper, 2001; Rothwell, 1994). Cooper's (2001) *Stage-Gate process* is the most common approach to develop new products in the industry. Besides proposing individual process steps that companies must complete, Cooper also designed rules to steer the development process in general. Therefore, every process step consists of an activity-driven phase and a decision point. Activities within individual process steps refer to the stages and the required decisions along the process to the gates. Overall, five stage and gate sequences form Cooper's innovation process (Figure 5).

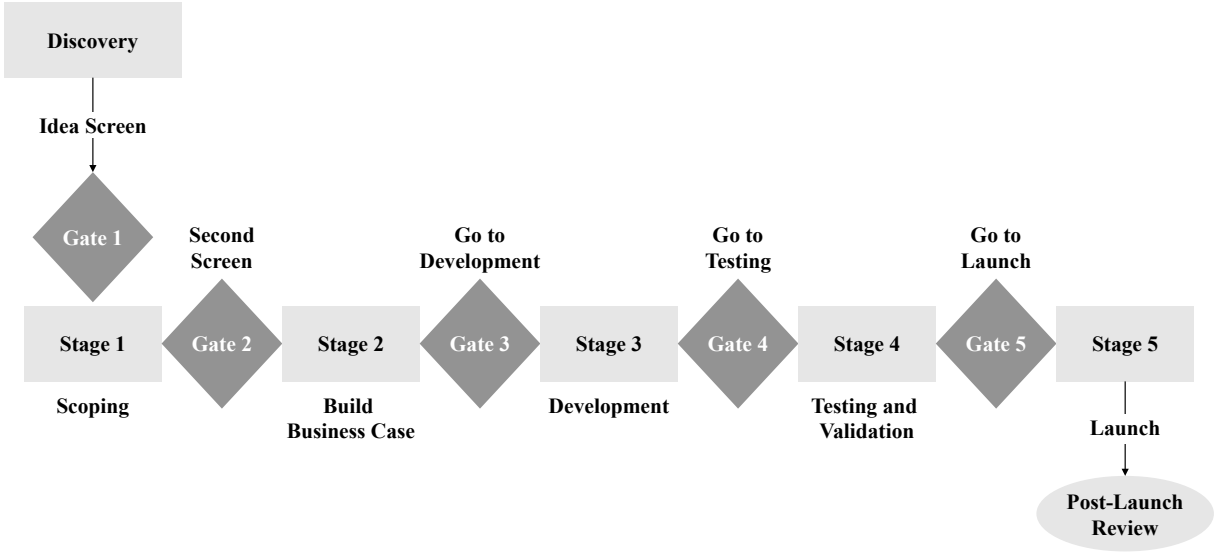

Figure 5: Stage-Gate process. Adapted from Cooper (2008)

More recently, researchers suggested going beyond linear and rigid NPD processes, such as the Stage-Gate process, to react – sufficiently – to shifting market requirements (Hidalgo & Albors, 2008). The subsequent research enhanced earlier studies that highlighted the importance of interactive process models (Edquist, 1997; Kline & Rosenberg, 1986) and knowledge exchange (Patel & Pavitt, 1994).

Presently, agile methods comply with the demand that interactive process models ensure competitiveness (Cozzolino, Verona, & Rothaermel, 2018; Desyllas & Sako, 2013). These agile methods are described as "the capacity of an organization to efficiently and effectively redeploy/redirect its resources to value-creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant" (Teece, Peteraf, & Leih, 2016, p. 17). Agility also aligns with the dynamic capabilities view. Hobbs & Scheepers (2010) highlight its capacity to detect and react swiftly to changing conditions. Agile business processes are designed in a flexible manner to leverage fast and efficient innovation. Thereby, agile development methods ensure adaptation to changing requirements at any time (Conboy, 2009). They allow for structured cooperation with all relevant stakeholders during the entire development process (Abrahamsson, Warsta, Siponen, & Ronkainen, 2003). In this sense, agile methods analyze internal and external innovation impetuses to develop successful offerings (Nagano, Stefanovitz, & Vick, 2014).

In particular, the three agile methods of Lean Startup, Design Thinking, and Scrum support firms to build customer-driven offers (*cf.* Blank, 2013; Brown, 2008; Camuffo, Cordova, Gambardella, & Spina, 2020). As they represent the most dominant methods,

the following specifications of the three methods describe their characteristics and possible interplay.

Lean Startup's objective is to pursue customer-centric development through constant exchange with customers (Maurya, 2012). Users of this method follow three major phases (Ries, 2011). First, they start with the hypothesis development of their business idea. Second, they apply the build-measure-learn cycle to iterate their initial business idea and turn it into one that is desirable, viable, and feasible for all stakeholders (Brown, 2008). Third, they aim to build a minimum viable product (MVP) that represents a "preliminary basic version of the offering with just enough features to let customers experience it and assess their willingness to pay for it" (Camuffo et al., 2020, p. 566). Finally, the goal is to follow the process of revising the hypothesis, conducting the build-measure-learn cycle, and updating the MVP until reaching a satisfying product-market-fit (Blank, 2013). Figure 6 depicts the build-measure-learn cycle and emphasizes the importance of continuous iteration until landing a ready-to-market offer.

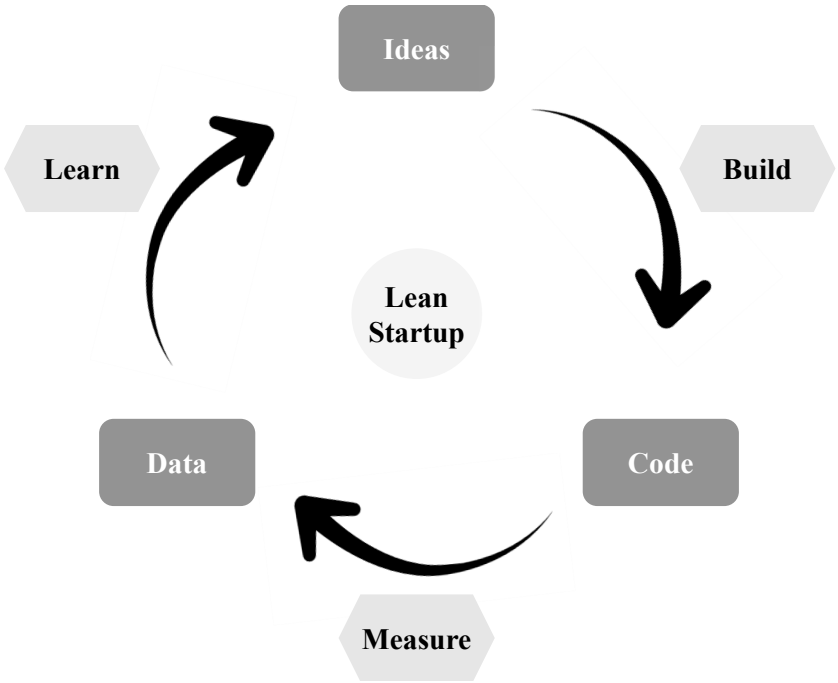

Figure 6: Lean Startup method. Adapted from Ries (2011)

Design Thinking is another iterative approach to develop customer-centric solutions. It builds on a human-centered process that leverages diverse teams to achieve solutions that suit the users' personal needs (Plattner et al., 2011). Again, the objective is to attain the offer's desirability, viability, and feasibility (Camacho & Kelley, 2016). Six steps

(understand, observe, point of view, ideate, prototype, and test) represent the core activities of Design Thinking (Figure 7). Understand, observe, and point of view represent the initial phase in which the current situation or the perceived challenge is analyzed. Based on the findings of the initial stage, various ideas are developed to broaden the solution space (Weinberg, 2015). The subsequent prototype renders all relevant features tangible for the designated users or customers (Brenner & Uebernickel, 2016). Thus, the followed testing activities assess the customers' perceived value. Although the process appears linear, the individual process steps are highly iterative and encourage the users of Design Thinking, if necessary, to move backward in the process (Plattner et al., 2011). The Business Model Navigator and the Business Model Canvas are exemplary tools that support the Design Thinking stages (Bonakdar & Gassmann, 2016; Gassmann, Frankenberger, & Csik, 2013; Geissdoerfer, Bocken, & Hultink, 2016; Osterwalder & Pigneur, 2010).

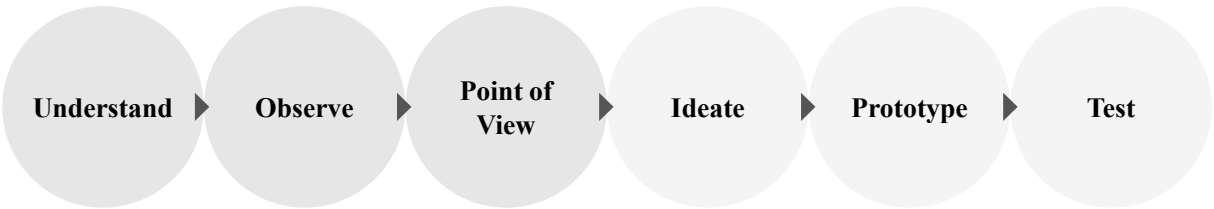

Figure 7: Design Thinking process. Adapted from Plattner et al. (2011)

Scrum is an agile solution development method introduced by Sutherland & Schwaber (1995). The critical characteristics of Scrum invert the standard operating procedure of development processes. Typically, a detailed work plan is outlined at the beginning of the actual development of new offerings. Scrum, instead, trusts the capabilities of the executing team. Their skills, combined with the continuous feedback of the customers, drive the evolvement of the product. Thereby, Scrum builds the final offer in small increments (Gloger, 2016). Following its overarching logic, different roles are at the core of this development method. First, the Scrum master accounts for the implementation of and adherence to the Scrum method. This role eases the interactions among the participants and teaches the standard procedures. Second, the product owner is responsible for defining the product specification and the underlying increments to be developed. All product specifications are divided into single sprints (work periods of about four weeks duration) that comprise the product or sprint backlog. Third, the development team (with a maximum number of nine participants) organizes the sprint backlog

to ensure that it works most efficiently (Sutherland & Schwaber, 2016). Figure 8 summarizes Scrum's procedure, based on the introduced core roles and activities.

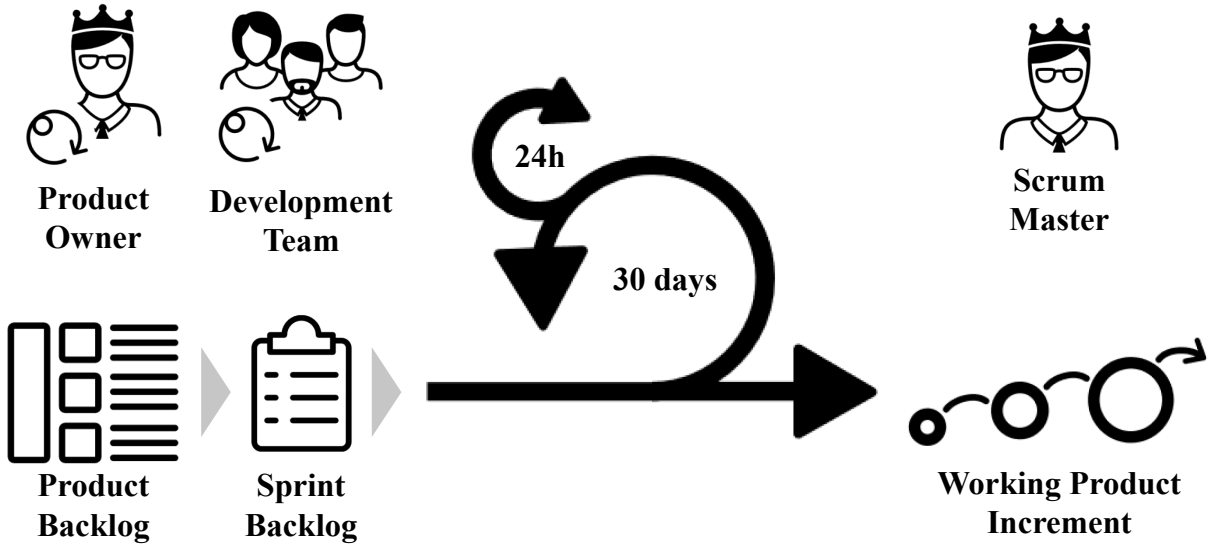

Figure 8: Scrum development process. Adapted from Sutherland & Schwaber (1995)

The three methods' preferred field of application determines their implementation. Lean Startup and Design Thinking are both suitable for driving innovation within complex environments at high uncertainty levels (*cf.* Hirschfeld, Steinert, & Lincke, 2011). Their main objective is to develop prototypes during the early innovation phase (Mueller & Thoring, 2012) that pave the way for comprehensive development at a later stage, e.g., grounded in Scrum.

Academia underlines the difficulty of incumbent firms to adopt agile methodologies in their field of application (Birkinshaw, 2018; Pavlou & El Sawy, 2010; Rigby, Sutherland, & Takeuchi, 2016; Sambamurthy, Bharadwaj, & Grover, 2003; Weber & Tarba, 2014). However, a strong combination of digital technologies with close customer cooperation and operational agility presents a promising way to master the shift toward more iterative innovation approaches (Sambamurthy et al., 2003).

2.4.3 Innovation governance

The sole definition of the aspired innovation outcome and process is not enough to pursue innovation successfully (*cf.* Tripsas, 2009). Throughout the entire process, decisions must be made on the continuation of the product or service development and the firms' resource allocation. Since the making of informed decisions requires an extensive

knowledge of the prevailing market conditions, firms must facilitate intensive cooperation across different functions and departments, aligned with an open-minded collaboration culture. However, the dominant innovation management procedures only make a limited contribution to these prerequisites (Svahn et al., 2017).

Firms' long history and experience of leveraging corporate governance models to coordinate the management's objectives and the interests of finance providers (Asensio-López, Cabeza-Garcia, & González-Álvarez, 2019) serve as a promising avenue to successfully guide innovation endeavors (Sapra, Subramanian, & Subramanian, 2014). The related innovation governance "provides a frame for all innovation activities by defining the roles, powers, and limits of the various players, and organizing the functioning of all innovation-related processes" (Deschamps & Nelson, 2014, p. 14). Therein, the challenge is to find a sufficient trade-off between allowing and avoiding uncertainty in the decision-making processes (Robeson & O'Connor, 2007).

Deschamps & Nelson (2014) propose the four dimensions of *strategy*, *opportunities*, *steering*, and *capabilities* to help firms approach innovation governance in practice. *Strategy* deals with the innovations' purpose setting and the business sectors it should address. It also defines the targeted risk to be entered into by a firm. Thereby, firms can identify possible opportunities grounded in deep market knowledge. Moreover, *opportunities* should be gathered by organization-wide information sharing and intense market research. Based on the derived information, firms need to *steer* the kind of innovations they should pursue. To pursue innovations, they need to specify the preferred innovation approach, the related responsibilities, and relevant partners in their steering practices. Finally, the required *capabilities* of innovation endeavors define the necessary hard and soft skills and represented values of the involved employees. Overall, steering groups mainly govern innovations as they can perform this complex task better than when it is done through individual, organizational roles.

In conclusion, the general introduction of the innovation outcome, process, and governance provides the foundation to further analyze digital service innovation's peculiarities. Thus, the next section presents the current perspectives on digital service innovation based on innovation practices.

2.5 Digital service innovation as a microfoundation

The dynamic capabilities view, and the core concepts of innovation set the boundaries for digital service innovation. As digital service innovation is a specific subdiscipline

within innovation, it operationalizes the dynamic capabilities view on the microfoundation level (*cf.* Section 2.2).

Academia approaches digital service innovation from various perspectives. The broader topic of service innovation and the specific topic of digital service innovation are described in ambiguous and sometimes interchangeable ways. This leads to many unresolved challenges (Eloranta & Turunen, 2015). In particular, the lack of coherent definitions regarding digital service innovation's constituting dimensions results in disparate definitions of digital services (*cf.* Klein, 2017; Meier et al., 2010; Tukker, 2004).

This study considers service innovation related to advanced technologies as digital service innovation. The following analyses present the current literature on digital service innovation, based on its introduced elements: outcome, process, and governance. As the digital service literature on these elements is still immature, the next subsections elaborate on services in general before specifying the elements of digital service innovation.

2.5.1 Digital service innovation outcome

The lack of a definition of the overarching concept of service innovation leads to the absence of an agreement on service innovation's universal outcome (Dreyer, Olivotti, Lebek, & Breitner, 2019). Furthermore, the existing range of definitions presents a significant barrier to the definition of a suitable digital service innovation process. Therefore, more light is shed on the characteristics of services and the ability thereof to delineate an appropriate understanding of digital services. Thereafter, the underlying innovation process is analyzed.

Vargo & Lusch (2004) define services "as the application of specialized competencies (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself" (p. 2). Besides this definition, a plethora of service definitions exists in academia. These service definitions not only refer to varying views on services but also facilitate interpretations of services at different levels of aggregation. Mathieu (2001) distinguishes between services supporting the supplier's products (SSP) and services supporting the customer's actions (SSC). In contrast, Bullinger, Fähnrich, & Meiren (2003) define services in terms of three dimensions, namely outcome, process, and structure. Table 3 presents a selection of common concepts that describe service innovation outcomes related to the service's purpose and constituting elements (Raddats, Kowalkowski, Benedettini, Burton, & Gebauer, 2019).

Table 3: Dimensions of services, adapted from Raddats et al. (2019) and extended by the author

Innovation outcome	Description	Indicative sources
Services supporting products (SSP), services supporting the customer's actions (SSC)	SSP: facilitate the sale and usage of physical goods SSC: facilitate process-orientated offerings, not linked to specific products	Mathieu (2001)
Customer or supplier ownership of equipment	Customer buys the equipment and services The supplier retains ownership and is responsible for operations and maintenance services	Windahl & Lakemond (2010)
Product complements, product substitutes	Services not only complement products but can also substitute them	Cusumano et al. (2015)
Input-based vs. output-based	Input-based: focus on the delivery and performance Output-based: focus on the achieved outcome	Ulaga & Reinartz (2011)
Base, intermediate, advanced services	Base: focus on product provision, maintenance Intermediate: focus on product condition capability Advanced: focus on the performance of the product	Baines & Lightfoot (2013)
Service structure, processes, and outcome	Structure: ability to deliver the service Process: integration of resources for service delivery Outcome: effects on internal and external factors	Bullinger, Fähnrich, & Meiren (2003)
Service concept, client interface, intra- and inter-organizational delivery system, technology	Service concept as the value proposition is enabled by client interfaces, internal delivery systems, and technological options to support service delivery	Barrett, Davidson, & Vargo (2015); den Hertog & Bilderbeek (1999)
Service concept, service process, service system	Supplier offers the service concept and enabling processes and systems that customers should receive	Edvardsson & Olsson (1996)

The different dimensions of service innovation outcomes presented in Table 3 are consolidated to propose a universal definition of a service. Uniting the purpose-driven descriptions and the constituting elements results in this study's universal and holistic service definition. Generally, the derived service dimensions draw heavily on the research of Barrett et al. (2015), den Hertog & Bilderbeek (1999), and Mathieu (2001). Figure 9 illustrates the consolidated definition of industrial companies' services in terms

of six dimensions. This unified set of dimensions defines how this study considers services in detail. Each of the six dimensions specifies services regardless of their purpose or embeddedness within the provider's service or product portfolio.

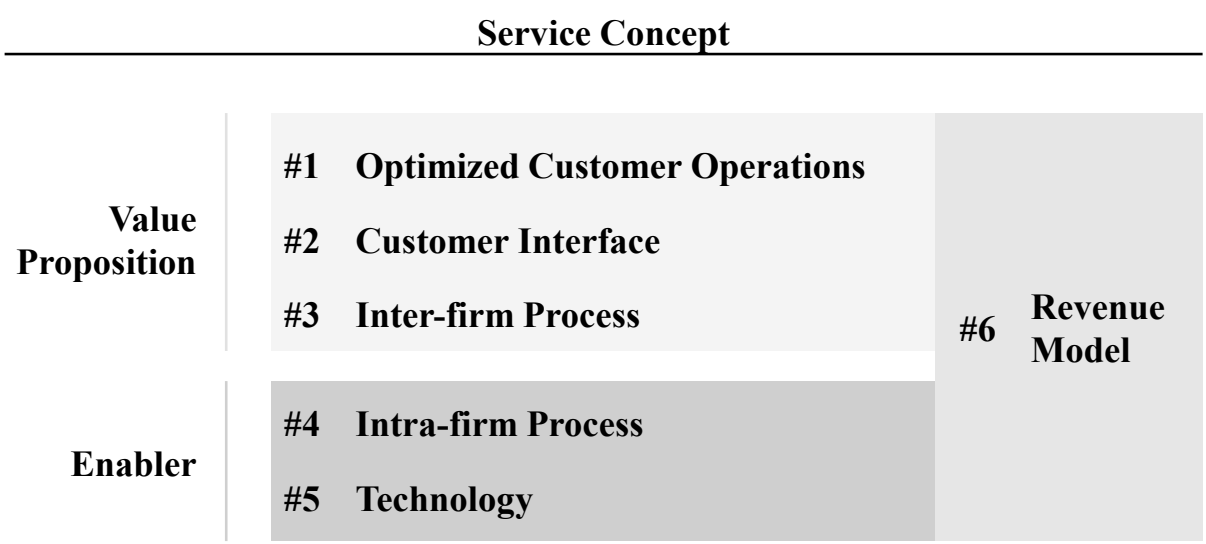

Figure 9: Six dimensions of service. Own illustration

In general, service offerings consist of value propositions and enablers. The value propositions build on three dimensions: *optimized customer operations*, *customer interface*, and *inter-firm processes*. Only these three dimensions are visible to the customers. Thus, there is a line of sight between the value propositions and the enablers. This distinction is aligned with the established framework to conceptualize service offerings, namely with the *service blueprint* (Bitner, Ostrom, & Morgan, 2008). *Optimized customer operations* are the overarching goal of every service (Mathieu, 2001). Edvardsson & Olsson (1996) refer to this outcome as "an efficient customer process adapted to the logic of the customer's behavior and with a good customer outcome, i.e., service, providing quality and added value in the eyes of the customer" (p. 140). Currently, the deployment of *digital or physical interfaces* between the supplier and the customer ensures the achievement of this outcome (Barrett et al., 2015; den Hertog & Bilderbeek, 1999). For example, the interaction between frontline employees and customers is considered a physical customer interface. Digital interfaces refer to graphical user interfaces (GUI) or any digital interaction between providers and customers. Furthermore, *inter-firm processes* are process steps that providers perform in cooperation with their customers (e.g., reception of an order or on-site maintenance work). The enablers rest on two dimensions: *intra-firm processes* and *technology*. *Intra-firm processes* are process

steps that providers must perform in order to deliver a service without engaging with their customers (e.g., frontline employees driving to customers or preparing repair jobs). *Technology* enables all kinds of services. Software, digital infrastructure, connectivity, and hardware constitute this dimension (Barrett et al., 2015; Cusumano, 2012; den Hertog & Bilderbeek, 1999; Henfridsson & Bygstad, 2013; Porter & Heppelmann, 2015). Moreover, the hardware consists of the installed base, supporting devices that ease service delivery, and third-party devices to generate insights through data exchange (Barrett et al., 2015; Brax & Visintin, 2017). Finally, the revenue model can be part of the value proposition and the enablers (Ulaga & Reinartz, 2011). If the revenue model is more focused on reactive service delivery, it is instead considered to form part of the enabler dimension. In contrast, if the revenue model focuses on the performance of the service, it is regarded as being part of the value proposition.

As stated earlier, the six service dimensions – introduced above – apply to both analog services and digital services and allow for a differentiation between the characteristics of both. The objective of digital services is to optimize customer operations by leveraging digital connectivity and data analyses (Klein, Biehl, & Friedli, 2018; Williams, Chatterjee, & Rossi, 2008). Therein, the digital services highlight the importance of digital technologies in all dimensions. They furthermore become partly tangible as customers can own these two dimensions through the application of software and data processing (Williams et al., 2008).

2.5.2 Digital service innovation process

The presented perspective on the definition of services lays the foundation to elaborate on their development approaches. The current body of literature on service innovation processes is extremely heterogeneous (Gustafsson, Snyder, & Witell, 2020). The constructs researchers apply to describe topics related to developing new services are *service innovation*, *new service development (NSD)*, *service engineering*, and *service design* (Bullinger et al., 2003; Gustafsson et al., 2020; Witell et al., 2016).

Service innovation and *NSD* refer to comprehensive frameworks of the service development process and their outcomes. *Service engineering* and *service design* concentrate on technological solutions and design principles for new services. However, their focus areas are superficial as the literature interchangeably applies all designations (Witell et al., 2016).

Furthermore, three views on developing new services exist superordinate to all concepts: the *assimilation perspective*, the *demarcation perspective*, and the *synthesis perspective* (Coombs & Miles, 2000). The *assimilation perspective* concentrates on transferring product innovation practices to service innovation without adaptation (Evangelista, 2000). With the rise of services, certain researchers argued in support of the similarities between services and products. Their studies focused on a technology push as the main driver of new services (Toivonen & Tuominen, 2009). The *demarcation perspective* contradicts the assimilation perspective by arguing that service innovation is fundamentally different from product innovation (Coombs & Miles, 2000). In this sense, non-technological elements, organizational knowledge, and customer involvement are essential to successful service offerings (Hipp & Grupp, 2005). Consequently, the unique characteristics of services call for an independent service innovation process (Storey, Cankurtaran, Papastathopoulou, & Hultink, 2016). The *synthesis perspective* claims that a unified approach to innovating products and services is the most promising way to develop successful services (Gallouj & Savona, 2009). The motivation for pursuing the synthesis perspective is grounded in ongoing servitization (Biemans & Griffin, 2018). Following the synthesis perspective, the literature argues that industrial companies should combine innovation activities to bundle products and services in a unified offering.

At first glance, these three perspectives seem to follow disjunct approaches. However, Witell et al. (2016), in their systematic literature review to analyze the classifications of service innovation, conclude that all perspectives follow a service-specific innovation approach. Instead of following disjunct approaches, each view focuses on different innovation outcomes. While the assimilation perspective concentrates on innovating radical service outcomes, demarcation aims at innovating incremental service adaptations, and synthesis emphasizes the value proposition design of services. Consequently, service innovation processes can hardly be classified based on the influence of product development. In contrast, they should be classified according to the specific outcome that companies pursue when innovating new services.

Furthermore, the specific process designs that exist in academia show additional improvement potential. Across the three perspectives, several researchers propose different service innovation processes. Three dominant examples are presented to demonstrate their main characteristics. Academia recognizes these examples as service-specific innovation approaches and highlights their attempts to meet service requirements.

Alam & Perry (2002) introduced a fundamental example of a linear service innovation process. Their ten steps, namely strategic planning, idea generation, idea screening,

business analysis, forming a cross-functional team, service design and process system design, personnel training, service testing and pilot run, test marketing, and commercialization, align with product innovation's traditional Stage-Gate model. Simultaneously, they emphasize the importance of involving customers throughout the process. Besides linear models, Johnson et al. (2000) and Menor, Tatikonda, & Sampson (2002) stress the importance of iterative process designs. Their four steps of design, analysis, development, and full launch constitute a cycle that iterates the service design until it reaches a level of customer satisfaction. In the same vein and in order to develop successful services, Kindström & Kowalkowski (2009) suggest following a cycle of market sensing, development, sales, and delivery.

Although all of these approaches include service-specific development characteristics, further analyses indicate that the attainment of these characteristics is not entirely met (Troilo et al., 2017). This is exemplified by industrial companies facing difficulties in implementing digital service innovation approaches (Baines & Lightfoot, 2013; Fang, Palmatier, & Steenkamp, 2008). In particular, the companies experience a lack of guidance as the firms' structures, cultures, roles, processes, and skills are not designed to pursue service innovation (Biemans et al., 2016; Bullinger et al., 2003; Troilo et al., 2017). As a result, it is necessary to design a new, suitable innovation approach to the development of services that can help industrial companies drive their competitive advantage (Gebauer, Krempl, Fleisch, & Friedli, 2008; Thakur & Hale, 2013).

To the best of our knowledge, as suitable service innovation processes are rare, there is no process that sufficiently develops digital services at industrial companies. The systematic literature review of Blum, Budde, & Friedli (2019) confirms the existence of this shortcoming; a shortcoming that is even more relevant in the age of digitalization since strong innovation practices gain importance with the increasing magnitude of (digital) service innovation's growth (Kowalkowski, Kindström, & Gebauer, 2013).

Besides researching aggregated digital service innovation processes, as described above, academia also approaches service innovation at the routine level (Subsection 2.3.1). This narrower research approach explores the required routines that firms should execute to pursue service innovation successfully. Stähle (2020) analyzed these routines in the existing literature comprehensively. From a theoretical point of view, the identified routines are mandatory to operationalize digital service innovations purposefully. Therefore, these routines provide the building blocks for this research's digital service innovation process. Table 4 presents and positions Stähle's (2020) findings in the context of this study.

Table 4: Service innovation routines. Based on Stähle (2020)

Dynamic Capabilities	Routines	Sources
Sensing	Experimental learning	den Hertog et al. (2010); Janssen, Castaldi, & Alexiev (2016)
	Continuous learning	(den Hertog et al. (2010); Salunke, Weerawardena, & McColl-Kennedy (2019); Tsou & Cheng (2018)
	Knowledge management	Jin, Chai, & Tan (2014); Ordanini & Parasuraman (2011); Shang, Lin, & Wu (2009); Sharma, Conduit, & Rao Hill (2014); Tang, Wang, & Tang (2015)
	Customer co-development	Giannopoulou, Gryszkiewicz, & Barlatier (2014); Kindström & Kowalkowski (2014); Liu & Huang, (2018); Parida, Sjödin, Lenka, & Wincent (2015); Randhawa, Wilden, & Gudergan (2018); Salunke et al. (2019); Tsou & Cheng (2018)
	Open innovation	Agarwal & Selen (2013); Giannopoulou et al. (2014); Randhawa et al. (2018); Thanasopon, Papadopoulos, & Vidgen (2016); Tsou & Cheng (2018)
Seizing	Formalized service design and development	Bhatnagar & Gopalaswamy, (2017); den Hertog et al. (2010); Jin et al. (2014); Parida et al. (2015); Storey & Hughes (2013)
	Cross-functional collaboration	Mennens, Van Gils, Odekerken-Schröder, & Letterie, (2018); Ordanini & Parasuraman, (2011); Sharma et al. (2014)
	Modularization and standardization	den Hertog et al. (2010); Kindström & Kowalkowski (2014)
	Scale and roll-out	den Hertog et al. (2010); Janssen et al. (2016)
	Building relationships with customers	Agarwal & Selen (2013); Chen, Wang, Huang, & Shen (2016); Jin et al. (2014); Kindström & Kowalkowski (2014); Swift & Hwang (2008); Weng & Huang (2012)
	Building relationships with suppliers and external partners	Agarwal & Selen (2013); Bhatnagar & Gopalaswamy (2017); Chen et al. (2016); den Hertog et al. (2010); Giannopoulou et al. (2014); Witell et al. (2017)
	Orchestrating external relations	Ghoshal, Roy, & Dutta (2018); Janssen et al. (2016); Kindström & Kowalkowski (2014); Liu & Huang (2018); Ordanini & Parasuraman

Dynamic Capabilities	Routines	Sources
		(2011); Sharma et al. (2014); Thanasopon et al. (2016)
Transforming	Identifying customer needs and market opportunities	Agarwal & Selen (2013); Cantaleano, Rodrigues, & Martins (2018); den Hertog et al., (2010); Ghoshal et al. (2018); Janssen et al. (2016); Kindström et al. (2013); Thanasopon et al. (2016); Tsai & Wang (2017)
	Identifying technological opportunities	den Hertog et al. (2010); Kindström et al. (2013); Tsai & Wang (2017)
	Portfolio management	Jin et al. (2014); Kindström & Kowalkowski (2014); Kindström et al. (2013)

2.5.3 Digital service innovation governance

The implementation and execution of digital service innovation need guidance through governance (*cf.* Deschamps & Nelson, 2014; Leonhardt, Hanelt, Huang, & Mithas, 2018). Although still in its preliminary stages, the primary research on innovation governance provides the foundation for digital service innovation (Subsection 2.4.3).

In general, researchers interpret digital service innovation governance "as structures, processes, and relational mechanisms for the effective development of digital innovations in an organization" (Leonhardt et al., 2018, p. 3). However, a suitable model covering the relevant dimensions seems absent (Brown, Ambler, & Royce, 2013; Leonhardt et al., 2018; Young, 2018). Nambisan, Lyytinen, Majchrzak, & Song (2017) claim that the peculiarities of existing innovation governance models are insufficient to steer digital service innovation. For this reason, academia leverages the concepts of *project governance* (e.g., Karlsen, 2020) and *IT governance* (Leonhardt et al., 2018) to elaborate on the mechanisms guiding digital service innovation.

Project governance "is about the systems, mechanisms, processes, and relationships by which projects are controlled and directed" (Karlsen, 2020, p. 928). Young (2018) designed five underlying dimensions that constitute project governance. First, all involved stakeholders must align their joint project objectives. Second, a project sponsor must be held responsible for achieving the aspired goals. Third, project governance must define metrics to measure the projects' success rate while, fourth, continuously controlling these during the execution. Fifth, transparent decision-making processes need to define adaptations of the projects' deliverables along with the project execution.

IT governance builds upon two dimensions. First, formal structures enable suitable decision-making to guide firms' IT applications (Sambamurthy & Zmud, 1999). Second, horizontal networks establish mechanisms to cooperate within organizations by defining organizational roles and committees, separate from the existing hierarchical structures (Brown, 1999). Thereby, a dilemma arises concerning the implementation of IT governance. The centralized or decentralized allocation of the roles and committees influences the governance's effectiveness. Each firm must assess the most suitable configuration according to its boundaries. Usually, centralization results in more efficient approaches, while decentralization increases responsiveness (Leonhardt et al., 2018). This basic understanding of digital service innovation governance serves as the starting point to further elaborate on its constituting elements in Chapter 3 and Chapter 4.

2.6 Theoretical foundation

To conclude this chapter, it is noted that the value propositions of competing industrial companies converge in various markets. Similar technologies and comparable quality standards drive this evolution. Nevertheless, the affected companies seek to escape from the current conditions as their margins are shrinking. Accordingly, academia proposes the building and leveraging of dynamic capabilities to transform firms' resource bases. This transformation should secure the firms' competitiveness by satisfying customer needs.

Sensing, seizing, and transforming activities make firms' capabilities dynamic. In the firms, these three clusters are implemented through organizational processes. The organizational processes comprise routines, artifacts, and actors, which also define their implementation.

This work applies the dynamic capabilities view in the realm of digital service innovation. Generally, in the context of dynamic capabilities, innovation is divided into its outcome, process, and governance. Each of the three dimensions contributes to the motivation of this research.

Product and process innovations characterize disjunct innovation outcomes. Digital services, however, involve these two types of innovation, as illustrated by the services' six core dimensions (Subsection 2.5.1). The optimized customer operations, inter- and intra-firm processes, technology, and revenue model underline the intense interrelationship between product and process innovations in digital services.

Traditional innovation processes support industrial companies in developing highly successful products (Wheelwright & Clark, 1992). However, their focus is mainly on

technology-driven innovations based on their successful product business history. Thus, current innovation approaches mostly neglect other sources of innovation (Birkinshaw, Hamel, & Mol, 2008; Miles, 2005). In this regard, industrial companies keep to technology-driven innovation approaches instead of driving customer-centric innovation processes (Pinheiro & Stein, 2014). Blum et al. (2019) endorse the notion that, in the context of digital service innovation, suitable processes are scarce in academia and practice. In this respect, routines of digital service innovation have not been consolidated into a coherent and consistent process, although research has comprehensively identified individual routines (Den Hertog et al., 2010; Kowalkowski et al., 2013; Pettus et al., 2009).

Moreover, the increased complexity of customer-centric innovations compared to technology-driven innovations also drives the need to adjust the steering mechanism of innovation. Although initial findings have been made on how firms should approach innovation governance, there is a need to propose suitable digital service innovation governance models as researchers tend to apply IT or project governance only as an aid to address this topic.

The missing organizational process of digital service innovation and its governance sets the foundation for the subsequent research. The next chapter (Chapter 3) explores the necessary requirements for digital service innovation, based on the theoretical background (Chapter 2) and an interview study involving 24 industrial organizations. The following synthesis of the literature's identified routines and the interview study's findings constitute the framework for the subsequent analysis of a single embedded case study. Finally, the results lead to the definition of digital service innovation's organizational process (Chapter 5).

3 Requirements for digital service innovation

The existing knowledge to guide digital service innovation at industrial companies is limited (Chapter 2). This chapter presents the interview study on industrial companies' routines to navigate through digital service innovation. The expected findings provide the starting point to analyze the corresponding artifacts and actors (Chapter 4).

Academia discusses digital service innovation routines at various levels of detail (Gebauer et al., 2017). The resulting variability of the routines' contexts prevents their aggregation into a consistent innovation process. Also, the identified building blocks (routines) mainly refer to the required actions on an abstract level (*cf.* Stähle, 2020). This abstract routine level is insufficient in practice and needs more context to become an implementable organizational process (Biemans et al., 2016). Moreover, the literature makes an imprecise distinction between service innovation and digital service innovation (Section 2.5). Therefore, this study contextualizes the routines (Table 4) evident in digital service innovation at industrial companies by analyzing the firms' current approaches.

Three contributions augment the motivation of this introductory study. First, the exploration of routines in the realm of industrial companies adds to their applicability. Second, their context grants the finding of a suitable level of abstraction. Third, the chronological coordination of the routines is vital to attain the aspired organizational capability of digital service innovation (Helfat & Peteraf, 2003). Hence, the subsequent analyses start with a presentation of the required routines and their practical context within digital service innovation.

The next sections provide a detailed description of the applied research method (Section 3.1), indicate the study's findings along aggregate dimensions (Section 3.2), and synthesize the results by combining them with the literature's previously defined routines (Section 3.3). To construct the digital service innovation process, the final framework (Figure 12) summarizes the results and guides the subsequent case study research (Chapter 4).

3.1 Research method

Exploratory case research based on an interview study is suitable to reveal the intricate detail this study seeks to consolidate (*cf.* Eisenhardt & Graebner, 2007; Yin, 2018). Furthermore, as Voss et al. (2002) contend, case studies provide "an excellent means of

studying emergent practices" (p. 199), being an attribute that justifies their suitability for this work.

Two factors determine the appropriateness of case studies (Yin, 2018), namely the research question that the author wants to answer and the maturity of the research field. In addition, to ensure its implementation, Eisenhardt (1989) underlines the importance of directing case study research within clearly defined boundaries. Multiple case companies allow the gaining of comprehensive and generalizable insights (Eisenhardt & Graebner, 2007; Yin, 2018). These cases are identified based on a purposeful selection scheme, illustrated by Patton's (2002) view of purposeful sampling:

> *The logic and power of purposeful sampling lie in selecting information-rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term purposeful sampling. Studying information-rich cases yields insights and in-depth understanding rather than empirical* (p. 273).

This study aligns with the literature's suggestions to conduct case study research as it, among others, analyzes the emergent field of digital service innovation. In this respect, it explores the required routines and their application with the help of "how" and "what" questions. Therefore, the research setup suits both case study criteria (*cf.* Section 1.5). Moreover, the study leverages 24 organizations as knowledge sources. Since these organizations are active in several industrial sectors, they further increase the generalizability of the findings. The entire sample was selected on the basis of a purposeful strategy in order to ensure an in-depth understanding of digital service innovation.

Four criteria were applied to select the sample. First, large corporates in the business-to-business area were targeted. Second, at least during the pilot phase, the firms' portfolios had to include digital services. Third, organizations that had already started to transform their organizational configuration were preferred. Fourth, existing cooperation between the organizations and ITEM-HSG eased access to current approaches. In addition, the organizations' willingness to share knowledge also directed the selection process.

Based on the use of these inclusion criteria, the sample comprises a heterogenous but balanced distribution of organizations that offer digital services ranging from a few to a substantial number. As a result, the wide range of offered digital services ensures a maturity spread that provides holistic insights and enables the deriving of recommendations for a wide range of industrial companies.

3.1.1 Data collection

Individual in-depth interviews served as the foundation of this study. The use of the dynamic capabilities view and additional background research on the informants and their organizations ensured extensive knowledge gathering. Twenty-four informants were asked open-ended questions in semi-structured settings (Table 5). As proposed by Misoch (2019), the structure included four phases: information phase, warm-up phase, main part, and conclusion. The triangulation process during the preparation also supported the validity of the interview results.

The interviews were primarily conducted by the lead investigator, supported by assistants. Face-to-face meetings and, during the COVID-19 pandemic, online tools like Microsoft Teams enabled the interviews. The data were collected between November 2019 and April 2021, with a share of 70% in German and 30% in English. Each interview was recorded and transcribed with the informant's consent to enable extensive data analysis (*cf.* Mayer, 2012). The informants' roles in their organizations range from the upper management level (e.g., Managing Director, Division Head, or Head of Service) to product or portfolio management (e.g., Strategy Manager, Product Manager, or Product Owner). Each interview, on average, lasted 80 min.

Following the iterative research approach (*cf.* Section 1.5), four iterations produced the total sample of the interview study. Each iteration focused on slightly different focus areas of digital service innovation to gather a holistic understanding of the topic. The data gathering was completed once the body of existing insights became saturated (*cf.* Baker & Edwards, 2012; Eisenhardt, 1989).

Table 5: Overview of the case companies

#	Informant's role	Pseudonyms	Industries	# Employees
1	Service Manager	AgriCo	Agricultural machinery	70,000
2	Director Aftersales	Agri2Co	Agricultural machinery	20,000
3	Country Director	CleanCo	Cleaning equipment	15,000
4	Head of Division	ComCo	Machinery	50,000
5	Director Innovation	ConstCo	Building technologies	70,000
6	Service Manager	ElecCo	Electrical engineering	140,000
7	Innovation Manager	InfraCo	Infrastructure	10,000

#	Informant's role	Pseudonyms	Industries	# Employees
8	Head of Innovation	IntLogCo	Automatization	5,000
9	Director Aftersales	LogCo	Logistic equipment	20,000
10	Head of Service	MachineCo	Machinery	5,000
11	Country Director	MachineCo	Machinery	N/A
12	Head of Service	MedCo	Medical technology	10,000
13	Marketing Manager	MedCo	Medical technology	N/A
14	Product Manager	Med2Co	Medical technology	65,000
15	Service Manager	MobCo	Mobility equipment	400,000
16	Sales Consultant	Mob2Co	Mobility equipment	40,000
17	Country Director	PlantCo	Plant engineering	10,000
18	Division Head	PrintCo	Machinery	10,000
19	IIoT Manager	PumpCo	Machinery	5,000
20	Service Manager	ScaleCo	Weighing equipment	15,000
21	Country Director	ScaleCo	Weighing equipment	N/A
22	Service Manager	Scale2Co	Weighing equipment	5,000
23	Strategy Manager	SteelCo	Machinery	105,000
24	Service Manager	TexCo	Machinery	5,000

3.1.2 Data analyses

The transcribed interviews were analyzed following a thematic interpretation approach (Clark, Gioia, Ketchen, & Thomas, 2010). Accordingly, a three-step contextualization ensured abstract patterns to gain knowledge from the complex raw data (Braun & Clarke, 2006; Gioia, Corley, & Hamilton, 2013).

First, the transcripts were read repeatedly for data aggregation, and essential phrases and passages were highlighted when they contributed to the research purpose. These phrases and quotes served as the nucleus of the derived coding structure. Thus, inductive coding was applied in the nascent stage of the analysis (*cf.* Tomczak, 1992). The interviews of the later iterations were mainly coded based on a deductive scheme. However,

the general coding structure evolved throughout the coding process to best contribute to the research objectives. The resulting first-order quotations were assessed in terms of their interrelationship. Second, this consolidated, first-order themes into second-order quotations. Third, the latter allowed a further condensation to build aggregate dimensions. After completing the analyses and where necessary, the entire data structure was translated from German into English.

Through this three-step contextualization and the aggregations, generic insights were derived from the interview study (Noor, 2008). The well-known coding software *Atlas.ti* supported the full analyses of the transcribed interviews. Figure 10 summarizes the entire data structure and presents the aggregate dimensions.

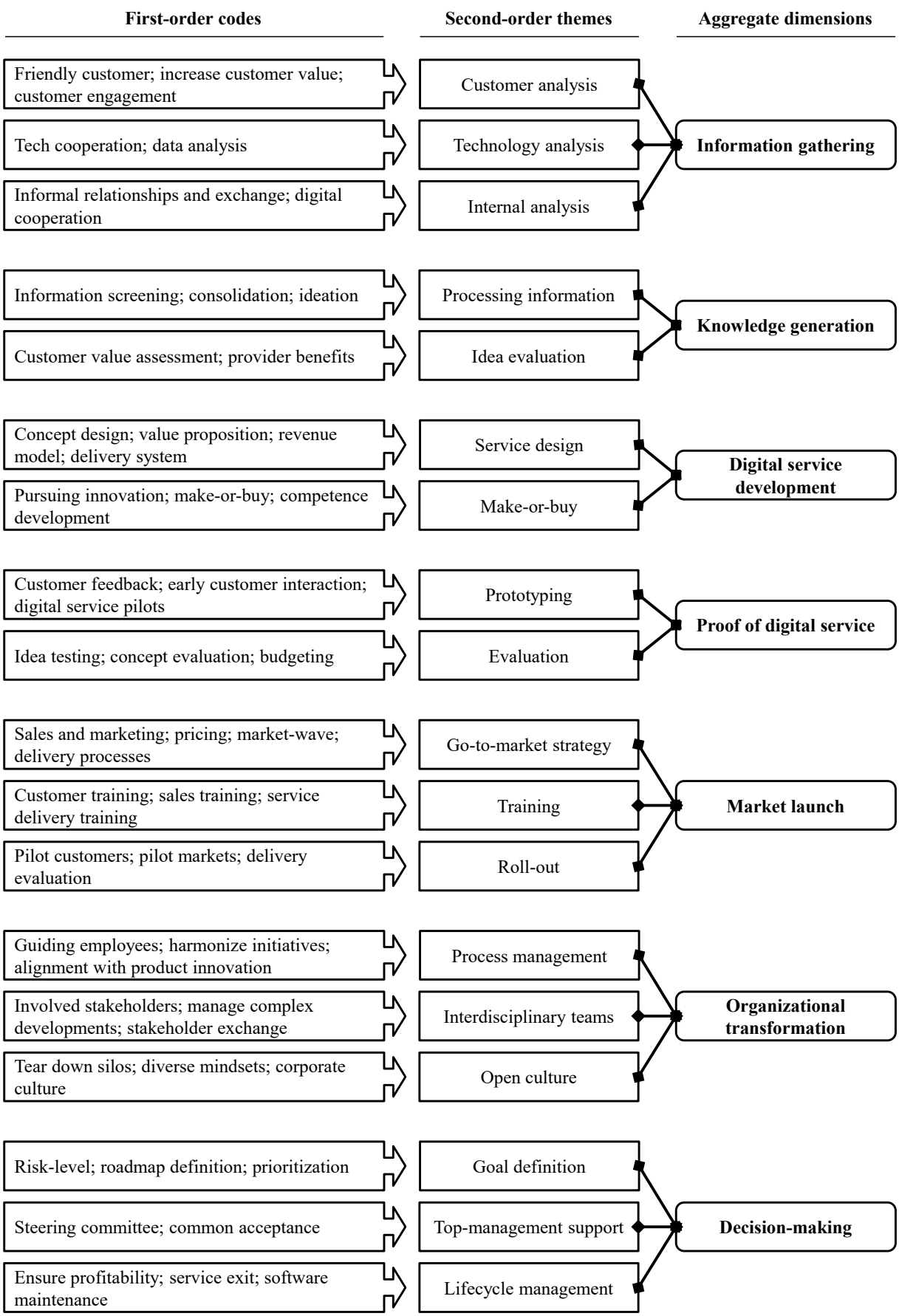

Figure 10: Data structure of the interview study. Own illustration

3.2 Findings

The interviews revealed eight aggregate dimensions (Figure 10) that form the basis of the case research framework (Chapter 4). In the next sections, the dimensions are described to clarify their meanings and to provide more background information, before synthesizing the practical examples into theoretical insights (Section 3.3).

Moreover, the following exposition provides initial context to and information on the links between the routines of each aggregate dimension. In addition, verbatim quotes give voice to the informants of the analyzed organizations. Their companies' pseudonyms and the corresponding number, e.g. (MedCo, 01), indicates each quote's allocation in the interview study. In this example, the number 01 refers to the first quote in MedCo's transcript.

Information gathering rests on the three subdimensions of *customer*, *technology*, and *internal analysis*. These subdimensions comprise all sources and activities that companies need to sense new digital service business opportunities. The customer analysis represents one of the key areas to identify new pathways to increasing customer value. A manager from PrintCo (16) vividly elaborates on the customer value perspective:

> *Many chief digital officers care deeply about technology, and I read all these articles on […] how to do blockchain and so on. But, from my experience, all of that is not mission-critical. There is enough technology for what we are doing here, at least in this environment of classic machinery and plant engineering. […] There is no shortage of technology. But the skill now is to say I'll use it to create a value-added service […] that I can also successfully bring to the market.*

Moreover, several informants explain how they interact with their customers to gain insights into the customers' businesses and related opportunities. Table 6 summarizes the most prominent interaction methods for information gathering.

Table 6: Means to gain market insights from customers

Means to engage with customers	Indicative sources
To analyze customer needs, we seek conversations with our customers. So that's where it starts for us.	TexCo, 15
We have periodic discussions with [our customers], not just at a senior manager level but even on the ground, which is where the operation guys are. You do not get the solution there but all their pain points. You know you [get] a piece of everything together like a jigsaw puzzle.	CleanCo, 6

Means to engage with customers	Indicative sources
We regularly send questionnaires to our customers for them to answer. These are not so long; they contain only ten questions. So, after long experience and different iterations, we have improved this questionnaire step by step to identify customer needs as well, and [as] fast as possible.	AgriCo, 9
So, what we do is that we do a site walk. A site walk is where we walk with a client […] to pinpoint all their needs at once. It typically takes three to four hours per site. We have a checklist of questions we ask. After this whole exercise, we can sit down and identify what the top pain points are and whether we have a solution to address [these] pain points.	CleanCo, 4
We have customer panels that we maintain. Also, we work with influencers in the customer area who represent a more or less standing panel.	ScaleCo, 16
A new product […] replace[s] the existing one, [based on] a platform for feedback on the quality issues and all [of] this. So, they will probably use the database of the previous model […] to overcome the weak points of the previous model. So, that's why […] every machine probably has a lifespan of maybe five years […] before the model gets replaced. So, we get feedback and improve on the new product.	CleanCo, 18
We actually engage [with] organizations that provide market intelligence to do this kind of survey on our customers [in order] to rank and list the type of service that is most important to them all the way down to the ones that [they] don't really care about.	MedCo, 4

Although companies apply several tools to engage with their customers, clients must be willing to cooperate with the provider. A MedCo manager describes this requirement as "a need to have a friendly customer who is willing to go on a journey with me to develop such a topic together" (MedCo, 24). However, the manager adds that "it is very challenging for most companies to have people with the right skills and mindsets on both sides to enable such discussions" (MedCo, 43).

Information gathering's next dimension of *technology analysis* concentrates on two areas. First, it includes the cooperation of service providers with established technology companies. Thereby, industrial companies "do not need to reinvent the wheel […] and [thus] can utilize the experience [of tech companies]" (MedCo, 33). Second, research and development combined with data analytics shape this subdimension. A ScaleCo manager explains the opportunities as follows:

> *Device data [are], of course, interesting. I'll give you the example of analyzing usage data and thus examine which devices make sense for the customer in order to optimize his equipment pool.*

Information gathering's *internal analysis* closes its set of subdimensions. The informal information exchange among the providers' employees plays a significant role in many organizations. Some companies support this through their corporate culture. Alternatively, firms encourage their employees to conduct "workshops with brainstorming and posting sticky notes at the wall to discuss the current situation in the different markets" (LogCo, 5). In the same vein, the internal identification at MachineCo relies on "word-of-mouth recommendation" (MachineCo, 20). IntLogCo and others also communicate with their employees:

> *We actually leave the mailbox more or less open. So, throw in what you want to throw in, and we take care that the ideas are then taken up.*

Contrarily, LogCo emphasizes the benefits of a globally available enterprise resource system (ERP) to better serve the customers by having the correct information at hand. Finally, digital service innovations rely on intense market analytics and close interaction with the key stakeholders. The systematic processing of the gathered information is a prerequisite for profound knowledge generation.

The three sources of information gathering (customer, technology, and internal organization) are consolidated and refined to develop valuable digital service ideas in **knowledge generation**. The overarching objective is to develop ideas for future digital services. The firms, however, mainly concentrate on the passive collection of ideas, with the result that proactive analysis and idea generation are still rare. Also, companies focus on developing new technologies instead of designing customer value. On the contrary, an AgriCo manager concludes that their "customers do not mind how AgriCo manages to provide the services" (AgriCo, 10). ComCo adds, among others, that the evaluation of services also lacks suitable criteria to assess service characteristics. Hence, the specific processing of derived market intelligence and the subsequent assessment thereof require further specification in the overarching digital service innovation process.

After the identification of future service business opportunities, the firms start to **develop digital services**. The development's core elements are the *service design* and the *allocation of resources*. The service design creates the overarching concept of the digital service and includes the value proposition, process designs (e.g., service delivery), technology development, and the revenue model. MedCo clarifies the relevance of the service process design by contrasting products and services:

> *The typical difference between product and service: Product is tangible, I can touch it, I can test it, I can try it. Service is much about trust. So, the process is extremely important. How well are these service delivery or execution processes defined? So that everything works.*

At this point, the main challenge of the firms is to develop the service-specific elements, e.g., the value proposition, related processes, and revenue model. The firms' long history in product innovation supports them in developing tangible products or tangible service elements. In this context, the digitalization of products enabled them to develop software and related components. As the companies were familiar with this area, they primarily targeted the technology part of the digital services.

Hence, many firms discuss the trade-off between partnering with experienced service developers and the internal expansion of their competencies. Pioneers in digital services address this issue by involving various departments in the development. The cooperation between business development, IT, sales and marketing, and training organizations is, in particular, a promising avenue to leverage the firms' expertise in digital service innovation. Contrarily, managers face the challenge that important stakeholders are often not available when needed. IntLogCo indicates that they "decide to follow the opportunistic way of directly proceeding with the development" (IntLogCo, 3) without involving internal stakeholders or customers.

Along with the digital service development, **proofs of** the evolving **digital service** ensure the market fit and general viability. Typically, prototypes in manifold appearances enable these proofs. In the early development phase, PowerPoint presentations and white or concept papers are the prototypes that the firms discuss with their customers. From this stage onwards, the development team hones the prototypes into a marketable digital service. MachineCo proceeds with its prototypes as follows:

> *We create a preliminary prototype and see how we can realize it in order to get a budget for the development [of the service from the senior management]. Once we have the next [-level] prototype, we see if we can find one or two test customers in our vicinity. Then we test this prototype with the customers [and keep on continuously improving the service]. That's actually our approach.*

The prototypes create the foundation for the evaluation and steering of digital service development. The firms' conviction on how to implement the assessment of the prototypes is controversial. Some managers argue that the procedure should be identical to product innovation. This produces a universal orientation to different development projects across the entire organization. Opposing managers highlight the digital services' peculiarities and thus emphasize the establishment of new evaluation mechanisms and

practices. These should have service-specific evaluation criteria and steering committees, as elaborated upon in the implementation and evaluation of the prototypes (Chapter 4).

The **market launch** benefits from an iterative approach similar to leveraging prototypes in the development phase. ComCo describes this as:

> *Quite an agile process. [It] means that we first collect the requirements. Then we check implementation and consult with the customer every fourteen days. We ask them if everything is working as expected. Then the first real release hits the market. However, before that, a small group will first check everything internally. Then there is a limited number of user groups [that] in turn give their feedback before the rollout. So, there is a multi-stage process behind it.*

In this phase, firms define the go-to-market (GTM) strategy (e.g., promotions, pricing and selling approach, delivery processes, and timing) and identify the pilot customers and regions where they want to launch the new digital service. From this moment, the service is rolled out to an increasing number of customers in all target markets. To ensure the successful roll-out, the firms' organization and involved customers must be trained to deliver and receive the service.

The firms must also address more generic topics beyond the chronological execution of the aggregate dimensions, ranging from information gathering to the market launch. **Organizational transformation** is required to ensure a *formalized digital service innovation process*, the support of *interdisciplinary teams*, and *open culture*. LogCo, in particular, illustrates the need for a formalized innovation process in the digital world:

> *Quite frankly, that's one of the areas where we still struggle. We have to work on that. That's still new. The amount of data is growing, of course, especially in the digital world. It's always easy to accumulate huge amounts of data. But if you don't use it in a proper systematic way, it's actually worthless. And especially in the course of the growing amounts of data, we simply have to establish this process. I'll be quite frank with you – this is our area of improvement. This is actually reactive management of the data. In other words, we take a look when we identify a customer need or have a meeting with the customer. Then we consult the data reactively. What we don't do is proactively analyzing the data to [identify] benefits for our customers.*

Other firms similarly underline the advantages of a formalized process, with its ability to consolidate innovation initiatives and to guide employees through the innovation endeavors underpinning the dominant improvements. This process, however, requires a

comprehensive alignment with the existing product innovation process to ensure a strong offering portfolio.

In addition, digital service innovation relies on open-minded employees who frequently enter into exchanges with their peers and other entities to gain the required knowledge. Therefore, an innovation-friendly environment builds on an open work culture that encourages all stakeholders (including customers and suppliers) to verify or falsify the options they develop in response to the existing business problem.

The entire digital service innovation journey is accompanied by **decision-making**. The executing stakeholders intuitively make most of the decisions along the course of digital service innovation. However, more strategic decisions require further guidance through a systematic decision-making mechanism. This typically relies on the support of upper management. They decide on the continuation of innovation projects and acts in accordance with their experience as enablers. More specifically, because the possible options are too broad, firms define guiding principles to steer their digital service innovations. Managers also specify the desired risk level and the targeted implementation roadmap in their goal definition. Furthermore, digital services need guidance through proactive lifecycle management to protect their profitability and customer value.

In sum, the interview study developed a comprehensive understanding of digital service innovation's seven dimensions (Figure 10). In the next section, based on these insights, the practical perspective is united with the initial theoretical elements of digital service innovation.

3.3 Definition of requirements

The interview-based case study revealed seven dimensions that constitute digital service innovation. These dimensions provide a practical perspective of the topic. On the one hand, they indicate the specific activities firms need to accomplish to pursue digital service innovation. On the other hand, they make provision for an interpretation of the connections between the activities. A consolidated set of digital service innovation routines can be developed, based on this practical perspective and the presented theoretical routines.

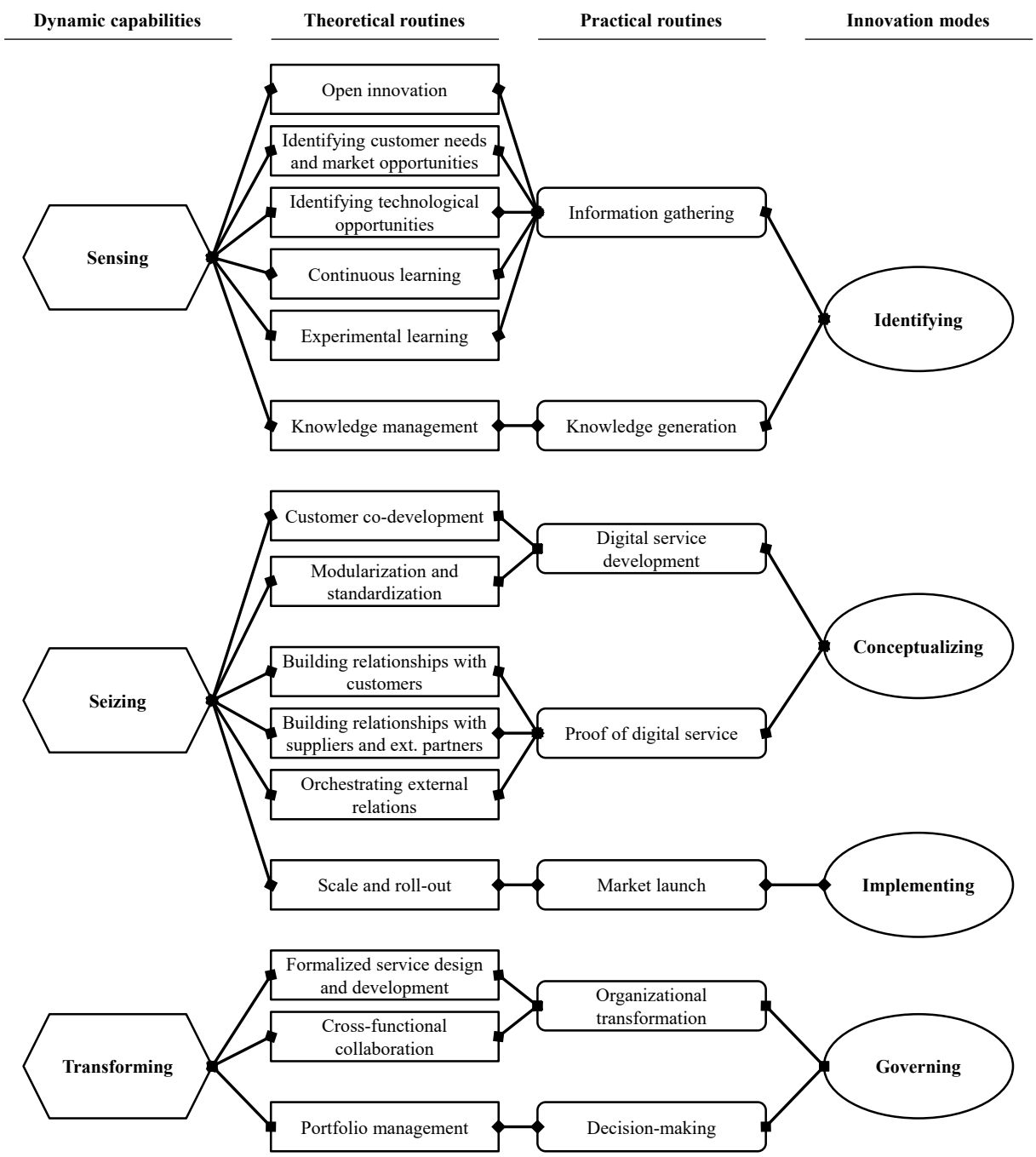

Figure 11: Dynamic capabilities mapped on aggregate dimensions. Own illustration

A comparison of the theoretical routines shows that both sets match each other. Thus, the fifteen theoretical routines can be linked to the identified practical routines (aggregate dimensions) as their descriptions enable this consolidation. As a result, the routines derived from the context of the dynamic capabilities view gain context and chronological order.

Moreover, the practical routines allow for a further consolidation of the higher innovation process and the governance level. Based on the innovation modes proposed by

Blum et al. (2019), the practical routines are further consolidated into a process perspective. Furthermore, the supporting literature of Schilke et al. (2018) and Teece (2007) enables the connection of the governance dimensions. Figure 11 depicts the mapped sets of routines and the added innovation modes.

Finally, Figure 12 summarizes the findings at a highly consolidated level by visualizing the practical routines and innovation modes. The dynamic character of the three innovation modes, namely identification, conceptualization, and implementation, is rooted in the interview study's results and is thus located at the core of digital service innovation. Also, the governing part encloses the process dimensions and steers the entire process through organizational transformation and decision-making. In summary, this chapter outlines the fundamental structure and, accordingly, provides a basis for the subsequent case research (Chapter 4).

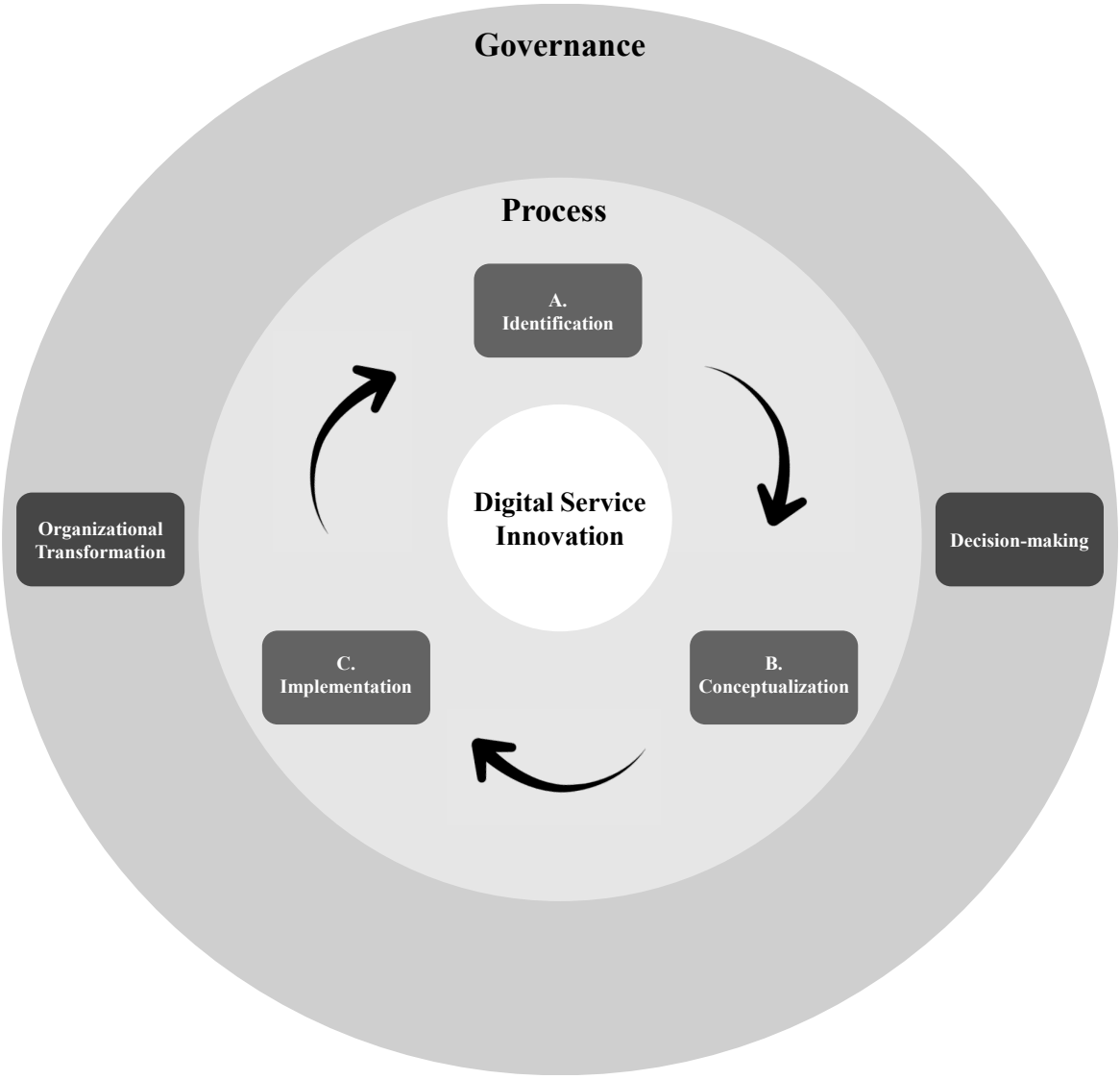

Figure 12: Core elements of digital service innovation. Own illustration

4 Toward a suitable digital service innovation approach

Whereas the previous chapter presented core elements of digital service innovation that demarcate the case research's boundaries, this chapter elaborates on these core elements to develop the governance and related process models of digital service innovation. The core elements are analyzed within the framework of the three categories of routines (SRQ-1, Section 1.4), artifacts (SRQ-2, Section 1.4), and actors (SRQ-3, Section 1.4). Empirical research fuels the upcoming analyses to gain an in-depth understanding and, based on the aforesaid, derives the management framework for practice (SRQ-4, Section 1.4) and enhances the dynamic capabilities of digital service innovation (PRQ, Section 1.4).

Subsequently, this chapter explains the applied research method based on a single embedded case study approach (Section 4.1), sheds light on the basic characteristics of all embedded case companies (Section 4.2), and shows how the presented companies currently pursue digital service innovation (Sections 4.3 and 4.4). The latter two sections synthesize the findings to develop a new understanding of a sufficient digital service innovation approach based on the governance and process models.

4.1 Research method

The research method of this study relies extensively on case study research. The previously introduced concepts (Sections 1.5 and 3.1) also apply to this research. However, since a single embedded case study is used, a different spin on this method drives the approach.

Scholz & Tietje (2002) define three layers of embedded case studies that serve this investigation (Figure 13), namely the *case definition*, the *syntheses*, and the *subprojects*. The primary objective of this study – to develop a new, universally valid path to support industrial companies' pursuit of digital service innovation – directs the operationalization of the three layers. Therefore, the study considers industrial companies' digital service innovation as the related case definition since a case is defined as a theoretical construct that serves as an empirical unit of analysis (Ragin, Becker, & others, 1992). This case definition also allows the study's results to directly contribute to the building of a suitable digital service innovation approach for the broader industrial sector. Consequently, the syntheses refer to the generation of the governance and process models. The implication is that the industrial case companies are subprojects because they pro-

vide the required database (*cf.* Scholz & Tietje, 2002, Figure 13). Hence, the case companies' individual insights facilitate the design of the new digital service innovation approach via the definition of their governance and process models.

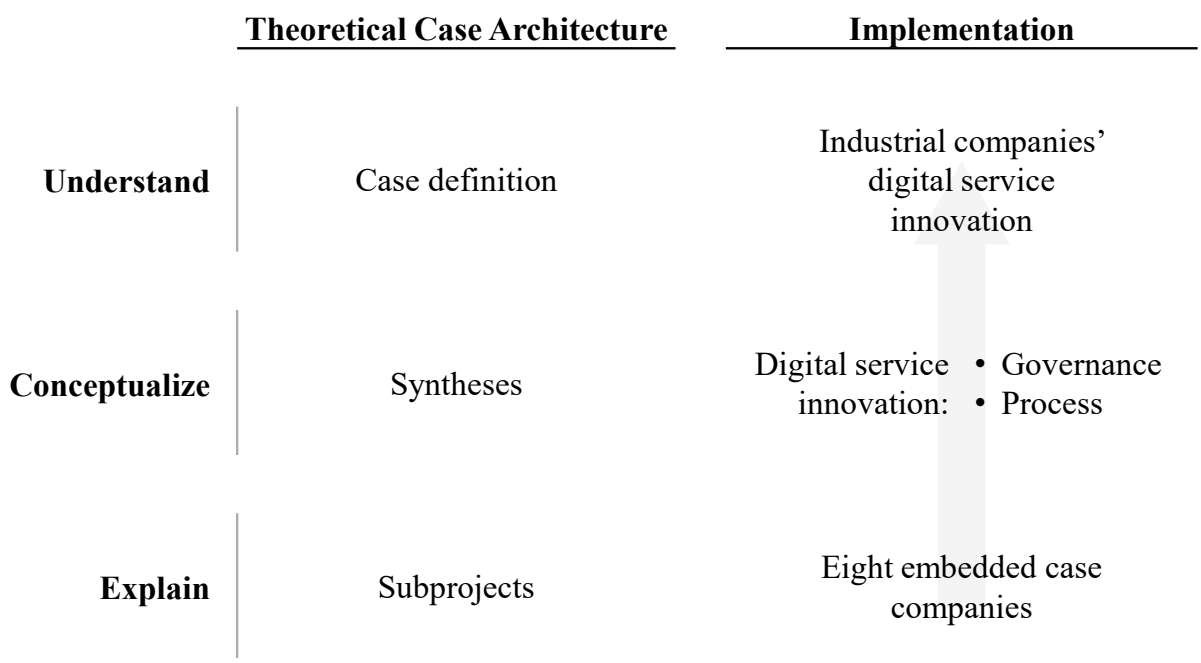

Figure 13: Architecture and implementation of the single embedded case study approach. Own illustration

The single embedded case study approach is highly suitable for this research. First, the resulting management framework, i.e., the governance and process models, is designed to be universally valid for most industrial companies pursuing digital service innovation (Chapter 5). Second, cross-company cooperation to spur innovation is gaining momentum in the industrial sector (Chesbrough & Crowther, 2006). Thus, aligned innovation approaches would further contribute to facilitate and ease the cooperation among industrial companies.

The subsequent sections describe the underlying data of this study. Specifically, the case selection (Subsection 4.1.1) describes criteria that lead to the involvement of the embedded case companies, the data collection (Subsection 4.1.2) explains how the data acquisition is operationalized, and the data analyses (Subsection 4.1.3) shed light on the process from collecting data to deriving insights.

4.1.1 Case selection

This study is grounded in eight embedded case companies, whose inclusion was the product of a purposeful selection scheme (Section 3.1). Although the companies' organizational maturity in terms of digital service innovation varies, it benefits the research objectives (Section 1.4) as comprehensive insights can be derived from these variations.

Mature companies are those companies that have embarked on the transformation journey toward more digital services at an early stage. They provide well-established learnings on and considered insights into the research topic. Immature companies are late adopters of digital transformation. They not only add their experiences, but specifically report their current needs. Of the eight selected case companies, two are mature and three are immature. The remaining three companies are in the course of their digital service transformation and cannot be classified as either mature or immature. Since most industrial companies' digital transformation is ongoing, the findings derived from the heterogeneous sample of case companies reflect the needs of the broader industrial sector (*cf.* Sebastian et al., 2020).

Eisenhardt (1989) recommends the consideration of four to ten cases for a comprehensive analysis. The eight selected companies meet this criterion. They produce a sufficient amount of data to gain meaningful insights, while simultaneously preventing information overload. In addition, the selection of this total of eight companies was also based on the observation of data saturation.

4.1.2 Data collection

The operationalization of the single embedded case study through a focus group contributes to the dissertation's objectives and research setting. Furthermore, focus groups allow for the direct implementation of the three layers of Scholz & Tietje (2002) as the overarching focus group topic relates to the case definition, the participants' discussions represent the syntheses, and the subprojects are the participants themselves.

Therefore, the focus group setting serves as the primary data source of this part of the study. All eight companies participated in the joint focus group that discussed industrial companies' most suitable digital service innovation approaches. Since they all shared the common interest to develop an adequate approach, they were willing to exchange information on their previous experiences.

The focus group meetings followed the scheme introduced by Wilkinson (2004) as "a way of collecting qualitative data, which – essentially – involves engaging a small number of people in an informal group discussion (or discussions), 'focused' around a

particular topic or set of issues" (p. 177). The leveraging of the focus group setting has two distinct advantages (Gall, Gall, & Borg, 1999): First, focus group participants share their personal opinions more openly in group settings than in individual interviews. Second, the participants not only share their expertise but also directly discuss emerging information and ideas. These advantages not only promote an incisive, shared understanding among the participants, but also discussions and related consensus-building that directly contribute to the overarching goal of developing a new digital service innovation approach.

Nine focus group meetings were held between October 2019 and June 2021 – conducted in German – with an average interval of about two months between the sessions. Six were face-to-face meetings (held in Switzerland, Austria, and Germany) and, due to social-contact restrictions because of the ongoing COVID-19 pandemic, three meetings were conducted online via Microsoft Teams and Zoom. Three embedded case companies participated in all nine meetings, while the remaining five joined at least four of the nine meetings. The embedded case companies, on average, participated in five of the nine sessions.

On average, the embedded case companies sent two representatives to participate in the discussions (within a range of one to three representatives) (*cf.* Table 7). Each meeting entailed a full business day of discussions on specific topics related to the digital service innovation governance or process. The meetings were extensively documented in accordance with strict protocols, which comprised detailed notes and written information produced by the participants, assistants, and the lead investigator.

Triangulation of the data sources was achieved by adding to and enriching the focus group data (*cf.* Eisenhardt, 1989; Gibbert & Ruigrok, 2010). The knowledge generation was supplemented and supported by countless informal discussions, along with meetings, telephone calls, interviews, and company documents. The informal discussions and telephone calls were documented from memory, but only if the content was conducive to the research purpose. Interviews were recorded and transcribed following the research approach (see Section 3.1). Table 7 summarizes the key characteristics of the embedded case companies.

Table 7: Embedded case companies

#	Informant's roles	Pseudonyms	Industries	# Employees
1	Service Manager	AgriCo	Agricultural machinery	70,000
2	Head of Service Service Manager	ComCo	Machinery	50,000
3	Service Manager	FoodCo	Food processing	15,000
4	Head of Service	MachineCo	Machinery	5,000
5	Head of Service Head of Digital Service Product Manager	MedCo	Medical technology	10,000
6	General Manager Service Manager	ScaleCo	Weighing equipment	15,000
7	Head of Service Service Manager	TexCo	Machinery	5,000
8	Head of Service Service Manager	TransCo	Transport equipment	5,000

4.1.3 Data analyses

The objective of data analyses is to understand and describe the experience of the embedded case companies (Miles, Huberman, & Saldana, 2014). Therefore, a comprehensive investigation of the sourced data is required to answer the research questions (Evers, 2016). The analyses enable the identification of the applied practices of the focus group participants (David, 2009).

Bertrand, Brown, & Ward (1992) propose a procedure to analyze focus groups. Initially, after each meeting, the researcher conducting the focus group should recapitulate the discussed topics. This approach brings significant aspects mentioned by the participants to the surface. Consulting the collected data also enriches the topics by adding more background information. Finally, a multiple review of the database reduces the risk of following personal perceptions.

The data analyses of this study were guided by a combination of recapitulating the major aspects of each meeting and adding information to the introduced framework (Figure 12, Section 3.3). As a subsequent step, if necessary, the focus group data were consulted to correct initially defined aspects. Additional information on the case companies (summarized in Subsection 4.1.2) was analyzed based mainly on the developed understanding of digital service innovation (Figure 12, Section 3.3). Hence, a deductive coding scheme was applied to support digital service innovation's governance and process specifications.

The initial data analyses were performed in German, the primary communication language within the focus group. Afterward, following the suggestions of (Nikander, 2008), the results were translated into English.

4.2 Case description

This section provides a generic overview of the embedded case companies, based on the collected data. The context thereof is highly relevant for case research as external factors influence subsequent interpretations and resulting findings (Yin, 2009). More specifically, these initial descriptions enable a better understanding of the respective business contexts and strategic positioning of the firms. Although the eight embedded case companies each had an own digital service experience, their current digital service innovation approaches do not deviate significantly. More specifically, the individual insights of the firms can be clustered based on their digital service innovation maturity. This results in the identification of three groups. AgriCo represents companies that started to build digital services at an early stage. In contrast, TexCo represents the later adopters of the digital service business. ScaleCo exhibits the characteristics of firms situated in between the early and late maturity poles. The three clusters form the basis of the detailed description of the companies' current digital service innovation practices (see Sections 4.3 and 4.4).

AgriCo is a market leader in the agricultural equipment industry. Its products and services empower farmers to cultivate their land and, therefore, its portfolio comprises various hardware machines, physical and digital services. Its digital services, in particular, are gaining momentum, especially as an increasing number of farmers recognize their impact on performance improvement in farming. AgriCo initially built digital services that it and its customers could easily implement. Currently, it strives to increase the capabilities of its services. Hence, AgriCo has started to explore digital services that rely on more complex technology, with a continued upside potential.

Although the development of products and services is based on identical innovation phases, AgriCo – for service innovations – adapts certain activities that suit the digital services' peculiarities. In future, its aim is to place more emphasis on the service idiosyncrasies in its universal innovation approach.

AgriCo operates globally with distributed production and engineering facilities. Its sales channels rely heavily on a solid dealer network. Since these dealers define the specific offers to the farmers, AgriCo only defines the main building blocks of its digital services. Subsequently, each dealer compiles the final offers from these building blocks. This approach adds complexity to its operations, considering that AgriCo does not have full sovereignty over its digital service business.

ScaleCo is a market leader in the high-precision weighting technology sector. Its products and services are mainly applied in the process industry. Typically, pharmaceutical and food and beverage companies use its offerings in their production and quality control processes.

Governmental institutions highly regulate the application and maintenance of ScaleCo's products. Consequently, the performance of certain services is mandatory. As such, these obligatory services have given rise to a significant business. However, the market around these services is highly competitive as third-party providers also offer them to ScaleCo's customers. Therefore, ScaleCo strives to improve its competitive advantage through innovative digital services.

ScaleCo addresses product and service innovation through two disjunct innovation processes. Each process is tailored to the parameters of the intended innovation outcome. Based on some initial experiences in digital service innovation, ScaleCo aims to extend the development of its digital service innovation approach. A more institutionalized process, completely independent of the traditional product innovation process, drives this evolution.

The distribution of ScaleCo's offerings is realized via a direct sales force. Agents and dealers play a minor role. Local distribution and service hubs ensure close contact with customers around the world. However, the portfolio's engineering and production accumulate in and are centered on Central Europe.

TexCo is a technology and market leader in the textile industry. Its products and services enable crucial parts of yarn production based on raw cotton. The future goal of TexCo is to offer the complete range of products and services required for yarn production. Besides coping with technological boundaries, TexCo also has to manage cultural differences in its customer base as it is mainly located in the Americas and Asia.

Whereas customers in developed countries (e.g., in the USA) appreciate digital service innovations, Asian customers are still reluctant to leverage digital services in their operations.

TexCo's innovation approach to products and services involves independent setups. Digital service innovation follows spontaneous initiatives while product innovation is systematically institutionalized. Currently, TexCo is formalizing its digital service innovation approach in order to enhance the service portfolio and thus its competitive advantage.

TexCo's engineering department is located in Central Europe, while production capacities are increasingly being shifted to eastern countries. The direct sales force primarily drives the sales of the entire portfolio. To a lesser extent, TexCo cooperates with local dealers and agents. Further expansion of local subsidiaries intensifies customer contact and satisfaction.

The three embedded case companies provide detailed insights into their current innovation approaches (*cf.* Section 4.3 on governance and Section 4.4 on the process perspective). The reduction of the described digital service innovation approaches (from the original eight embedded case companies to three) improves the clarity of the research results, while simultaneously ensuring a sufficient understanding of the topic under discussion.

4.3 Analyzing digital service innovation governance

Digital service innovation governance encompasses the innovation process, as highlighted by the core elements of digital service innovation (Figure 12, Section 3.3). Therefore, the analyses of the embedded case companies start with governance, being digital service innovation's steering element.

The next subsections present the current status of the embedded case companies' governance mechanisms. Their content presents synthesized results, enhanced by explicit examples of the three exemplary, embedded case companies. The more the individual experiences deviate from the norm, the more comprehensive is the description of the individual perspectives of the exemplary case companies. First, this study elaborates on the required organizational transformation. Second, it expands on decision-making practices to guide digital service innovation. Since the dynamic capabilities view drives the study, the related routines, artifacts, and actors form the core of the analyses.

4.3.1 Organizational transformation

The interview study (Chapter 3) revealed the firms' need to transform their organizations systematically in order to master digital service innovation. To specify how industrial companies can address this transformation, the subsequent analysis describes the main areas of interest and how they are approached by the focus group's case companies. The main elements deal with the *organizational setup*, *corporate culture*, and the *interaction between traditional product development and digital service innovation*.

The **organizational setup** defines the overarching boundary conditions of digital service innovation. Table 8 summarizes the different configurations of the case companies.

Table 8: Organizational Transformation – Organizational setup

Company	Organizational setup	Artifacts	Actors
AgriCo	Dedicated service department linking the market organization and engineering	(Global) Organization chart	Global service head and interdisciplinary team
ScaleCo	Global service department harmonizing the initiatives of the product line service units	Organization chart	Global service head, product line head
TexCo	Dedicated service department within the product innovation department, separate after-sales business	Organization chart	Product innovation head

Routines: AgriCo installed a dedicated unit, the service department, to manage digital services along their entire lifecycles. This unit is located – organizationally – between the engineering department and the market organization. The engineering department develops the hardware products and the supporting technology of the digital services. The market organization plans the go-to-market strategy for products and services. Therefore, the service department links the relevant disciplines of digital service innovation.

This dedicated service department is globally distributed. Its main part is located at the headquarters, and it constantly consults with relevant stakeholders in the local market organizations. As a result, AgriCo not only connects professional disciplines, but it also incorporates regional market needs in its digital service innovation.

Although ScaleCo has many independent product lines that offer product-specific services, its digital services' value propositions and underlying technologies are quite

similar across these product lines. Therefore, ScaleCo has started to consolidate its efforts by aligning the digital service business at the headquarters. Surprisingly, the underlying development process of all product lines includes the requirement to coordinate with other product lines. However, the expected alignment of upcoming digital services failed to realize. In practice, the coordination has significantly slowed down the development process. Hence, many stakeholders are neglecting their exchanges with the other product lines.

Initially, TexCo faced challenges similar to those of ScaleCo, as several development activities appeared "to take place in silence" (TexCo, 4). This provided an incentive for previous attempts to merge digital service innovation with product innovation. As a result, interfaces to various important departments were built, e.g., to the customer support organization. However, TexCo has since recognized the major differences between product innovation and service innovation. Currently, it strives to implement a digital-service-innovation-specific innovation process at its headquarters to align with its global initiatives.

Artifacts: The artifact relevant to the organizational setup is mainly the organizational chart. In particular, e.g., as AgriCo defined it, this artifact includes its definition at a specific level and on a global scale.

Actors: Managers, who manage and therefore play managing roles, are the core actors in this dimension. The service department heads and managers, who are organizationally superior, steer digital service innovation at the embedded case companies. For example, AgriCo highlights the value of institutionalizing an interdisciplinary team responsible for digital service innovation. Such a team can handle the high level of complexity by adding stakeholders to the team, if necessary.

Culture deals with the firms' attitude to digital service innovation. The case companies have various views on how their organizations regard digital service innovation. Table 9 summarizes the key findings of this dimension.

Table 9: Organizational Transformation – Culture

Company	Culture	Artifacts	Actors
AgriCo	Digital innovation enthusiasts and the seeking of incremental improvements	Communication technology	Interplay between all stakeholder groups in the organization
ScaleCo	Digital innovation enthusiasts and the seizing of business opportunities with promising returns		
TexCo	Digital innovation unenthusiastic and the pursuit of a stronger digitalization commitment		

Routines: AgriCo approached digitalization early enough to be at the forefront of transformation. Its main asset is that it started with incremental innovations as its employees continuously sensed and sought new digital service opportunities. Most of these digital service innovations were directly linked to its product business and were thus associated with little risk. Once these incremental innovations took off in the markets, AgriCo continued with more advanced digital services. At present, its digital service portfolio consists of services supporting product utilization and services that comprehensively assist customers in their operations. ScaleCo, in addition, emphasizes the entrepreneurial mindset of its employees. As a part of this spirit, they "identify business opportunities and try to seize them whenever possible" (ScaleCo, 4).

TexCo, however, is faced by its management's reluctance to digitalize. The mindset of many managers and employees is that digital solutions do not contribute to their customers' primary key performance indicator (KPI): maximizing the amount of produced yarn. During the COVID-19 pandemic, the managers' lack of digital affinity became more apparent, as illustrated by the following example.

Digital messaging services (e.g., iMessage, WhatsApp, or Signal) appeared to be a quick fix to the challenges of the COVID-19 pandemic. These messengers enable remote communications among the employees. However, as described in one of our interviews, an upper manager, who had never heard of these messenger services, turned to the interviewee, and required an explanation of what they were. The interviewee commented on this situation as "highly shocking that a colleague did not know about these mobile applications" (TexCo, 8).

Moreover, many of TexCo's employees have been with the organization for over 40 years. This is a mixed blessing. On the one hand, these employees are highly skilled in the company's specific needs. On the other hand, their openness to innovation decreases over time. A promising way out of this predicament is to be transparent about the new initiatives, as described during one of the interviews: "Many half-truths exist in the organization that cause fear of change. Thus, informing the employees helps to eliminate these" (TexCo, 7).

Artifacts and Actors: Specific artifacts and actors are of minor importance to the participants, who did not specifically highlight their characteristics. Thus, culture covers a broad topic that embodies several artifacts at the embedded case companies. All employees influence and are influenced by the existing and evolving culture of the organization. Hence, all involved employees can be seen as actors in the cultural dimension.

Furthermore, the interplay between **product and digital service development** plays a vital role. Traditionally, firms had a clearly defined and established product development process. Along with the emergent topic of digital services, suitable innovation processes were required to thrive in this business area. Therefore, the case companies developed different strategies to address the new innovation approach around the digital services. Table 10 presents the main findings of running, in parallel, product and digital service innovation in the organization.

Table 10: Organizational Transformation – Product and digital service development

Company	Product & digital service development	Artifacts	Actors
AgriCo	Integration of digital service innovation into the existing product innovation process	Formalized product innovation with integrated digital service innovation	Interdisciplinary digital service development team, service marketing team
ScaleCo	Advancement of the digital service innovation process, interfaces between product and digital service innovation have to be defined	Formalized product and digital service innovation process and their interfaces	Digital service developers, product developers, customers
TexCo	Application of digital-service-innovation-specific process and intensive alignment between product and digital service innovation	Formalized product and digital service innovation process and their interfaces	Head of product innovation, head of digital service innovation

Routines: AgriCo's innovation endeavors all follow a generally defined innovation process. Historically, this innovation approach mostly suits the needs of product innovation. Politically, the definition of an independent digital service innovation process would be too complicated. Changes in the innovation process landscape require the intense involvement of many stakeholders. For this reason, the service department decided to define necessary adaptations within the existing process to meet their needs efficiently.

ScaleCo strives to implement two independent yet connected innovation processes for products and digital services. They consider the product innovation process to be too ill-defined to develop successful services. A ScaleCo manager describes the shortcomings of the product innovation process as follows:

> *The milestone and documentation requirements, templates, and minimum viable product (MVP) calculations of the product innovation process are all designed insufficiently for digital service innovation. We are just applying it of necessity. It only works as skilled consultants in the organization guide all involved stakeholders toward a viable outcome.*

Furthermore, an interview partner from ScaleCo describes how the services' scale-up works differently than product innovation: A completely developed product moves on to industrial production and distribution. Digital services, however, come with intensive training in the organization and infrastructure building. Thus, digital service innovations' complexity and resource consumption are unequally higher compared to product innovations (ScaleCo, 12).

TexCo has the confidence to run two separate innovation processes. Three main reasons for this separation justify its point of view. First, in its portfolio, services are independent marketable products. This notion requires a stand-alone innovation approach for products and digital services in order to enable the product and digital service portfolio setup. Second, the duration and cost of development differ tremendously between products and services and thus have to be managed differently. Third, digital services are more tailored to specific customer needs. Therefore, a responsive process design is required to implement digital services addressing individual customer needs. Nevertheless, a TexCo manager emphasizes the need for a process-wise alignment of product and service innovation (TexCo, 5). If not, the sufficient supply of data from the hardware products to be utilized by the digital services would be at risk.

Artifacts: Dedicated service process descriptions enhance the general process artifact. For example, AgriCo leverages the organizational structure to its advantage. Shared responsibilities between service and product development teams regarding various functions in the organization are essential for their success.

ScaleCo highlights the necessity of having a sufficiently designed digital service innovation process as a main priority. Besides, a basic IT infrastructure, e.g., the global availability of an enterprise resource system in the organization, is a prerequisite to drive the digital service business.

TexCo's major artifact consists of two parts. First, a defined process landscape of product and digital service innovation that contains the process flows. Second, specified interfaces between the two to ensure meaningful cooperation during the execution process.

Actors: The actor perspective plays a major role at AgriCo. In particular, it installed a data analytics team that links product and service development. This team has an in-depth understanding of the product. Therefore, it can assist in defining the best technical solution for any upcoming digital service. Simultaneously, it is aware of the product and digital service innovators' intentions and is thus able to align these intentions to ensure a reasonable offering. Later in the process, the service marketing team is responsible for aligning the various service and product GTM strategies. However, during the early innovation stage, sufficient interfaces are still missing.

At ScaleCo's operational level, the precise definition of product and service developers facilitates the pursuit of innovative projects. This allows tackling topics more comprehensively instead of keeping to the natural environments of its products. Moreover, the customers are an essential resource. On the one hand, besides the product operations, they serve as sources of additional information. On the other hand, along with the entire digital service development, they are sparring partners.

TexCo accentuates the importance of digital service innovation management. Although different process designs are essential, product and digital service innovation management should be consolidated under a single manager. Thus, the manager heading the product innovation is also responsible for the digital service innovation. Based on TexCo's experience, this setup supports the development of an astute service business.

4.3.2 Decision-making

Firms need to apply suitable decision-making mechanisms to enable successful innovations. More specifically, managers reach many decisions when innovating digital services. Two topics require particular emphasis. First, decisions have to be made regarding the firms' *resource allocation*. This relates to all decisions on the spending of financial resources (e.g., budget) or non-financial resources (e.g., access to research and development capacities). Second, continuous control is required over the *performance* of the emerging digital service and its innovation process. Accordingly, decision-makers align the evolving digital service with the corporate strategy. Furthermore, reviewing the performance of the deployed process ensures that the optimal approach to innovate digital services is applied on a continuous basis. The following sections provide a detailed understanding of the peculiarities of these two realms of decision-making.

So far, **resource allocation** in digital service innovation was mainly discussed based on the firms' experience with product innovation. Thus, traditional product innovation marks the point of departure at which managers define required adaptations to meet the demands of digital service innovation. Discussions regarding the required resources mainly take place during the early phase of digital service innovation. Table 11 summarizes the decision-making configurations of the exemplary embedded case companies.

Table 11: Decision-making – Resource allocation

Company	Resource allocation	Artifacts	Actors
AgriCo	Product-innovation-driven assessment adapted to focus on development time and budget	Project request (incl. business case)	Enabling committee, customer support managers
ScaleCo	Managers' gut feelings drive the early innovation phase, later proof of concepts deliver more reliable data to fuel the project request	Proof of concept (project request)	Steering committee, service manager, business developers
TexCo	Product-innovation-driven assessment supported by an adapted group of stakeholders to meet service requirements	Project request (incl. business case)	Steering committee, service product manager

Routines: AgriCo's resource allocation mainly depends on established product innovation practices, due to its traditional innovation focus on products. A standardized project request is mandatory when applying for digital service innovation's required resources at an enabling committee.

The project request contains a standardized business case template to assess the viability of the service idea. This artifact stems from product innovation and therefore contains the typical KPIs related to the financial performance of the new product or service (e.g., market size, return on investment, and contribution margins). However, when deciding on digital service innovations, decision-makers mostly emphasize the expected development time and the budget. This deviation from the defined project request underlines the major role of the organizational culture in decision-making. In this regard, the decision-critical aspects of time and budget reflect the general culture of prioritizing ideas that are associated with minor risks (*cf.* Subsection 4.3.1). Thus, in AgriCo's view, the focus on the development time and budget represents appropriate adaptations of the product-driven decision-making approach. Interestingly, the business case template would otherwise be perceived as an ill-defined attempt to assess digital service innovations.

ScaleCo's resource allocation depends on the convincing nature of individual managers' digital service innovation ideas. Impending ideas are discussed in the organization's business divisions. Then, each division decides whether to continue with the development or to pivot to a different option. Because a corporate-level perspective on digital service innovation is lacking, the existing procedure results in an uncoordinated plethora of digital service innovation initiatives.

TexCo mainly leverages its well-proven product innovation mechanisms to optimize digital service innovation's resource allocation. It also deploys the standardized business case template of product innovation in digital service innovation. In addition, TexCo adapts the product-driven approach by involving different stakeholder groups. For example, an adaption is to discuss the internal feedback of product developers. Moreover, assessing customer feedback plays a major role when evaluating the market potential of digital service ideas.

Artifacts: Generally, the firms' managements consult the project request or business case template, as the main artifact, before allocating resources. In addition to the described challenges of the related routines, AgriCo and ScaleCo face specific issues with their decision-supporting artifacts.

For example, AgriCo's management values clear definitions of the digital service's technologies. For this purpose, a dedicated template exists to support the selection and subsequent development of new technologies. However, AgriCo's informant reflects on this as follows:

> *We are guided through the template on how to define which technology, hardware-wise or software-wise, should enable our upcoming service offer. However, we are missing a template defining how actually to define the service offer. We know the kind of customer value we want to provide and the technology, but the connecting element, the digital service design, is missing.*

Currently, this shortcoming translates into a high level of uncertainty during the early innovation phase as the intended digital service is hardly specified. Without predefined digital service characteristics, even at a low fidelity level, it is difficult for all involved stakeholders at AgriCo to envision how digital service ideas could unfold. Thus, AgriCo seeks to enhance the existing project request with digital service-specific elements to overcome the current condition and to ensure more informed decisions.

At ScaleCo, the promoted ideas primarily convince managers based on their gut feeling, although the company tries to deploy a standardized business case template. Critical stakeholders in the organization neglect the typical benefits of a business case template in digital service innovation. They argue that the inputs at hand during the early innovation phase are too vague to support informed decisions. Therefore, ScaleCo deploys proof of concepts to assess the digital services' market potential. The proof of concept's implementation scope depends on the individual digital service. Once the proof of concept is successful, a more detailed financial analysis is required to clear the necessary resources for market introduction.

Actors: The enabling committee is a permanent institution at AgriCo. Its responsibilities are threefold. First, it reviews suggestions for innovation. Second, it clears the firms' resources to start pursuing the proposed innovation idea. Third, it initiates innovation activities if the organization is reluctant to propose new avenues for innovation. This committee consists of upper managers who participate in addition to their daily responsibilities.

ScaleCo's innovation initiatives rely on the interplay between a business developer and the related manager(s) until management assigns the required resources. Later, a steering committee guides the digital service innovation. Finally, ScaleCo's manage-

ment describes the missing alignment and the availability of sufficient evaluation templates in resource allocation as "one of the major barriers to transferring product innovation mechanisms to digital service innovation" (ScaleCo, 26).

At TexCo, a product manager for services, the related supervisor, and a steering committee cooperate to decide on the required resources and the continuation of the development project. The steering committee is appointed every time a new digital service development project starts.

Digital service innovations and their organizational approaches also require clearly defined decision-making mechanisms to **control** their **performances**. Digital service innovations are mainly assessed during their actual development (conceptualization) and market introduction (implementation) phases. Regarding the process performance, decision-makers need to evaluate the organizational status quo and, if necessary, derive suitable adaptions. Thereby, the firms' optimal digital service innovation approach is deployed and maintained. Table 12 indicates the core findings on this dimension.

Table 12: Decision-making – Performance controlling

Company	Performance controlling	Artifacts	Actors
AgriCo	Controlling of the defined KPIs in the project request, separate definition of KPIs for market introduction, process review based on process specifications	Project request criteria, proof of concepts, market introduction KPIs, process templates	Enabling committee, customer support managers, process manager/owner
ScaleCo			Steering committee, service manager, business developers, process manager/owner
TexCo			Steering committee, service product manager

Routines: Across the embedded case companies, digital service innovation control utilizes the criteria initially applied to decide on resource allocation. These initial criteria are continuously monitored to track the performance of the digital service innovations. Thus, the steering or enabling committee checks in to evaluate the current status of the development projects. In addition, conducted proofs of concept within the organization or with customers are preferred means to obtain feedback on the perceived customer or market value and the digital service's feasibility. Finally, service managers define a set of criteria before the market introduction of the new digital services. These criteria are also applied to control the market launch.

The process of performance controlling is a special case of decision-making. The embedded case companies review the process performance at the major decision points or after achieved innovations. Thus, the frequency of the process review varies among the presented companies. For example, AgriCo strives to assess its digital service innovation process every three months, while ScaleCo applies it every year and TexCo every second year. These evaluations lead to processual and organizational adjustments of the embedded case companies to increase their innovativeness.

Artifacts: The main artifacts are the process templates. These templates guide the involved actors through the entire process as they contain the courses of action for each process step (routine). Furthermore, all applied process templates and the resulting digital services are the units of analysis for evaluating the process performance.

Actors: The critical actors of performance control are almost congruent with the digital service's resource allocation. In addition to the described actors, AgriCo and ScaleCo have dedicated process managers to track the efficiency of their processes and, if necessary, to propose adaptations. TexCo, however, reviews the processes with the assistance of all stakeholders involved in digital service innovation.

4.3.3 Implications for digital service innovation governance

The focus group discussions underline the importance of organizational transformation and decision-making within digital service innovation governance. The three subdimensions of organizational transformation, namely organizational setup, culture, and the interaction of product and digital service development, lead to dimension-specific findings. The focus group discussions reveal that an intense interplay between the headquarters and local subsidiaries is important to direct digital service innovation. At the headquarters, all important information is typically aggregated into market insights. The regional subsidiaries supply the necessary information to the headquarters. Depending on the corporate culture, the subsidiaries are also involved in the subsequent stages of digital service innovation. In this manner, they can be an asset during service delivery, especially by providing a quick response time to customers, as well as intense feedback loops to the headquarters.

Furthermore, an entrepreneurial mindset is conducive to drive digital service innovation. Firms initially benefit from sensing and seizing digital service opportunities that foster quick successes. Their experience and subsequent conduct are based on the initiatives of employees who understand digital services' associated benefits and who try to

leverage them before their firms are mature enough to pursue more complex digital service innovations. The findings also show that digitally open-minded employees contribute to the digital service business.

At a later stage, the alignment of product and digital service innovation needs detailed design. Compared to traditional product development, the focus group participants emphasize installing a separate process. However, the early identification of customer needs can simultaneously be performed for both products and services. Subsequently, the gathered information should initiate outcome-specific innovation approaches. Irrespective, the traditional product and digital service innovation approaches should be aligned throughout their entire implementation.

Decision-making practices, along with their innovation approaches, support the development of digital services. Managers mainly apply pragmatic decision-making as their established practices are grounded in product innovation. The pragmatic style often relies on gut feelings in the decision-making process, instead of primarily relying on facts. Most managers realize that adaptations of their current decision-making practices are required to steer digital service innovation. Yet, they mainly transfer product innovation decision-making to digital service innovation. This leads to decisions being mostly based on too rigid or too pliable steering committees and KPIs, which hardly promote iterative development cycles and informed decisions.

4.4 Analyzing digital service innovation processes

This section elaborates on the focus group's insights regarding the underlying digital service innovation process by specifying the core elements of digital service innovation (Chapter 3, Figure 12) in more detail. The presentation of a deeper understanding of the three innovation modes of identification, conceptualization, and implementation illustrates the building blocks of digital services' innovation process.

The subsections are structured along the line of the three innovation modes (Chapter 3). Thus, the description of digital services' innovation modes starts with the companies' identification of new digital service opportunities, followed by the conceptualization mode that explores current approaches to develop digital services. The implementation mode closes industrial companies' digital service innovation by describing how these services are introduced to their target markets. Finally, the three exemplary, embedded case companies give voice to practitioners' expertise, which provides insights into their current digital service innovation practices.

4.4.1 Identification

Information gathering and knowledge generation define the identification mode of the digital service innovation process (*cf.* Chapter 3). The focus group discussions revealed that, compared to previous analyses (Chapter 3, Figure 12), a more specific understanding is required to describe the necessary activities at an adequate level. Three stages surfaced in the focus group, collectively constituting the identification mode. These stages are *market analyses*, *ideation*, and *feasibility tests*. Accordingly, as described, information gathering and knowledge generation are operationalized within these stages, based on the embedded case companies' experiences.

AgriCo, ScaleCo, and TexCo have a common understanding of **market analyses'** primary objective: sensing the current and future customer needs. At this point, emerging trends regarding evolving technologies or new ways to drive the service business are also relevant.

Routines: AgriCo operationalizes its market analyses through service-specific market research. In particular, AgriCo leverages a strong dealer network to source and forward customer information to its market organization. Also, individual meetings with invited customers at the dealers present added opportunities to gain insights into their pain points. Besides service-specific market research, AgriCo measures customer satisfaction at a product level. Every customer is asked to submit their responses to a standardized questionnaire. These insights complement the service-specific findings. However, there are currently overlaps in the product-driven and service-driven market research. Therefore, AgriCo strives to eliminate these overlaps to reduce inefficiencies in its market organization.

ScaleCo directly communicates with its customers. Permanent exchange platforms with selected customers fuel knowledge acquisition. In addition, it maintains close contacts with individual key accounts, thus allowing in-depth conversations about their needs. Apart from this, field data from the installed base add to ScaleCo's understanding of their customers. ScaleCo also seeks to drive its innovativeness by engaging with and participating in international regulatory committees and the monitoring of other industrial sectors. However, ScaleCo seeks to improve its approach as its multi-divisional organization lacks alignment in identifying digital service innovations. It runs market research in various divisions almost independently. In future, these analyses should be streamlined to allocate ScaleCo's resources more efficiently.

TexCo specifically emphasizes the importance of individual customer touchpoints. Having friendly customers willing to share their thoughts with the provider is essential

to develop digital services that sufficiently address customer needs. However, the insights gained through customer contacts require interpretation and abstraction. As TexCo's informant states:

> *I have to say that talking to customers at a high level proves difficult for us. Our customers are definitely educated, but they are really into their business, and therefore cannot imagine far-reaching improvements of their business operations.*

Therefore, TexCo leverages external and internal sources. In this regard, sales and service field staff are invited to internally share their knowledge about the customers. Moreover, TexCo also explores emerging trends in other industries to gain a comprehensive understanding of the market.

Artifacts: All companies must codify the acquired information, especially considering that codification enables information utilization in digital service innovation. TexCo does not currently have a suitable artifact to store the analyzed market intelligence. Presently, informal and personal relationships within the TexCo's organization serve as a substitute for codification. This leads to upper management's tendency to initiate digital service innovation instead of relying systematically on market intelligence. In cases where upper managers define the new digital service, they often prioritize internal benefits over customer value. This mainly results in customer needs not being satisfied. Consequently, AgriCo and ScaleCo clearly define codification schemes with templates to guide employees through this stage. AgriCo even supports the codification with online tools.

Actors: Product managers and supporting upper managers are generally responsible for the acquisition and storage of market analyses' results at the three companies. Furthermore, the market analyses of AgriCo and ScaleCo are supported by business developers and analysts.

Once the companies have gathered a sufficient understanding of the current market conditions, the information is compiled during the next stage of **ideation**. The three exemplary companies (AgriCo, ScaleCo, and TexCo) share a common understanding of the objective of ideation. High-level ideas are developed and adjusted based on initial feedback from internal and external stakeholders during the ideation stage. Furthermore, the ideation's objectives match the common perspective of the three companies and their experience of required routines to implement ideation.

Routines: The idea generation mainly relies on the consolidation of market analyses' results. Individuals and groups of assigned employees aggregate the information and are

inspired by the generated market insights. Existing ideas are collected to get a full picture of possible business opportunities using digital services. As noted by TexCo, existing ideas surface when internal stakeholders participate in the market analysis. However, focusing on existing ideas limits the possible courses of action. Therefore, a balanced approach between proactively developing ideas and passively collecting them promotes a comprehensive understanding while allowing the emergence of different ideas.

Iterative idea generation and screening lead to a comprehensive set of ideas. However, employees working on ideation intuitively explore and reduce the total number of ideas to a manageable size. The most promising ideas are mainly identified based on the gut feelings of the involved stakeholders.

The next step involves a further assessment of the viability of the developed ideas. The companies evaluate the ideas' financial characteristics and implementation methods with the highest perceived value. In particular, the digital services' value proposition, the delivery system, and the related financial and non-financial returns for the provider and customer are estimated and iteratively scrutinized at a high level of detail. In order to assess the added value of new ideas, AgriCo emphasizes their direct transfer to the real-life scenarios of customers:

> *We always make an example [of] our traditional products. These are highly suitable to demonstrate the value of our digital services. That's always the case. So, we make [our idea] more tangible as its benefits have to be explained to the customers.*

Once a trustworthy configuration of the ideas' description is produced, the companies question the ideas' strategic alignment with the current business model of their firms. If the digital service business model fundamentally deviates from the existing model, strategic decisions are required on the continuation of the idea.

Artifacts: Based on the described routines, the main artifacts that support ideation are simple lists of ideas, described digital service ideas, business model canvases (*cf.* Osterwalder & Pigneur, 2010), and the corporate strategy, collectively the general business model of the firm.

Actors: Service business developers and business analysts drive the ideation and subsequent evaluation of the developed ideas. In addition, financial analysts can assist in the evaluation process of the ideas' financial impact. For example, AgriCo emphasizes the benefits of interdisciplinary teams that link the traditional product and technology development and the market organization. Thereby, the required specialists are added to the team whenever conducive to the current tasks. In addition, more inclusive teams introduce new perspectives and increase the acceptance of the new service.

Before the firms allocate significant resources to develop digital services, **feasibility tests** are required. These include internal tests and further discussions with customers to obtain a comprehensive understanding of the associated risks and benefits. The embedded case companies similarly conduct internal tests, while the external tests follow different approaches.

Routines: Typically, internal tests are performed before the companies reach out to and ask their customers for feedback. Internal feasibility tests mainly cover three topics: *legal*, *technical*, and *financial viability*. These three topics are evaluated through workshops, interviews, and simulations. The workshops enable the discussion of new ideas with a broader audience and specific experts to obtain their feedback. Interviews with subject matter experts facilitate further in-depth delving into relevant topics. Simulations describe the new digital service in depth, thereby helping to define and quantify the key characteristics of digital services.

The *legal examination* of the digital service idea results in the definition of usable field data and an initial appraisal of whether the digital service complies with legal regulations.

The *technical assessment*, in turn, concerns the companies' capacity to implement the digital service. Generally, a high-level technical specification of the digital service forms the basis of these discussions. The results can relate to the entire spectrum, ranging from directly pursuing the market introduction to terminating the idea if its implementation is technically impossible. The companies' access to the required field data or third-party data also influences the decision on the continuation of the idea.

Financial analyses of the digital service idea are also based on the ideas' high-level technical specifications. This analysis estimates the development, maintenance, and delivery cost. These costs are contrasted with the expected benefits of the digital service for the provider, as well as for the receiving customers.

Up to this point, the embedded case companies exhibited a homogeneous understanding of the feasibility testing that guides the description of required routines. Subsequently, they approach digital service innovation differently, as illustrated by their varied implementation of the feedback loop with their customers. This relates to the design of their decision-making practices. For example, TexCo's management is sufficiently confident to decide, after the internal feasibility test, on their willingness to invest in the development of new digital services:

> *By the time we go out with the prototype, we are sure that it is working 90-95% as we have planned. The feasibility studies are certainly before prototyping with customers and the related development gate.*

In contrast, ScaleCo and AgriCo require customer feedback at a basic level before significant resources are allocated for the subsequent digital service development. ScaleCo typically invests small amounts of resources in building a prototype at low fidelity. This low-level prototype sparks the necessary discussions among customers about their willingness to consider and accept the digital service and to pay for it. AgriCo, instead, mainly leverages user stories and initial visualizations at this stage since they "tend to focus more on the feasibility internally, because we are primarily focused on technical systems" (AgriCo, 25). Moreover, AgriCo follows a linear approach to identify and assess new digital service opportunities.

Artifacts: Grounded in the approaches of the embedded case companies, three artifact groups support the feasibility testing. First, the codification of the digital service idea is crucial. Rough descriptions based on user stories or visualization enable the provider to communicate the new idea within the organization and to potential customers. Second, initial prototypes provide more detailed descriptions of the new digital service. These comprise simple programs with a user interface and process manuals, allowing target users to interact with the digital service idea. Third, scenario planning and simulations of the aspired digital services facilitate internal provider analyses of the idea's feasibility. In addition, projected financial statements and business cases support the feasibility tests.

Actors: Different stakeholder groups are involved, along with feasibility testing. At this stage and in general, service product managers guide its entire execution. Compliance managers and legal experts are typically responsible for basic legal checks. More advanced companies, like AgriCo, deploy data protection officers and data governance councils to address the complexity and significance of digital service innovation.

The technical viability assessment is supported by technical and market-oriented staff. Development engineers, data scientists, platform architects, R&D employees, and external specialists share their knowledge when challenging digital service ideas. Simultaneously, they are solution-oriented and leverage their expertise to bring digital services to the market. In addition, service market and key account managers, marketing representatives, and project managers augment the purely technical perspective by adding supporting market information.

Financial analysts, controllers, accountants, and executive representatives in finance provide the required expertise to derive the financial benefits for both the provider and the customer. Again, service business developers, service market and key account managers, and aftermarket product managers enhance the specialist perspective by presenting a broader market view.

Pilot customers, the IT experts of providers and customers, service developers, and service field staff drive the external assessment of the digital service idea. During this crucial stage, service market managers and sales staff once more enhance the expertise to cover all aspects of the digital service.

Finally, the embedded case companies refer to the end of the identification mode via a major decision point. At this point, management decides on the allocation of significant resources to develop the digital service. All gathered information is aggregated by the service product manager and presented to upper management. A project request, in the form of a pre-defined template, guides the aggregation of information. This structured approach supports informed decision-making before the commencement of the comprehensive development of digital services.

4.4.2 Conceptualization

Following the identification mode, the conceptualization mode also requires further specification in order to be implementable in industrial companies. Two overarching categories, *digital service development* and *proof of digital service*, became apparent in the interview study and are still applicable when describing the case companies' digital service development approaches (*cf.* Chapter 3). Therefore, the focus group uncovered more details on how the embedded case companies build their new digital services.

Digital service development constructs the digital service based on the identification phase's initial market and service understanding. Therein, the digital services' value proposition supporting processes and technology (e.g., connectivity devices and software) is developed in order to produce a marketable digital service.

Routines: Although the value proposition, processes, and technology seem equally important, the embedded case companies approach them differently in their digital service development. In this regard, the embedded case companies emphasize the vital role played by clearly defined processes of successful digital services. However, almost every case company neglects its proactive design. AgriCo, at least, composes the target customer operations in digital service development. This composition provides guidance to customers on how they can improve their businesses. It also includes the detailed

design of AgriCo's target customer experience. Each touchpoint between AgriCo and its customers is carefully evaluated and proactively developed to an optimal arrangement. Contrarily, TexCo is aware of the process design's importance. Nevertheless, they entrust it to the stakeholders involved in the digital service's delivery. Thus, their service field staff and the customer's digital service users mainly consider how to leverage the digital service by themselves. The informants stress that, in future, they need to focus more on the proactive process design of their digital services. TexCo's informant underlines the necessity of overcoming the current thought-action gap as follows:

> *In [...] future, the challenges in service delivery will increase. We will have problems hiring specialists, and [they] won't be able to travel around the world so easily. So, we have to reposition ourselves in this regard [so] that remote maintenance becomes true. This will be possible through defined processes that guide rarely trained service personnel through the jobs to be done.*

Besides the process design, the embedded case companies develop technology during the stage of digital service development. This specifically refers to the development of software. It implies that the companies utilize their established experience in building machine control software to support their traditional hardware products' digital transformation. Agile development methods, such as Scrum, are widely used by the embedded case companies to develop this type of software. In addition, some companies already embarked on a general transformation journey by introducing Scrum approaches to the entire organization.

Moreover, the value proposition is iteratively developed based on the digital services' process and software development. Although it is essential for customers, most companies do not specifically address the value proposition design. Instead, it is considered to be inevitably evolving.

Digital service developers also need to design the revenue model directly related to the customers' perceived value through the digital service. This means assessing the customers' willingness to pay and their perceived value. In addition, the development and delivery cost are monitored and forecasted. This ensures the constant tracking of the expected profitability of the digital service and therefore influences the specific design of the revenue model.

Artifacts: The general digital service concept design is supported by holistic templates like the Business Model Canvas (Osterwalder & Pigneur, 2010). The service blue-

print (Bitner et al., 2008) also guides many practitioners through digital service development. The customer perspective is incorporated in the customer journey design and evaluation.

AgriCo struggles to design its digital services as it mainly concentrates on technology development. As a result, although AgriCo defines the customer value it wants to address with the new digital service, it misses suitable artifacts to outline the link between the targeted customer value and the supporting technology. AgriCo's informant elaborates on this as follows:

> *We are missing a clear approach to defining digital services, and that is also one of our weaknesses. So, we are always focused on technology first. And a lot is being done in the area of IT and standardization. But what is still missing is which digital service should support the technology in the first place. We jump directly to the customer benefit, but in between, how should this digital service be designed is not clear. The customer benefit is clear, but then how should this digital service be called and be defined? We want to improve our approach here to clearly address the process from technology to digital service and from digital service to customer benefit.*

Actors: After the approval of the submitted project request, a clearly defined digital service development project starts. In it, the companies not only spend a significant amount of resources to develop digital services, but also designate a dedicated digital service project manager to lead the development after the project request approval. The service product manager, business developers, analysts, IT specialists, and user experience designers support the digital service development.

The **proof of digital service** follows once the provider feels comfortable enough to discuss the digital service with its customers. This proof assesses whether the service meets customer needs and operational requirements.

Routines: Intensive customer involvement is the basis of the proof of digital service. Typically, the embedded case companies build a minimum viable service (MVS) to execute this innovation stage. The MVS contains the main elements of the digital service. The provider can therefore assess internal operations and the interaction with the customers while delivering the MVS. In particular, delivery processes and the enabling technology are tested – for the first time – with the customer.

Two characteristics are evaluated within the proof of digital service. First, the technical viability of the developed services is assessed. ScaleCo applies a special MVS approach to guide its employees through this evaluation stage. This approach includes

company-specific tools and internal consultants to support the development team. In addition, ScaleCo leverages MVS to obtain initial feedback on how to proceed with the development. Contrarily, TexCo emphasizes that it only invites customers to test the MVS if they are "almost 100% sure that [they] achieved what [they] had planned for" (TexCo, 36). Second, the embedded case companies seek to quantify the added value perceived by customers. A major challenge is that customer feedback always needs interpretation. As a TexCo representative puts it:

> *We never know whether the market will demand the estimated quantities. These are all assumptions. At on-site visits, if you ask a customer: Would you be interested in buying the digital service? [t]hey will always say yes. Unless the customer really has to pay for it. Then, it mostly turns out that the customer doesn't really want to buy it. Therefore, it is so difficult to interpret customer feedback correctly.*

In the same vein, a ScaleCo manager describes the value assessment based on the MVS and the subsequent customer feedback as "reading tea leaves" (ScaleCo, 36). Therefore, it is highly relevant to keep all options open, as TexCo's representative explains:

> *It is so important for digital services to have this [customer feedback]. But you also have to have the courage to say no or to pivot. In this sense, to terminate the project and to do something different.*

Artifacts: At this stage, the key artifact is the minimum viable service. Supporting development tools, as applied by ScaleCo, are also conducive to conduct the proof of digital service.

Actors: The provider's team to conduct the proof of digital service comprises the service product manager, technicians, field and sales staff, and IT specialists. At the customer site, a panel consisting of all involved operators and managers serves as a suitable means to gather proper customer feedback.

Finally, similar to the identification mode, the conceptualization mode also terminates in a major decision point. The MVS, its business case, and all the gathered information through the proof of digital service provide the foundation for informed decision-making. The service product and project managers present the results to upper management, who approves the market introduction.

4.4.3 Implementation

The implementation of the digital services' *market launch* is specified by the embedded case studies. The overarching objective is to roll out the digital service to the target

markets. This objective can only be pursued after the developed digital service has proven the viability of its entire concept and after it has added value to a broad customer base.

The related **market launch**, which is used to roll out the digital services, consists of required organizational adaptations and sales and marketing activities. At the same time, the emerging trends in the addressed markets should be monitored to prevent competitors from intervening in the market launch.

Routines: The market launch of digital services mainly relies on the companies' experience with their traditional hardware products. In this regard, sales and marketing materials are developed to communicate the new digital service adequately. Not only does the material address the targeted markets' customers, but the providers' country subsidiaries are also brought on board through this channel and also through additional workshops and meetings.

Furthermore, the timing of the digital services' market introduction needs alignment with the traditional product development department and its market organization. Ideally, the service product managers and traditional product managers should closely collaborate to streamline the provider's general offer.

However, a significant difference between the market introduction of traditional products and digital services is the impact of digital services on the provider's resources. To deliver digital services at a global scale, many parts of the provider's organization need adjustment. For example, field staff require training to learn the appropriate delivery of the service. In addition, providers' and customers' infrastructure enhancement is likely required to provide customers access to the services' digital interfaces. A representative of ScaleCo describes the embedded companies' related experience as follows:

> *If you have developed a traditional product, then you have developed it. At some point, it will be right in front of you. No matter the version [alpha, beta, ...] it is, then you can take it and put it out on the market. So, now do that with a service or something similar. Sure, on the product side, you also have special countries with special regulations, etc. There are also steps required to roll out the product. But now do that with a non-tangible service, do that, that's just a huge difference. And if you think about it in terms of digital services, I have exactly the same complexity. And on top of that, we have to build a new infrastructure, which we have to have available. We have the infrastructure, of course, but not to the required extent. Our normal infrastructure, our ecosystem, is not designed for this. Therefore, we have to adapt it for each digital service roll-out.*

Besides preparing the organizations for the digital services' roll-out, customers also need to learn how to reap the associated benefits. Therefore, AgriCo starts with at least one year of evaluation. Within that year, it can improve its service delivery and engage with its customers in a more in-depth manner regarding the digital services' impact at their end. After this limited market launch, decision-makers decide how to proceed with the service. On the one hand, the next step could lead to the global roll-out of the digital service. On the other hand, process or technology adaptations could be required, thus redirecting the digital service back to the conceptualization mode.

When digital services clear this final hurdle, they move to digital service innovation's closing stage of digital service delivery. During this stage, the digital services' roll-out continues while a growing number of customers receive the digital service. The embedded case companies have to ensure that all customers of the new offer perceive a similar quality standard. Therefore, they define sets of KPIs to monitor market performance. An additional feedback loop with their customers complements the perspective on the digital services' market performance. These bits of information enable smaller delivery adjustments but can also lead to the restart of the entire digital service innovation approach if major shifts are identified, e.g., in customer needs.

Artifact: The core artifact of the implementation mode is the digital service itself. The complementing marketing, sales, and training material also support this stage. Moreover, the monitoring of KPIs operationalized in the form of interview guidelines or surveys adds to the operationalization of the implementation.

Actors: Although a number of stakeholders participate in the implementation mode, the service product manager guides the final phase of digital service innovation. Moreover, upper management remains in charge of steering the market introduction and service delivery. These two groups are further supported by sales, marketing, and field staff, IT specialists, service developers, and customers' employees.

4.4.4 Implications for digital service innovation processes

In summary, the reports of the focus group participants enrich the three innovation modes of identification, conceptualization, and implementation. The more granular understanding of the identification mode leads to descriptions of the market analyses, ideation, and feasibility tests. Collectively, they enable the recognition of existing customer needs and the development of feasible digital service ideas. Subsequently, through conceptualization, new digital services are developed; the objective being to build a mar-

ketable digital service and to prove its feasibility via proof of concepts. Finally, the implementation mode structures the go-to-market approach to deliver the digital service to a broad customer base.

The detailed approaches and comments of the focus group participants reveal the major benefits of a standalone digital service innovation process compared to the application of the traditional product innovation process to digital services. Three aspects highlight the differences between traditional product development and digital service innovation.

First, the specific value proposition that customers perceive as value-adding is vague at the early phases of digital service innovation. Therefore, firms that innovate new digital services require iterative development practices to incrementally generate a suitable solution for their customers. Traditional product innovation processes do not make provision for these iterations as they are designed to work through all the provided steps in a sequential manner. Furthermore, market conditions change continuously. These emerging market trends challenge digital service developers as they have to adapt their work accordingly. Consequently, digital service innovators are caught in the prevailing rigid product innovation frameworks currently applied by most industrial companies.

Second, digital services are based on elements that differ from those of the traditional products or services. Their focus on digital technologies in combination with process designs has a comprehensive impact on provider's organizations. Each digital service development is associated with an evolution of the provider's organization. In this regard, the digital services' roll-out is directly linked to enhancing the existing IT infrastructure and delivery organization. Providers need to build new ordinary capabilities to upscale the digital services, both locally and globally. Therefore, digital service innovation must consider how to create the digital service and how to empower providers' organizations in order to ensure their successful roll-out once the development satisfies the providers and the customers. Comparatively speaking, new products of industrial companies mostly need adapted production lines instead of the development and implementation of entirely new production approaches.

Third, digital service innovation involves innovation stakeholders in different ways. Specifically, customer involvement follows a more intense interaction scheme compared to product innovation. Customer or market feedback is required during the entire digital innovation process. Not only do customers provide feedback to specify their needs, but their feedback also guides the iterative development of the digital service throughout all innovation modes. Furthermore, multiple internal stakeholders become

more critical during digital service innovation. Since many disciplines participate in innovating digital services, different stakeholder groups must be included in the development activities. These stakeholder groups emerge functional-wise and divisional-wise within the providers' organizations. This phenomenon adds to the complexity of digital service innovation and must also be considered in the process design of digital service innovation.

The individual insights and discussions of the focus group undeniably enable the development of new digital service innovation governance and process models. The synthesis of these findings forms the basis of the governance and process models that aim to address the significant peculiarities of digital service innovation, as presented in the next chapter.

5 Managements' backbone of digital service innovation

The detailed findings of the previous chapter reflect the embedded case companies' pursuit of digital service innovation in their respective organizations. As indicated, these individual insights underpin a new digital service innovation approach. The intense discussions that characterize the focus group meetings enhance individual perspectives and propel them toward a common understanding. This common viewpoint consolidates the experiences of the participating companies, enabling them to generate a suitable innovation approach to digital services that finds expression in a resulting governance model (Section 5.1) and a process model (Section 5.2).

5.1 Digital service innovation governance

The findings of the two previous research-based chapters lay the foundation to develop a new governance model for digital service innovation. These chapters' findings confirm the importance of organizational transformation and clearly defined decision-making mechanisms for digital service innovation. In addition, the significant influence of these two dimensions on the firms' business logic calls for a corporate strategy perspective that sets general boundaries. In particular, the influence of digital service innovation on the organizational setup, culture, process landscape, and business model deeply affects how the companies work. Therefore, digital service innovation must be aligned with overarching corporate strategy. Figure 14 presents this study's final perspective on digital service innovation governance. The artifact comprises three dimensions: *corporate strategy*, *organizational alignment*, and *performance control*.

According to this study's understanding, *corporate strategy* directs digital service innovation based on three categories. First, the defined purpose of the company guides the organizational culture and helps to coordinate involved stakeholders. Second, clearly defined service business objectives determine the required organizational setup and process landscape. Third, the firms' risk affinity impacts how radical they should pursue digital service innovations and how severely the business model will be affected by these innovations.

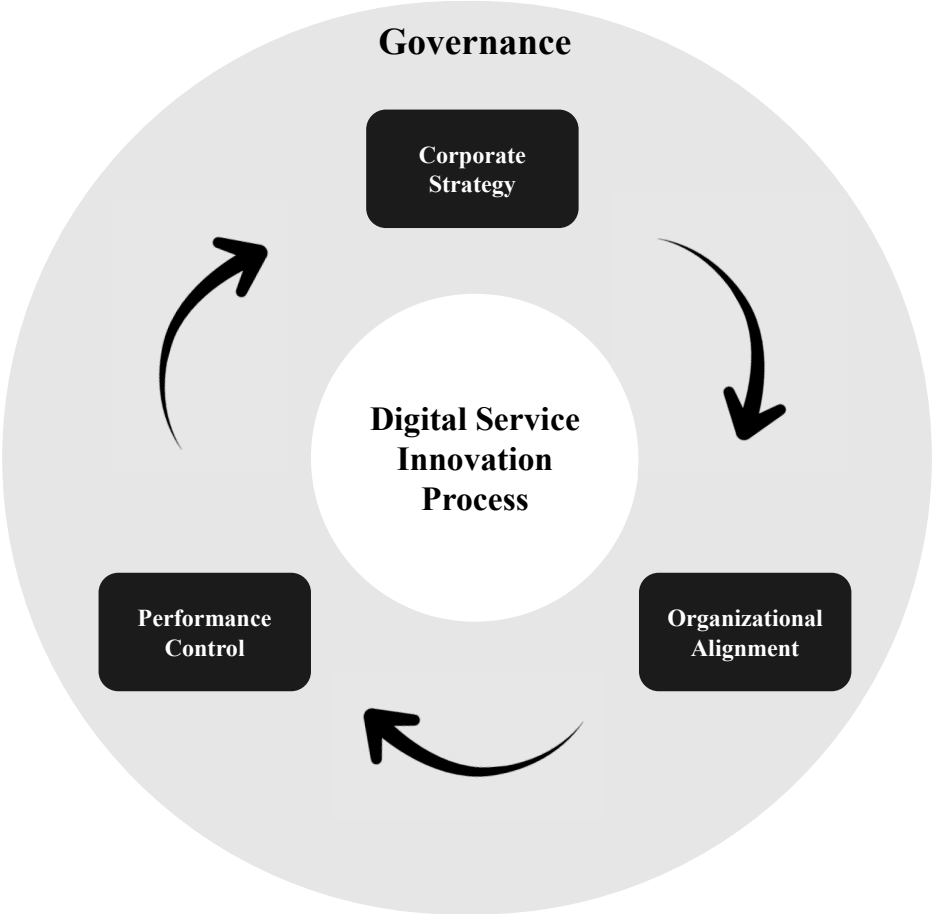

Figure 14: Digital service innovation governance. Own illustration

As described, the corporate strategy sets the boundaries for digital service innovation. Therefore, it is the starting point of its governance model. The *organizational alignment* builds on these strategic boundaries and enables firms to pursue digital service innovations (Subsection 5.1.1). Finally, the *performance control* leverages the defined preconditions to actively steer the digital service innovation process toward the introduction of successful offerings (Subsection 5.1.2). Although these three governance dimensions sequentially build on one another, their definitions and impacts are inextricably intertwined. Therefore, ongoing iterations among these three dimensions lead to advancements of their operationalization. Each dimension also has a direct effect on the underlying digital service innovation's process flow.

The focus of the subsequent presentations is the organizational alignment and performance control dimensions, as they are most relevant to digital service innovation. The corporate strategy and its implementation are only defined as input parameters to be considered in digital service innovation. The corporate strategy development, however,

is independent of digital service innovation (*cf.* Andrews, 1971; Wernerfelt, 1989). Therefore, this study does not discuss the peculiarities of its development.

Multiple actors implement the two most relevant governance dimensions. Figure 15 presents a generic overview of these actors. The firms' service business management mainly leads the organizational alignment. The dedicated process committees support organizational alignment in digital service innovation. The enabling committee is the highest authority responsible for performance control in digital service innovation. It directs all activities while pursuing the aspired innovations. The service managers and service owners also support performance control.

Categories	Governance	Identification	Conceptualization	Implementation
Primary actors	Executives; enabling committee; sponsor	Innovation leader	Service owner	Service manager
Secondary actors	Innovation leader, service manager; operations team	Sponsor; enabling committee	Service manager; sponsor; enabling committee	Service owner; sponsor; enabling committee

Figure 15: Actors implementing digital service innovation – Governance focus. Own illustration

Table 13 focuses on the detailed role profiles that implement actors of digital service innovation. In this study, the required actors are defined as being independent of company-specifics. Therefore, these role profiles – based on the attributed responsibilities and skill characteristics of the actors – provide basic guidance to the governance model's implementation.

Table 13: Governance actors, role profiles, and implementation guidelines

Actors	Role responsibilities	Roles' skill characteristics
Enabling Committee	Empowering and facilitating digital service innovation ([A1], G1-G2.2)	Members should be educated and experienced across multiple disciplines (e.g., economics, engineering, IT) and have detailed knowledge of the firm's strategy Business acumen with strong leadership, communication, and inspirational skills

Actors	Role responsibilities	Roles' skill characteristics
Sponsor	Supporting and supervising all process steps as an experienced advisor (A1-C6)	Educated and experienced in economics with detailed knowledge of digital services Demanding and monitoring leadership style with strong communication, inspirational and networking skills

Emanating from the aforesaid, digital service innovation governance relates to its organizational alignment (Subsection 5.1.1) and performance control (Subsection 5.1.2), along with the incorporation of theoretical routines in digital service innovation governance (Subsection 5.1.3).

5.1.1 Organizational alignment

The previous chapters introduced different aspects that firms must consider for the organizational alignment of digital service innovation. They include four vital dimensions, namely organizational setup, corporate culture, process formalization, and digital service innovations' interaction with product innovation.

The organizational setup and corporate culture (Subsection 4.3.1) are essential characteristics of a firm. Even though the focus group discussions support the significance of both aspects, they are complex and difficult to change as adaptations typically affect the entire company (*cf.* Morris, Avila, & Allen, 1993; Osterrieder, 2020). Furthermore, the participants highlight that their definition and evolvement are general management tasks. Therefore, digital service innovation governance should focus primarily on digital service innovation process management. As a result, the formalization of digital service innovation and its integration into the firms' process landscapes are at the core of governance's organizational alignment.

The process management of digital service innovation unites the earlier formalization and integration dimension (Subsection 4.3.1) and consists of the three categories of *process application*, *integration*, and *review*.

Process application adapts the digital service innovation process to the context of a specific industrial company. In this regard, the firms add the digital service innovation process to their process landscapes as an additional business process. Ideally, the defined process should contain all relevant templates that guide the involved stakeholders through the digital service innovation endeavors. In addition, clear examples of the

firms' individual experiences should be included in the process description. These insights assist the actors in managing similar situations and serve as an incentive to start as quickly as possible.

Simultaneously, a process owner should be defined at the executive level. This central role bears the profit and loss responsibilities associated with the implementation and execution of the digital service innovation process. A supporting team comprising of service managers should support the executive as the process owner. The operational innovation activities (including planning and executing the digital service innovation process), in turn, are represented by the operational level, e.g., the innovation leader or service manager.

Process integration is extremely important for digital service innovation as it requires intensive cross-functional cooperation. As previously described (Subsection 4.4.4), the digital service innovation process should be added to the companies' process landscape as a separate process. Nevertheless, it should remain part of the dense network that covers the entire provider organization, including third parties (e.g., customers or technology providers).

Multiple process interfaces drive the network. Prominent examples are interfaces to product management, market research, the research and development (R&D) department, product development/innovation, product delivery, marketing, sales, operations, and the general budgeting processes. The digital service innovation's process owner (and team) is responsible for weaving this network by designing the individual process interfaces. The detailed interface design, however, is created at the operations level.

The centralized process responsibility also ensures the general validity of the digital service innovation process in the providers' organizations. In addition, centrally steered process ambassadors and comprehensive communication support the process' integration. Thereby, all stakeholders are encouraged to follow the same process, thus paving the way for successful digital service innovations (Subsection 4.3.1).

The **process review** varies depending on the maturity of the process application and integration. At an early stage, when the digital service innovation process is initially applied and integrated, intensive monitoring of the process execution is required. The process owner (and team) should initiate feedback meetings – every second week or on a monthly basis – with all key stakeholders. These regular meetings generate comprehensive insights into the process execution. The experiences of all stakeholders should be collected and consolidated into precise lessons learned and be implemented in the next execution cycles to improve the process. Once the firms' digital service innovation

process has matured and stabilized, feedback meetings at every gate (G1 and G2) or every two years suffice to assess specific information sources. First, the process owner assesses the firms' recent experiences with the process. Second, the success rate of the digital services in the markets is evaluated. At this point, the definition of success is based on the firms' targets relating to the market introduction of the digital services (Subsection 5.2.3). Third, the stakeholders' compliance rate to the process is examined. The general documentation through templates indicates how the stakeholders apply the process. Finally, the evaluation of the process adherence and its success rate direct future improvements of the firms' digital service innovation process.

5.1.2 Performance control

The organizational alignment installs digital service innovation at industrial companies. To run the process successfully, it needs to be accompanied by continuous decision-making. These decisions ensure satisfying market performances of innovated digital services. Therein, the corporate (and service) strategy – as an overarching framework – guides all stakeholders. Three organizational role levels ensure sufficient performance control of the digital service innovations. The related decisions are made by the *organizational team*, *sponsors*, and the *enabling committee*.

Digital services' intangible nature requires an iterative innovation approach and thus, many set decisions regarding the continuation of the digital service innovations. Most decisions, however, are made by the *operational team* that directly pursues the innovations. Since this team works on new digital services, it possesses the most relevant information to direct digital service innovation toward a promising path.

In order to guarantee continuity, dedicated *sponsors* advise the operational team throughout the entire innovation process. Since responsibilities within innovation modes change (Section 5.2), the designated sponsor helps to manage these transitions. Sponsors also provide support in preparing the major decision points (gates) of the digital service innovation process.

The *enabling committee* reviews the achieved results at these gates and decides whether to continue with the proposed innovations. For example, at the first gate (G1, Subsection 5.2.1), the committee's strategic perspective challenges the required development resources (e.g., budget and development time), expected returns, and targeted markets. Subsequently, the committee selects the most favorable digital services propositions from the presented ideas. Afterward, the enabling committee reviews the devel-

oped digital services at gate G2. At this point, it benchmarks the developed digital services against the initial presentation at gate G1. If this review is successful, the enabling committee guides the implementation mode until reaching the full-scale launch of the digital services.

A constant composition of managers characterizes the enabling committee. The committee is defined in a manner that guarantees its independence from a specific digital service development project. This ensures the astute expertise of the highly selected group of managers. Typically, the committee meets every quarter to review the central gates. Between these quarterly meetings, if necessary and in addition to the sponsor, it also supports the innovation activities. Accordingly, as a ComCo manager contends, it is essential "that the enabling committee is always in the loop to avoid them getting cold feet." When the firm and especially the innovation leaders are reluctant to propose new innovation endeavors, the enabling committee makes suitable adjustments to increase the firm's innovativeness.

The close relationship and interaction between the steering actors (enabling committee and sponsor) and the operational team (innovation leader, service owner, and service manager) ensure appropriate performance controlling of digital service innovations along the entire innovation process.

5.1.3 Uniting the digital service innovation governance with theory

This study's understanding of digital service innovation governance was refined throughout the previous subsections. The initial understanding of transforming the firms' organizations in their core areas is key to digital service innovation. Also, identifying and defining precise decision-making mechanisms are crucial for successful innovation.

The consolidation of this study's findings focuses on process management (i.e., its application, integration, and review) as part of the required organizational transformation. Moreover, the broad decision-making mechanisms concentrate on controlling the digital services' performance along the innovation process. Collectively, the mechanisms operationalize the theoretical routines identified by previous literature. To summarize, Figure 16 presents the connections of the various routine sets.

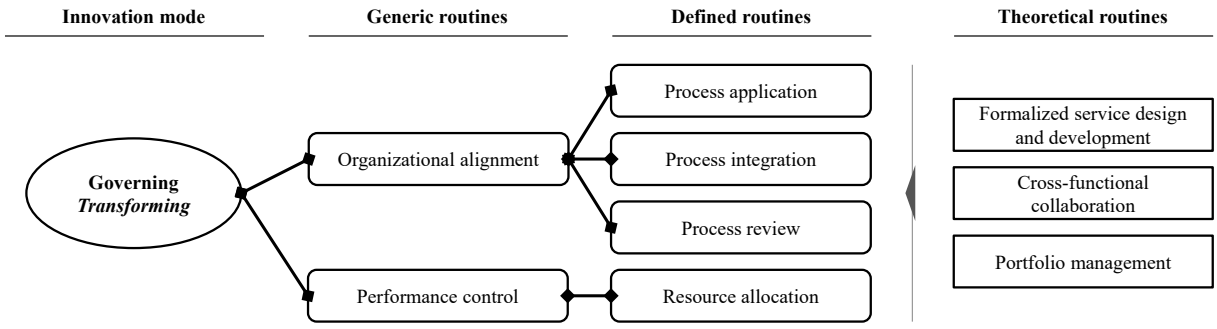

Figure 16: Integration of digital service innovation routines – Governance perspective. Own illustration

5.2 Digital service innovation process

This section presents the study's suggested process model to innovate digital services. All required routines form part of a general artifact that guides digital service innovation at industrial companies, as illustrated by Figure 17 (for the sake of the figure's readability, the term service refers to digital services).

The three innovation modes of identification, conceptualization, and implementation structure the routines required by digital service innovation. Each innovation mode contains a sequence of process steps. Although they are lined up within the modes, they represent a two-fold iterative implementation. First, the process model encourages involved actors to change the current process step if they feel "off track" with their innovation initiative regarding the set objectives. In these instances, actors are free to jump to any process step they consider appropriate (*cf.* grey arrows, Figure 17). This could lead to repeating or leapfrogging certain process steps. Second, actors can restart innovation modes if the digital service initiative does not meet the success criteria at the end of the modes (i.e., at the gates). Then, the actors restart at the beginning of the current mode to improve the initiative. To decide on the continuation of the innovation initiative, two major gates separate the three modes. The gates refer to key decision points where the enabling committee evaluates digital service innovations.

The continuous processing of customer needs throughout the entire innovation process is key to its success. At the outset, the provider and customers have a limited understanding of the digital service's potential. Close customer interaction is required to refine the definition of customer needs, thereby enabling suitable digital services.

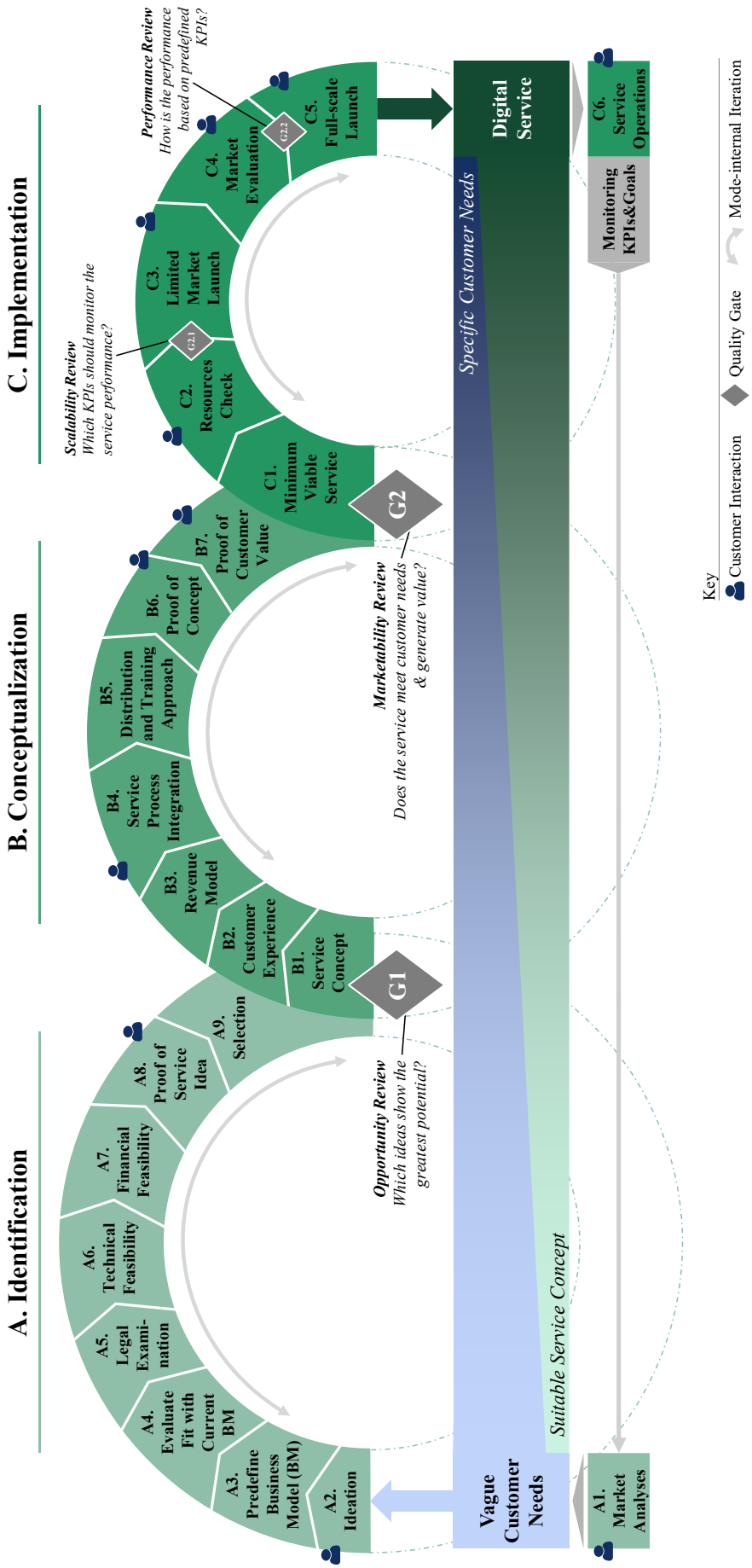

Figure 17: Digital service innovation process. Own illustration

Furthermore, the presented digital service innovation modes are primarily implemented by three actors: innovation leader, service owner, and service manager. Each actor assumes responsibility for a particular innovation mode (Figure 18).

Categories	Governance	Identification	Conceptualization	Implementation
Primary actors	Executives; enabling committee; sponsor	Innovation leader	Service owner	Service manager
Secondary actors	Innovation leader, service manager; operations team	Sponsor; enabling committee	Service manager; sponsor; enabling committee	Service owner; sponsor; enabling committee

Figure 18: Actors implementing digital service innovation – Processual focus. Own illustration

The innovation leader initiates digital service innovation. This actor implements the early innovation activities to identify new digital service business opportunities and, furthermore, also defines the ideas that the firms should pursue and subject to a feasibility test. Finally, the innovation leader presents the findings to the enabling committee during the opportunity review (gate G1).

Service owners continue the work of the innovation leader and guide the processual and technical development of digital services. For example, the service owners support the development team by designing the business model, prioritizing user stories, and creating appealing customer experiences. Also, service owners strengthen the robustness of the digital services' implementation by providing technical support.

The contribution of service managers starts in the conceptualization mode as they provide detailed knowledge about future customers. Besides, they oversee the development project and ensure compliance with the traditional project criteria (quality, time, and budget) of the digital service innovation. Moreover, they connect digital service innovation and the firms' managerial actors (i.e., sponsor or enabling committee) in the conceptualization and implementation modes. Finally, they lead the implementation activities to define the marketable digital service and its roll-out. Table 14 summarizes the key characteristics and presents the role profiles of the three actors. Once again, the role

profiles enable industrial companies to implement and operationalize the proposed process in their organizations.

Table 14: Process actors, role profiles, and implementation guidelines

Actors	Role responsibilities	Roles' skill characteristics
Innovation Leader	Initiating digital service innovation (A1-A9)	Educated and experienced in economics with detailed knowledge of market and technology trends Visionary mindset with business acumen and leadership, communication, and analytical skills
Service Owner	Implementing digital service development (B1-B7)	Educated and experienced in project management, agile development methods, process and IT development Holistic and creative thinking with a solution-oriented mindset and strong communication and networking skills
Service Manager	Guiding digital service development projects (B1-B7) and leading its market introduction (C1-C5)	Educated and experienced in economics, digital service delivery (sales, marketing, and operations) and project management Leadership and decision-making competencies as well as strong communication and networking skills

The next three subsections provide a more in-depth elaboration of the three innovation modes, describe the constituting process steps and close the explanation by presenting a summarizing table, respectively. The description of each innovation mode follows a hypothetical ideal path and does not consider all possible backward or forward iterations or terminations of digital service innovations. The fourth subsection connects the synthesized digital service innovation process to the theoretical routines.

5.2.1 Identification

The identification mode is critical to digital service innovation. In this mode, firms define what business potential they intend to leverage in future. However, their management is not required to allocate significant resources to operationalize this mode. Highly iterative development steps at low fidelity levels reduce the risk of economic losses. The nine defined process steps provide the necessary guidance to ensure that the identification mode's quality is sufficient to drive digital service innovations (Figure 19).

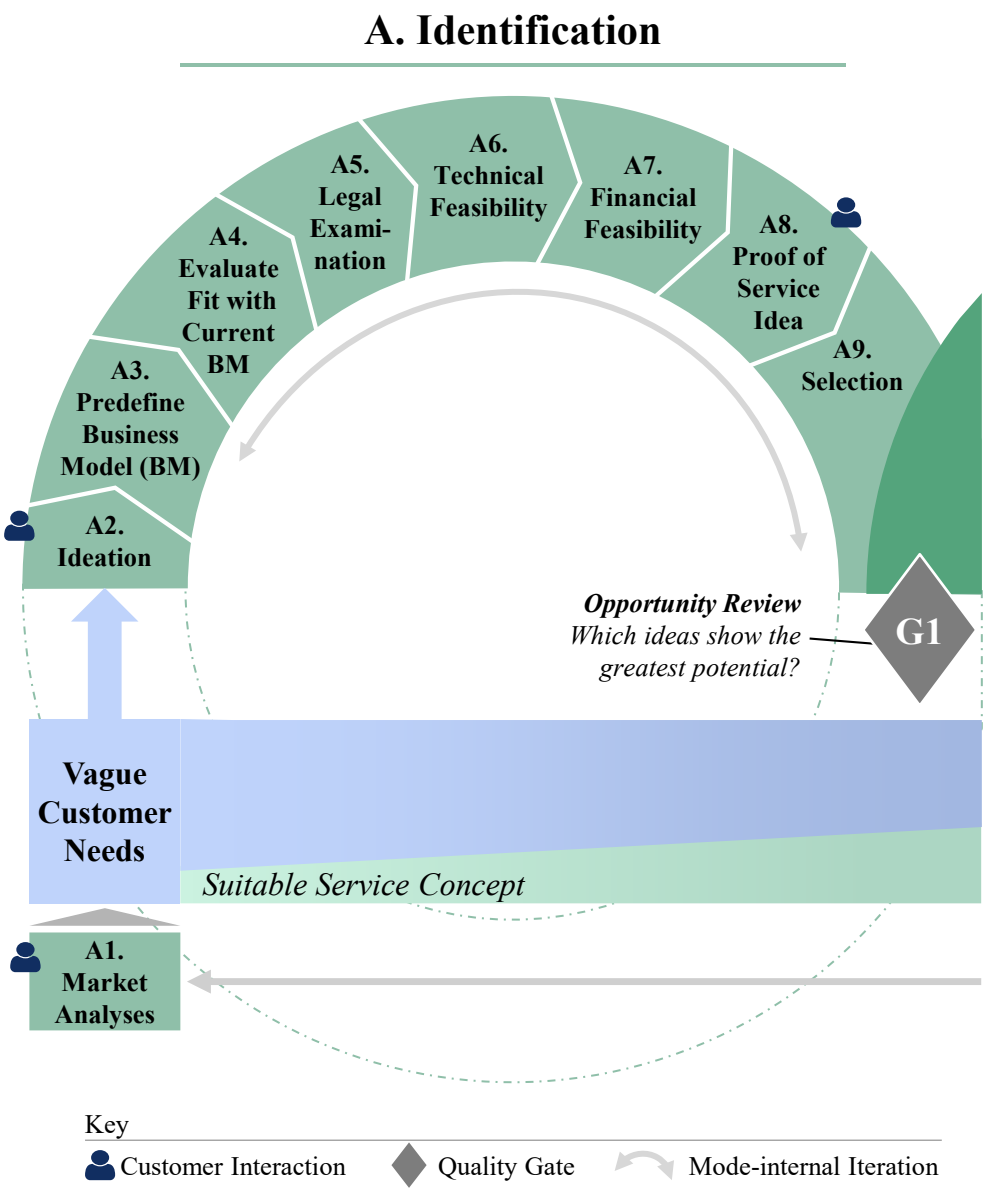

Figure 19: Close-up – Identification. Own illustration

The entire digital service innovation journey starts with **market analyses** (A1, Figure 19). Market analyses incorporate three research areas: *detailed market research*, *specific research on target customers*, and the *providers' internal research*.

Market research entails comprehensive trend analyses. Emerging technologies or competitors' changing strategies are at the core of these analyses. Moreover, start-ups introducing new business models are also sources of valuable insights.

In addition, the *targeted customer base* needs detailed analyses. The exploration of current operations is a pivotal starting point. Detailed knowledge of customers' work-flows enables a diagnosis of customers' pain points and options to accelerate providers' businesses. Typically, customers who have an excellent relationship with the provider

are the latter's first choice to interact with at the start of new digital service innovation initiatives.

Besides directly interacting with customers, the *providers' employees* (e.g., field staff or sales employees) are also a major source of information. Their observations contribute to a holistic perspective on customer needs. In addition, the internal employees can also reveal internal inefficiencies that new digital services could overcome. In general, site visits, workshops, interviews, surveys, institutionalized meetings, informal meetings, and official reports are relevant means to implement and guide market analyses.

Once all information is gathered, new digital service ideas must be distilled during the process step **ideation** (A2, Figure 19). The innovation leader and other involved actors gain inspiration by synthesizing the information. They begin by collecting a long list of possible value propositions of digital services. To make the ideas more tangible, these propositions should be enriched by visualizations (e.g., sketches, user stories, or storyboards). At this stage, all kinds of ideas can be discussed without judging them. Proving the ideas' feasibility in any of the given dimensions is not a requirement. While it is crucial to obtain a comprehensive overview of the possible pathways the firms can pursue, the long list needs consolidation before further steps are taken. Moving forward with too many ideas would waste resources. Hence, the idea providers prioritize the ideated ideas in a practicable shortlist. Another promising approach to shorten the long list is to send it out to the relevant parts of the organization, soliciting their opinions and votes on the ideas' expected contributions. Furthermore, it is beneficial to include customers in the ideation sessions. They enhance providers' understandings of customer needs and are thus likely to increase the market acceptance rate of digital services. However, involving customers in the ideation process is not beyond criticism. For example, there is a substantial risk of narrowing the ideation process to more valuable ideas for customers. The provider must carefully select the setup of the ideation and prioritization in alignment with its own objectives.

After ideation, the innovation leader needs to define the digital service ideas' **business models** (A3, Figure 19). At this stage, the Business Model Navigator is a suitable tool to summarize the key aspects of the aspired business models. The core elements of this tool are the target customers, value proposition, revenue model, and value chain (Gassmann et al., 2013). Moreover, the services' six dimensions (optimized customer operations, customer interface, inter-firm processes, intra-firm processes, and revenue model; Subsection 2.5.1) foster the specification of the digital service ideas at an adequate fidelity level. Simultaneously, they contribute to building the business model in detail.

The derived ideas and business models require comprehensive assessment. The next process step **evaluates** the developed business models with reference to the provider's **existing business model** (A4, Figure 19). The providers' current corporate and (digital) service strategy is the starting point to conduct the corresponding analyses. Therefore, the innovation leader must assess whether the ideated initiatives meet the strategic requirements. In this respect, the added value of the new initiatives regarding the existing product and (digital) service portfolio is examined. Only digital services that enhance the value proposition of the portfolio should be pursued. Firms should avoid possible overlaps of the value propositions in their portfolios. However, digital service ideas that could lead to entirely new business fields with immense economic potential can bypass this criterion. These innovations will likely change the corporate business model and, therefore, can contradict the current model if the potential is sufficiently large. Finally, at this stage, it is necessary to assess the digital service ideas' impact on existing infrastructures and process landscapes in the providers' delivery organization and at customer organizations.

The process step of **legal examination** (A5, Figure 19) assesses whether implementing the digital service ideas complies with all country-specific regulations in the target markets and with the providers' legal standards. At this early stage, the legal check is necessary since digital services rely extensively on various data sources. The digital services' integrity and compliance with all existing restrictions and guidelines must be ensured to avoid formidable roadblocks that may compromise the development at a later stage. However, the legal examination is limited and not exhaustive as legal advisors generally evaluate the digital service ideas at hand. Each change of the digital services' concepts can lead to an entirely different evaluation. The legal examination at this point is only the start of further analyses, undertaken during the course of the process. Therefore, innovation leaders and service managers should involve legal advisors throughout the entire digital service innovation process.

The **technical feasibility** (A6, Figure 19) assesses if digital services can address customer needs. The key question in this step is whether the digital service ideas are implementable and can satisfy customer needs. In particular, digital services seek to satisfy customers' wishes by applying technical and processual solutions. The related implementation is achieved by operationalizing functional and non-functional requirements. Functional requirements refer to enabling specific actions that the users or customers want to execute. Non-functional requirements, on the other hand, define aspects related to the delivery mechanisms, quality standards, and user experience of the digital service.

At this stage, the innovation leaders and the supporting teams develop a high-level specification of the functional and non-functional requirements to enable their technical feasibility assessment. The starting point is the initial ideas on how providers could address specific customer needs, developed in the market analyses (A1) and the ideation (A2). Furthermore, providers need to assess whether they can develop and deliver the new digital services themselves if the defined requirements are implementable. Simple simulations, workshops, and interviews are basic means to conduct the technical feasibility. Digital service innovators must also align with traditional product innovators in cases where digital services directly affect the product business. Such digital services primarily rely on product data. Therefore, it is essential to ensure connectivity with the installed base and upcoming product generations.

The **financial feasibility** (A7, Figure 19) sheds light on the expected long-term profitability. It is based on the associated *benefits* (financial and non-financial), *costs*, and *risks*. The associated *benefits* include direct and indirect benefits. Direct benefits of new digital services are typically evaluated by return-on-invest (ROI) or net present value (NPV) calculations. Indirect benefits refer, among others, to elevated customer satisfaction, which can increase customer retention or product sales. In addition, internal processes can be optimized to reap internal efficiency gains through the application of digital services.

The *costs* of digital services are mainly fourfold. First, the development costs contain all necessary resources to institute the digital service. Second, the distribution costs arise during digital service sales and operations that provide the expected value proposition to the customers. Third, the maintenance costs are induced by ensuring the availability of digital services to customers and field staff. Fourth, digital services need continuous advancement as the market conditions change and, accordingly, also customer needs.

Multiple *risks* are associated with the benefits and costs estimation of digital services. For example, the resulting profitability assessment is considerably influenced by uncertainties in market sizing. As digital services rely on a scalable infrastructure and skilled staff at the side of both the provider and the customer, the services' global roll-out could be challenging. Some companies experienced that significant parts of the infrastructure or employees' skills were suddenly not compatible with the digital service delivery, restraining scalability and the addressable market. Also, customers of western industrial companies expect the inclusion of services in the product price. Thus, adding price tags to digital services could be difficult if the customers' price sensitivity does not allow it.

Moreover, new digital services can cannibalize the providers' existing portfolios by decreasing sales of other current offerings. Finally, digital services are still considered as a new type of offering. Thereby, reference values are limited, causing insecurities in all assumptions supporting the profitability calculation. Nevertheless, scenario planning enables the evaluation of different pathways that are likely to occur. In addition, the existing risks can be hedged as different design strategies are balanced against one another in multiple scenarios.

The **proof of digital service ideas** (A8, Figure 19) process step helps to overcome the prominent level of uncertainties. This step's objective is to double-check the suitability of the designed value proposition, technical feasibility, and financial feasibility. Prototypes at low fidelity levels can spark discussions, on their opinions, with all stakeholders. This can further improve the digital service idea. Providers can seek feedback on the basis of initial drawings, storyboards, presentations, and other tangible artifacts of digital service ideas. Customers and internal stakeholders are addressed through the services' assessment. Formal or informal meetings are at the core of gathering this feedback. Even in an ideal innovation scenario, this stage entails multiple iterations that refine these prototypes and interactions with the stakeholders.

The **selection** (A9, Figure 19) enables the comprehensive consolidation, in the identification mode, of all gathered information. This step provides the opportunity to evaluate the five assessment steps collectively and to advance the digital service ideas based on the findings before presenting them to the enabling committee. During this step, in order to gather additional feedback on the viability of the digital service ideas, the innovation leader can brief the sponsor. Finally, the innovation leader prepares the documentation for decision-making at the point of the opportunity review.

The **opportunity review** (G1, Figure 19) refers to one of the two major decision points in the digital service innovation process. Its objective is to decide on the general continuation of the development of the generated ideas. Therefore, at this gate, the enabling committee decides on spending significant resources to develop the proposed digital services. A representative of FoodCo underlines the necessity of allocating resources at this point by stating: "It must be clear that money will be invested after this gate. Otherwise, you [as a company] have an innovation blockage."

Standardized artifacts support the decision-making process. Figure 20 provides an exemplary template to structure all necessary information. All key insights of the identification mode are represented in this template. By applying the template, innovation leaders pursue enabling decision-making at gate G1 during the entire innovation mode.

The opportunity review marks the end of the identification mode. The nine process steps and the opportunity review are summarized and specified in Table 15.

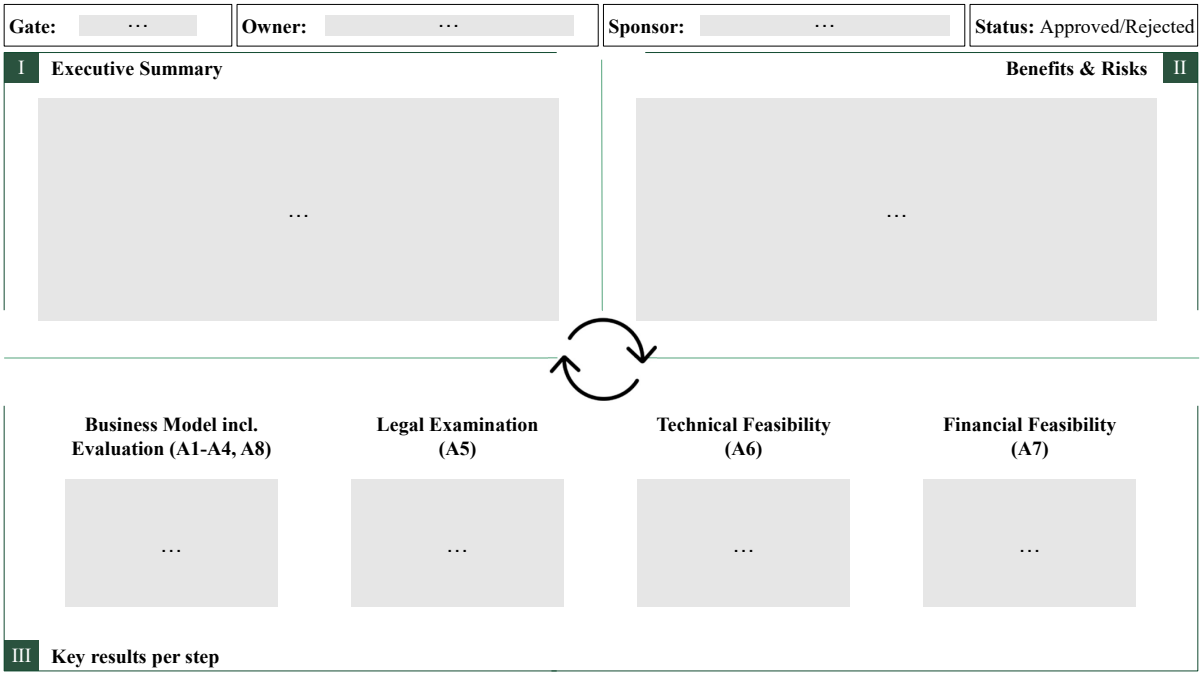

Figure 20: Template for standardized decision-making. Own illustration

Table 15: Identification mode's process definition

Steps	Objectives	Continuations	Activities	Artifacts	Primary actors	Secondary actors
A1. Market analyses	Gathering knowledge to drive digital service business	Onwards; reiteration	Analyze market trends (technology, competitors, Start-ups) and customers and their operations	Reports on site visits, workshops, interviews, customer meetings, and third-party interactions; CRM tools	Innovation leader	Product managers; sales and field staff; customers (key accounts); dealers; agents
A2. Ideation	Building ideas of new service offerings or ideas of how to improve existing service offerings	Onwards; reiteration; restart (A1)	Create idea long list and prioritize ideas toward a manageable short list	Sketches; user stories; storyboards; internal rating system	Innovation leader	Product managers; sales and field staff; customers (key accounts); dealers; agents
A3. Pre-define business model	Enriching the initial ideas through business model design	Onwards; reiteration; relocate forward or backward; restart (A1)	Specify digital service ideas as an entire business model based on the suggested templates	Business Model Navigator[1)], Business Model Canvas[2)]	Innovation leader	Product management; service business developers and analysts

Steps	Objectives	Continuations	Activities	Artifacts	Primary actors	Secondary actors
A4. Evaluate fit with the current business model	Aligning the new ideas with the firm's current business model (or disrupting the status quo)	Onwards; reiteration; relocate forward or backward; restart (A1)	Evaluate the ideas' fit and impact on the current product and service strategy, anticipate the ideas' contribution to future business performance	Corporate strategy; defined digital service ideas (business model); business model simulations	Innovation leader	Upper management; product and service management; portfolio lifecycle managers
A5. Legal examination	Evaluating the ideas' legal compliance	Onwards; reiteration; relocate forward or backward; restart (A1)	Assess the expected data utilization according to the target markets' data privacy regulation; define success criteria to be tested in A8	Legal regulations (e.g., General Data Protection Regulation[3)])	Innovation leader	Data governance council; data protection officers; compliance managers; legal experts; lawyers; legal advisors
A6. Technical feasibility	Drafting the ideas' technical specification and assessing required technical capabilities to develop and implement them	Onwards; reiteration; relocate forward or backward; restart (A1)	Create high-level technical definition; identify required (machine) data and technical capabilities to implement it; assess and match required capabilities with existing ones; define success criteria to be tested in A8	Ideas' technical specification; simulations; reports of internal interviews and workshops	Innovation leader	Digital platform team; data scientists and analysts; software engineers; external partners; key account managers

Steps	Objectives	Continuations	Activities	Artifacts	Primary actors	Secondary actors
A7. Financial feasibility	Assessing long term profitability with regards to future benefits and cost structures of the ideas	Onwards; reiteration; relocate forward or backward; restart (A1)	Compare the cost structure and the future benefits of the ideas and evaluate the financial feasibility of them; define success criteria to be tested in A8	Scenarios; business cases; reports of interviews and workshops	Innovation leader	Financial analysts; accountants; product management; business developers; partners
A8. Proof of service idea	Making fuzzy ideas tangible to share and gather feedback	Onwards; reiteration; relocate forward or backward; restart (A1)	Build rough prototypes and discuss them with key stakeholders and improve the ideas	Prototypes; test environments; feedback reports	Innovation leader	All stakeholders, e.g., customers, service developers, sales and field staff
A9. Selection	Preparing identification modes' information for the opportunity review	Onwards; reiteration; relocate forward or backward; restart (A1)	Consolidate identification mode's results, prepare opportunity review	Results of all previous process steps; opportunity review template	Innovation leader	Service (business) developers; product management; sales and field staff; analysts
G1. Opportunity review	Choosing ideas that show the most significant potential to drive the firm's business	Onwards; reiteration; relocate forward or backward; restart (A1)	Decide which ideas move to the conceptualization mode	Opportunity review template; results of all previous process steps	Enabling committee	Innovation leader

Note. 1) Gassmann, O., Frankenberger, K., & Csik, M. (2013). The St. Gallen business model navigator. St.Gallen: University of St.Gallen; 2) Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers (Vol. 1). John Wiley & Sons; 3) Regulation, G. D. P. (2016). Regulation EU 2016/679 of the European Parliament and of the Council of 27 April 2016. Official Journal of the EU.

5.2.2 Conceptualization

The conceptualization mode develops digital services based on the ideas that emerged within a dedicated development project. Figure 21 depicts the seven process steps and the closing gate G2. The execution of the conceptualizations' process steps is mainly characterized by the following of the proposed sequence. However, by iterating multiple times, the entire conceptualization mode helps to meet the target requirements at gate G2. Once the service manager and the service owner feel confident to present the status of the digital service innovation to the enabling committee again (after gate G1), the development project proceeds to gate G2.

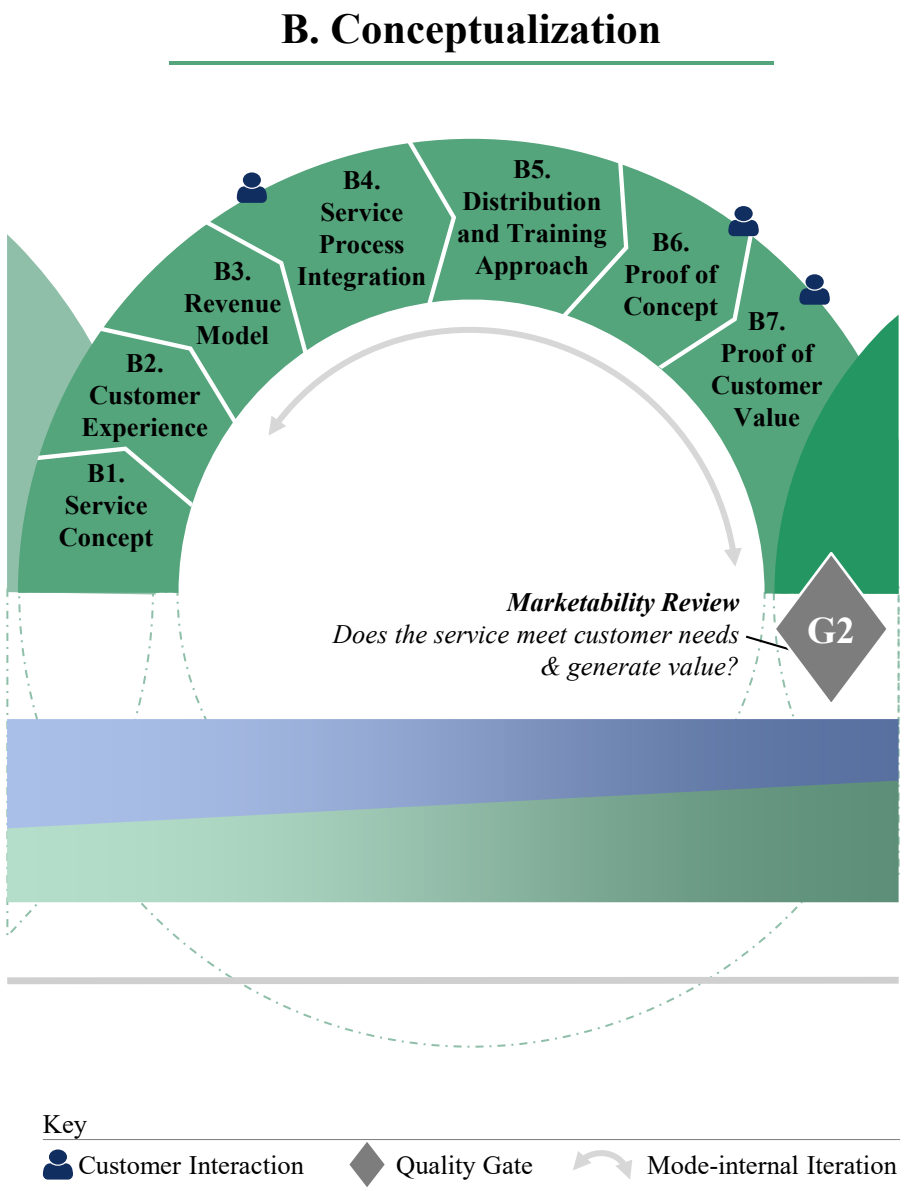

Figure 21: Close-up – Conceptualization. Own illustration

The conceptualization mode starts with the **digital services concept building** (B1 & B2, Figure 21). The previously designed value propositions serve as the overarching objective that the **service concept** step (B1) strives to operationalize. The foundations are initial process designs based on the prototypes and concepts of the identification mode. In this regard, the actual customer operations and supporting processes require further specification. With the aid of the six dimensions of services (Subsection 2.5.1) or the service blueprint (Bitner et al., 2008), it is possible to design the required processes of digital services.

Generally, digital service development is an intertwined iteration of value proposition refinement, process design, and software and hardware development. The detailed process designs enable the comprehensive development of user stories that are implemented through software development. Therefore, the defined processes direct the related software development. Moreover, the evolving software tools define the required infrastructure elements such as hardware generating data and the provision of connectivity.

The **customer experience** (B2) design integrates the process and software development into a unified offering. Generally, all touchpoints between the provider and the customer are part of the customer experience. The user interface designs create the customer experiences, depending on the specific customer needs and targeted value proposition. Typically, customers appreciate simple solutions that are easy to access and interact with.

The service concept and customer experience design mark the starting point of comprehensive digital service development. All subsequent steps add to this development stream while the concept building continues throughout the entire conceptualization mode.

Defining the **revenue model** (B3, Figure 21) complements the digital services' core elements (Subsection 2.5.1). The objective is to define the offer structure and the price points of digital services.

The nature of digital service development determines the offer structure. For example, the value proposition and user stories are individual requirements that digital services have to meet. Developers implement these requirements step by step and thus create multiple modules that represent an entire digital service. In this sense, digital services are supported by software tools that, in turn, are based on infrastructure elements such as hardware-generating data and the provision of connectivity. Because of this, different offers can be compiled based on different module groups. Generally, providers should arrange three or five offers per digital service initiative. These options create a consistent

offer structure that allows customers to select the degree of support that best suits their needs. Finally, each offer should, at an early stage, be provided with a powerful branding to increase its internal and external acceptance.

Customers' and providers' profitability influence the price point. The digital services' added value determines customers' profitability. Based on this impact, it is possible to assume the customers' willingness to pay. In addition, providers' profitability is grounded in development, maintenance, and delivery costs. Furthermore, at this point, the previously introduced financial benefits, costs, and risk analyses (Subsection 5.2.1) require revision to build – in a purposeful way – the revenue model.

The **service process integration** (B4, Figure 21) represents a virtual test with the real-world environment of digital services. After the first significant development steps (B1-B3), developers zoom out to create sufficient interfaces with the future working environment of the digital service. The existing service delivery organization needs assessment in order to determine whether it is currently capable of delivering the upcoming digital service. Also, customer organizations must be assessed to determine if they have the appropriate resources to receive the digital service. Thus, the providers' and customers' critical infrastructures, skills, and tools require comprehensive evaluation. Once again, workshops, interviews, simulations, and life demos enable the identification of required adaptations.

The aim of the **distribution and training approach** (B5, Figure 21) is to prepare the providers' organization to sell and deliver digital services. During the early iterations of the conceptualization mode, this process step is only specified at a low fidelity level. The more mature the digital service becomes, the more this step is specified. However, this process step is only about the preparation of the distribution and training approach. The actual execution is part of the implementation mode (Subsection 5.2.3).

The marketing and sales approach characterizes the distribution approach. Depending on the corporate strategy and the digital services' value proposition, the services are distributed as stand-alone offerings or distributed along with the traditional hardware products. The selected distribution strategy defines the design of marketing materials and the preparation of sales tools. The market communications should always be tailored to the specific digital service and should be able to innovate itself whenever possible. Internal workshops and cooperation with specialized agencies assist industrial companies to implement this process step.

Successful digital service delivery is mostly ensured by training all involved stakeholders. This training specifically requires the involvement of sales representatives, field

staff, and customer employees. Planning workshops with live demos, virtual meetings, and web-based training assist the provider to familiarize every stakeholder with the new offering before its market introduction. In particular, an intensive communication and rehearsal of the new processes (internal and external) and software tools are essential.

At the end of the distribution and training approach design, the digital services are – at least to a minimum extent – defined in every constituting dimension. To prove their real-world viability, providers need to conduct a pilot phase based on a **proof of concept** and a **proof of customer value** (B6 & B7, Figure 21).

Within the proof of concept (B6), digital services in their entirety are delivered for the first time. As a first stage, this proof starts with the internal testing of digital services. The alignment of the processes, software, and involved hardware is tested in an artificial environment. Thereafter, simulations and observations of internal applications are assessed. During a second stage, the digital service is exposed to a simplified real-world environment. Now, selected target customers are able to test the provided interfaces of the presented digital services. Simultaneously, providers' employees guide the customers through the digital service application and test their part of the delivery. In addition, the users can access the digital services' entire customer experience through augmented and virtual reality solutions. Hence, a comprehensive evaluation is possible of the functionality of the digital services' designed processes, software, infrastructure, and compliance with regulations.

The proof of customer value (B7) assesses the digital services' value proposition to customers. The proof of concept's real-world data quantifies the digital services' added value and challenges previously applied assumptions. Through this, data analytics and in-depth interviews with pilot customers reveal the necessary insights to validate technical and financial feasibility. Finally, a more reliable perspective on the expected customer and provider profitability is distilled.

The information on the proofs of concept and customer value, in total, lays the foundation for the second central decision point. At the point of the **marketability review** (G2, Figure 21), the enabling committee decides about finalizing the digital services' development. Therefore, service owners and managers must consolidate the results of the proofs of concept and customer value. These proofs are essential for granting the go-to-market approval. Prior to this, service owners and managers must ensure that the proposed digital services meet the companies' standards. Thus, multiple iterations of the conceptualization mode are possible prior to the decision of service owners and managers to present the results to the enabling committee. Ideally, the same template used for

gate G1 (opportunity review) should be applied to the marketability review. The corresponding consistency allows for efficient decision-making and covers all relevant items in order to decide on the go-to-market approval. Table 16 presents the detailed routine descriptions of the complete conceptualization mode.

Table 16: Conceptualization mode's process definition

Steps	Objectives	Continuations	Activities	Artifacts	Primary actors	Secondary actors
B1. Service concept	Defining services in their constituting dimensions	Onwards; reiteration; relocate forward	Define new/adapted customer operations, new/adapted internal operations, inter-firm processes and required technology and tools	Business model; service blueprint[1)]; customer journey; detailed user stories	Service owner	Service manager; service developers
B2. Customer experience	Creating value-adding customer-provider interactions	Onwards; reiteration; relocate forward or backward; restart (B1)	Define benefits and customer value; identify impact on customer satisfaction; design physical and digital integration	Customer experience dashboard; customer journey; service blueprint[1)]	Service owner	Service manager; customer experience analyst; user experience designer
B3. Revenue model	Defining price point and estimating profitability for provider and customers	Onwards; reiteration; relocate forward or backward; restart (B1)	Determine total delivery costs, revenue sources, price point, cannibalization of existing portfolio, and market size	Net present value and return on investment calculations	Service owner	Service manager; financial and business analyst; controller; pricing manager
B4. Service process integration	Integrating the designed service processes into providers' and customers' organizations	Onwards; reiteration; relocate forward or backward; restart (B1)	Align service operations with the existing service organizations	Process simulations; live demonstrations; business processes	Service owner	Service managers; marketing, sales, and compliance experts; customers

Steps	Objectives	Continuations	Activities	Artifacts	Primary actors	Secondary actors
B5. Distribution and training approach	Preparing market launch by setting up the sales and delivery organization	Onwards; reiteration; relocate forward or backward; restart (B1)	Review and create new sales, marketing, and training concepts, innovate market communication (internal and external)	Marketing, sales, and training tools and materials	Service owner	Service manager; sales and marketing experts; training academy and team
B6. Proof of concept	Assessing services' practical viability	Onwards; reiteration; relocate forward or backward; restart (B1)	Test all service features to prove their viability in action; gather comprehensive feedback from all stakeholders; improve the service	Services; feedback reports	Service owner	Service manager; technical service developers; field staff; customers
B7. Proof of customer value	Collecting evidence that the service is creating additional value for the customers	Onwards; reiteration; relocate forward or backward; restart (B1)	Gather customer feedback via interviews to evaluate perceived added value and ideas for improvement	Service; feedback reports	Service manager	Service owner; customer panel
G2. Marketability review	Granting market approval	Onwards; reiteration; relocate forward or backward; restart (B1)	Decide which digital services move to the implementation mode	Marketability review template; results of all previous process steps	Enabling committee	Service manager; service owner; sponsor

Note. 1) Bitner, M. J., Ostrom, A. L., & Morgan, F. N. (2008). Service Blueprinting: A Practical Technique for Service Innovation. California Management Review, 50(3).

5.2.3 Implementation

Implementation is the final innovation mode of this study's digital service innovation process. Its objective is to ensure successful market introductions of digital services. This mode is immediately followed by transferring new digital services to the department that continuously delivers them to customers. Figure 22 presents the detailed perspective on this closing mode.

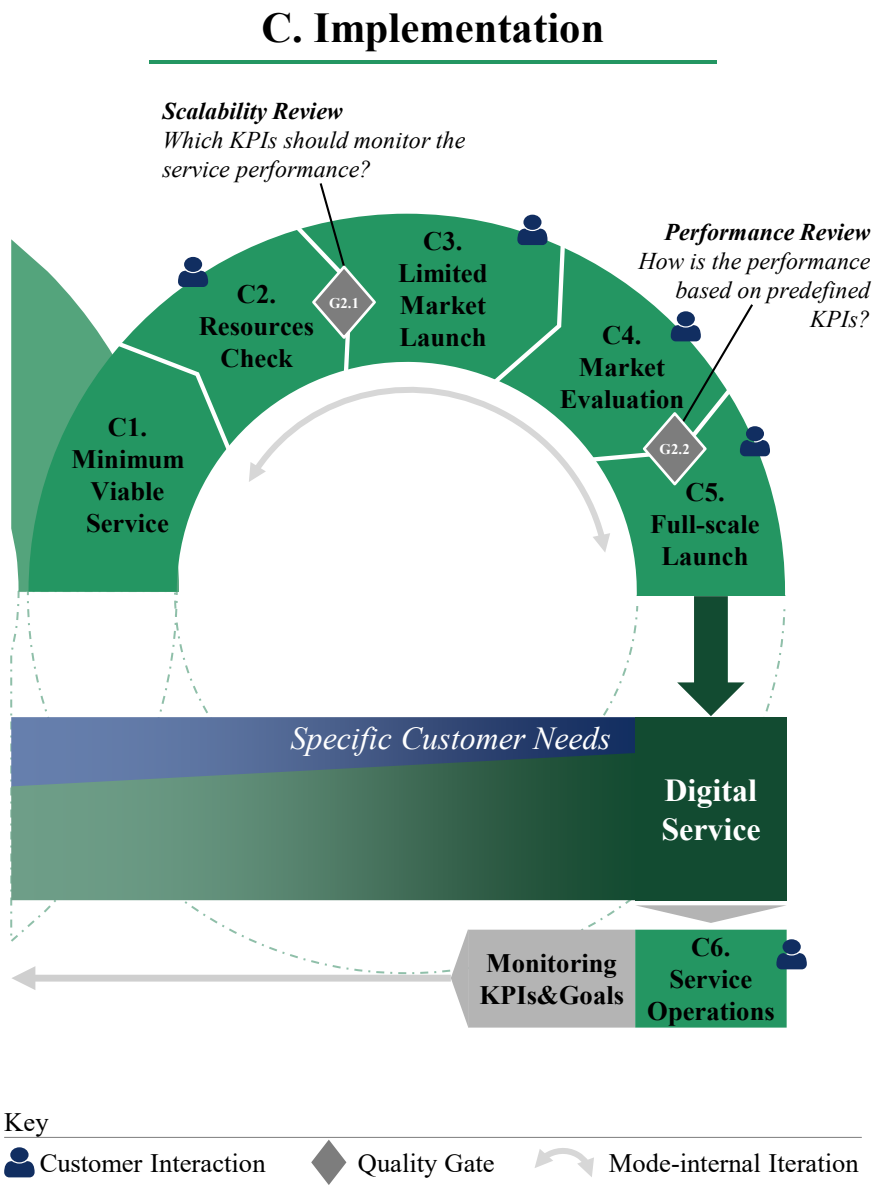

Figure 22: Close-up – Implementation. Own illustration

The roll-out of digital services starts shortly after the go-to-market approval. Local managements of all target markets are informed about the new offerings and their implications for the regional offer portfolio. At the same time, local managements get to vote on directing digital services' finalization and steering their market introduction.

The definition of the **minimum viable service** (MVS) (C1, Figure 22) is the first process step in the implementation mode. Its objective is to define a minimum set of modules that represent a marketable digital service. These modules should satisfy significant customer needs and spark customers' interest to receive the digital service.

Firms should market the MVS in three-stage or five-stage offerings. This allows customers to choose whatever suits their needs. To decide which modules should constitute the MVS, provider and customer-oriented parameters offer guidance.

From the provider's perspective, two factors mostly drive modularization. The first factor is the necessary knowledge to deliver the digital service. This knowledge plays an essential role as modules requiring similar capabilities are easy to group into a single offering. The second factor is digital service's impact on the provider organization. Achieving a good balance between complex modules and those easy to implement is the goal of MVS design.

From the customers' perspective, the received outcome, performance value ratio, and flexibility to choose an offer structure are vital parameters to consider while compiling the MVS. The perceived outcome specifically refers to the recognition of the customers' added value when using the digital service. Hence, complementing outcomes provides a foundation to structure the MVS appropriately. Likewise, the performance value ratio adds the related costs to customers' perceived added value. Providers should carefully design their MVS packages, especially by avoiding unbalanced digital services, to retain their attractiveness to customers. Customers typically appreciate their ability to influence the added value range of the offered digital service. The MVS and possible enhancements should provide this flexibility to them.

Furthermore, the MVS serves to finalize the offer structure and the necessary process landscape, software, and infrastructure. The distribution and training approach is implemented from this process step onwards. To prepare for the limited and full-scale launch, all stakeholders involved in the roll-out must receive the required materials and sufficient training. This lays the foundation for the successful market introduction of new digital services and helps those involved to gain more experience in delivering them.

The specific MVS design and enhancements lead to the **resource check** (C2, Figure 22). Therein, the service manager ensures that the digital service is ready for the market launch. All digital service elements, e.g., the developed processes, software, and infrastructure, are finally evaluated before the market launch. The objective is not only to test the functionality of the digital service as seen from the perspective of the provider

and the test customer, but also to broaden the view of the target market. The characteristics of the development do not necessarily apply to the providers' and customers' organizations in the different markets and regions of the world. Thus, by identifying necessary adaptations, the resource check ensures digital services' scalability to all target customers.

During the **scalability check** (G2.1, Figure 22), the enabling committee reviews the MVS definition and the resource check. The corresponding results justify the approval of the limited market launch. In addition, a set of KPIs is defined to evaluate the limited market launch. Three categories of KPIs are typically defined to track the performance of the subsequent steps. First, the overall performance of the digital service is recorded by tracking the total number of conducted deliveries, active users, and generated support tickets, as well as the availability of the digital service to the customers. Second, the operational review relates to the assessment of digital service delivery. Common variables that are monitored include the field staff utilization, the reaction time, and the delivery cost per hour. Third, the customers' feedback is a vital indicator of how the digital service performs in the markets. Their satisfaction and acceptance levels compared to their complaints provide detailed insights.

The **limited market launch** (C3, Figure 22) delivers the digital service to the market. Preferably, the provider's less important markets are selected to gather feedback in real-life scenarios. The objective is to validate the MVS and the related go-to-market approach. Therefore, close customer interaction and multiple feedback loops are conducive to gain insights into the performance of the limited market launch. The development team should support this stage to react to the occurring challenges as swiftly as possible. The resolved challenges should be incorporated directly in the digital service concept and the related distribution and training concepts.

The **evaluation** step (C4, Figure 22) assesses the limited market launch based on the defined KPIs of the scalability review. The comparison of the initially targeted values with the measured parameters defines necessary adaptations of the digital service. Direct customer feedback is most critical. The perceived added value of the customers and their satisfaction are the major drivers of the future success of the digital service.

The **performance review** (G2.2, Figure 22) empowers the enabling committee to verify the success rate of the limited market launch. Depending on the achieved performance and, if possible, the objective at this stage is to approve the full-scale launch. The evaluated KPIs of the limited market launch underpin this decision. If the full-scale launch is approved, the new digital service(s) becomes an integral part of the providers'

portfolio. The global roll-out requires further distribution, training, and infrastructure development. Therefore, significant resources are allocated to conduct the full-scale launch.

The **full-scale launch** (C5, Figure 22) finalizes digital services' market introduction. Besides the involvement of smaller markets to test the roll-out, major key accounts and strategic markets are now targeted with the new offering. Therefore, suitable incentive systems need to be installed and tailored to the needs of the individual markets. In the same way, the distribution approach needs further advancement as individual market requirements have to be met. It is also necessary to prove compliance with legal regulations at a global scale. If necessary, the initially defined performance KPIs are reviewed and adapted to the needs of the full-scale launch. In cases where regional market requirements deviate significantly from the test markets, it is appropriate to repeat the implementation cycle (starting with C1).

Moreover, the developed digital service is finalized in this process step to overcome the MVS status of the previous stages. All adaptations lead to a generally marketable definition of the digital service, including the staged offerings. Although the MVS status is mastered, the digital service requires continuous advancement over its entire lifetime. Market conditions, e.g., technologies, competitor actions, and customer needs, change. Therefore, the digital service has to keep track of the nascent and emerging conditions to stay attractive to customers.

The official development project of the specific digital service is terminated at the end of the full-scale launch. Hence, the responsibilities of delivering and adapting the digital service move from the service owner and manager to the service delivery team or department.

The **service operations** (C6, Figure 22) stabilize the market introduction. Their responsibilities are to attract new customers and to ensure delivery at a consistent quality level. Therefore, all initiated actions continuously drive the digital service's success from the limited market launch onwards.

Moreover, service operations continue to monitor the defined KPIs of the full-scale launch. This enables steering the delivery quality of the digital service. In addition, the feedback allows for continuous adaptations to advance the offering. If major deviations or opportunities are detected, the feedback initiates entirely new digital service innovations. In these cases, digital service innovation restarts with comprehensive market analyses of the identification mode.

Table 17 summarizes the key aspects of the implementation mode and provides additional information on the individual process steps and gates. This compilation finalizes the introduction of the entire digital service innovation process.

Table 17: Implementation mode's process definition

Steps	Objectives	Continuations	Activities	Artifacts	Primary actors	Secondary actors
C1. Minimum viable service (MVS)	Defining a service that meets customer expectations based on various offers	Onwards; reiteration; relocate forward or backward	Evaluate key features; divide service into a minimum and a maximum service offer; finalize development; start the training	Service offers; sales and marketing concept	Service manager	Service owner and developers; marketing and sales experts; local managements
C2. Resource check	Ensuring that all required resources and capabilities are available to deliver the new service to a broader customer base	Onwards; reiteration; relocate forward or backward; restart (C1)	Involve provider's service operations and customers in comprehensive testing and alignment	Service offers; service's operational footprint	Service manager	Service owner; entire operations team (local field staff and management); target customers
G2.1 Scalability review	Confirming services' readiness to scale	Onwards; reiteration; relocate forward or backward; restart (C1)	Review final service concept; agree on limitations in the implementation; define KPIs to measure service performance	Service concept; evaluation reports; list of KPIs	Enabling committee	Service manager; service owner; sponsor
C3. Limited market launch	Assessing the MVS and its go-to-market approach	Onwards; reiteration; relocate forward or backward; restart (C1)	Deliver the service; capture internal and external feedback to develop the service and its marketing approach further	Service offers; marketing and sales concepts and tools	Service manager	Service owner; sales and marketing staff; operations team; target customers

Steps	Objectives	Continuations	Activities	Artifacts	Primary actors	Secondary actors
C4. Evaluation	Reviewing market feedback to optimize the service and its distribution approach	Onwards; reiteration; relocate forward or backward; restart (C1)	Evaluate feedback and compare with expected outcome based on predefined KPIs; delineate measures; prepare the performance review	Feedback reports (internal and external)	Service manager	Service owner and developers; marketing and sales experts; local managements
G2.2 Performance review	Approving the final budget for global roll-out	Onwards; reiteration; relocate forward or backward; restart (C1)	Review results of the limited market launch evaluation; decide on continuation with the full-scale launch	Service offers; feedback reports; evaluated KPIs	Enabling committee	Service manager; service owner; sponsor
C5. Full-scale launch	Rolling out new services globally	Onwards; reiteration; relocate forward or backward; restart (C1)	Offer the service to all target customers; collect field data	Service offers; marketing and sales concepts and tools	Service manager	Service owner; sales and marketing staff; operations team; target customers
C6. Service operations	Delivering new services to all target markets and integrating them into the provider's organization	Onwards; reiteration; relocate forward or backward; restart (C1)	Distribute service to all target markets and monitor its performance; collect detailed feedback (internal and external)	Service offer; KPI dashboard	Sales and marketing staff; operations team	Service manager, sponsor, enabling committee

5.2.4 Uniting the digital service innovation process with theory

This subsection combines the theoretical and practical definitions of digital service innovation routines, more specifically the presented theoretical perspective (Chapter 2) and the developed practical view of digital service innovation routines (Chapters 3 and 4). The subsequent process (Subsections 5.2.1 to 5.2.3) provides the framework embedding all routines of digital service innovation. Thus, the original mapping of theoretical and practical routines (Section 3.3) is consolidated in the process model and enhanced by the process definition.

Figure 23 provides a general routine overview. In it, the innovation modes and generic routines are enhanced, based on the primary understanding of digital service innovation (Chapter 4). The process synthesis (Chapter 5) leads to the definition of the final routine set that is required to implement digital service innovation at industrial companies.

The comparison of this final set with the theoretical routines exposes three major differences. First, the defined routines in the process model have a clear chronological order. Second, they provide continuity throughout the entire digital service innovation endeavor. Third, they are aggregated at a level that is sufficient to ease their implementation at industrial companies.

Apart from these differences, each theoretical routine is operationalized by the defined set of routines. Moreover, some theoretical routines form part of multiple defined routines or constitute an entire innovation mode. Thus, all theoretical routines are incorporated in the new digital service innovation process.

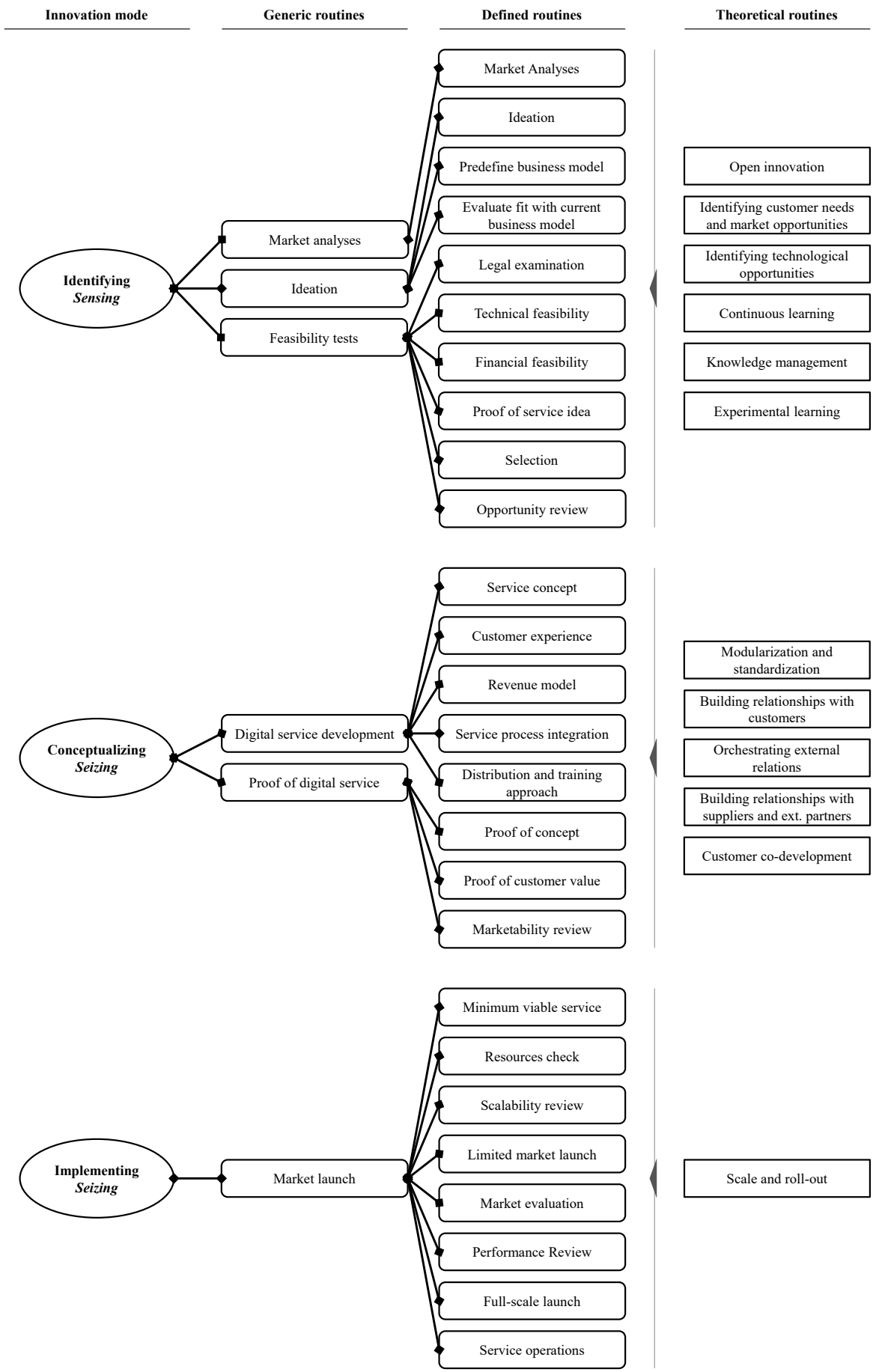

Figure 23: Integration of digital service innovation routines – Process perspective. Own illustration

6 Discussion

This dissertation presents a novel approach to how industrial companies should pursue digital service innovation. Closing the study, this chapter summarizes the findings, the contribution to practice and theory, and the limitations, along with the associated implications for future research.

6.1 Key findings on digital service innovation

Industrial companies experience a continuous intensification of competition in their historical markets. Adding services to the traditional hardware portfolio is a promising escape strategy from the problematic, current conditions as services show great potential to improve the firms' competitive advantage. In addition, with the rise of digital technologies, firms strive to increase their digital service offers. Unlike former, mainly physical services, digital services entail software and digitized hardware components. These digital elements enable companies to address customer needs more precisely than physical services. Digital services are thus more appealing to industrial companies.

As these companies seek to improve their market position through digital services, they recognize the difficulties involved in satisfying customers with these new offerings. The firms' application of their product-driven innovation capabilities often results in ill-defined digital services that hardly convince customers. Therefore, industrial companies need to build appropriate capabilities to innovate digital services successfully.

To help industrial companies overcome this nascent stage, this study explored *how industrial companies should pursue digital service innovation* (PRQ). Through a synthesis of previous literature, an interview study, and focus group research, it provides digital service innovation governance and process models that support industrial companies to shift toward digital service innovations. The models are constructed along the lines of the study's four secondary research questions, which support the overarching objective by applying the dynamic capabilities view.

1) What organizational routines constitute digital service innovation?

Organizational routines constitute one of the three building blocks of digital service innovation. Routines related to digital service innovation governance and process cover all necessary activities to activate digital service innovation at industrial companies. In particular, process management (process application, integration, and review) and performance control operationalize the governance perspective. The process management prepares the organization to facilitate the implementation of all required activities. It

also covers the continuous improvement of the firms' digital service innovation approach.

Moreover, performance control ensures structured decision-making along the entire digital service innovation process. As a result, it also ensures that digital services comply with the providers' standards to minimize the risks of poor market performances. Furthermore, process management and performance control implement the dynamic capabilities' transforming dimension.

The digital service innovation process includes 26 routines. These routines are structured along with the three innovation modes: identification, conceptualization, and implementation. Each mode represents an iterative development cycle that permits iterations within or across routines or restarts of full modes. Moreover, the process operationalizes the dynamic capabilities' sensing and seizing dimensions.

The identification mode exposes new digital service business opportunities. At the outset, the firms' inner and outer worlds are assessed to determine new pathways for digital service innovation. Thereafter, the collected information is synthesized, and the feasibility of upcoming ideas is comprehensively tested. Finally, the opportunity review concludes the identification mode as a gatekeeper. This review decides on the continuation of the identified opportunities. Simultaneously, the required resources to develop the surfaced digital service ideas are allocated if approval is granted.

The conceptualization mode follows the identification mode. Therein, firms develop digital services. At the end of this mode, the interplay between defined process landscapes, software, digitized infrastructure, and distribution systems come to life for the first time. The exhaustive testing of the digital services with target customers enables the final decision regarding their general market introduction. Therefore, the marketability review concludes the conceptualization mode with an in-depth assessment of the conducted proof of concept and customer value.

After the go-to-market approval, the implementation mode starts. Service developers define the basic offer that is comprehensively tested before its market introduction. In addition, a limited market launch allows the firms to increase their experience of the new digital service. Once the limited market launch is successful, the digital service is offered to all target markets. Finally, the implementation mode terminates the development project and transfers the digital service to ongoing distribution and delivery.

2) What artifacts support digital service innovation?

Clearly defined artifacts drive the operationalization of the digital service innovation governance and process. The two most fundamental artifacts are the digital service innovation governance model and the digital service innovation process model. Prominent artifact examples that support the overarching governance and process models are the corporate strategy, tangible visualizations of digital services, business model templates, templates for standardized decision-making, and the digital service itself.

3) What actors manage the operationalization of digital service innovation, and what are their role profiles?

Five actors activate digital service innovation routines and artifacts. The enabling committee and sponsors coordinate the governance perspective. The enabling committee makes all major decisions along the innovation process. It reviews the achieved results at every gate. In addition, the committee facilitates digital service innovation in situations where the organization lacks innovations. Sponsors support the operational level to actively pursue digital service innovations. Their responsibility is to supervise the entire process chain and support the developers, if necessary. Together, the enabling committee and sponsors drive the organizational alignment to continuously improve digital service innovation.

Innovation leaders, service owners, and service managers implement the digital service innovation process. The innovation leaders assume the responsibility to initiate new innovation avenues. In this regard, they guide the identification mode and consolidate all findings to present the results at the opportunity review. Service owners drive the development of digital services in the conceptualization mode. They are responsible for implementing the requirements that new digital services must comply with. Service managers support the service owners by bringing a project management and customer perspective into the development stage. Moreover, the service managers lead the implementation mode by introducing new digital services to the target markets.

4) How should a management framework be designed to guide practitioners through digital service innovation?

The digital service innovation governance and process artifacts comprise the management framework. Each model presents a high-level definition of the required routines, artifacts, and actors. The models also provide detailed guidance for their implementation. Therefore, managers and digital service developers can easily apply the proposed artifacts to pursue digital service innovations in their organizations.

6.2 Managerial implications

Digital services offer a myriad of options to industrial companies intending to enhance their competitive advantage. However, the firms' typical focus on product-driven innovation approaches hinders them from exploring the potential and reaping the benefits of digital services. Instead, digital service innovation requires innovation approaches tailored to specific needs.

This dissertation makes an essential contribution to managerial practice by presenting a management framework, which takes adaptations to existing innovation practices into account. By applying the management framework, industrial companies can innovate digital services that meet customer needs and that boost their competitive advantage. More specifically, the management framework guides industrial companies, based on its governance and process models. Both models navigate practitioners through the management framework's deployment and implementation. The framework instructs industrial companies in every stage of digital service innovation, from the early attempts to innovate digital services to the establishment of an extensive digital service business. Simultaneously, it permits all stakeholders to enter their perspectives and creativity into the process. Thereby, the management framework directs the stakeholders instead of explicitly prescribing what they must do.

Moreover, the process model unites established innovation approaches (e.g., Stage-Gate process styles and agile methods) into a single framework and adds digital service-specific elements. Generally, innovation approaches are either characterized as linear and rigid (e.g., the Stage-Gate process) or highly iterative and flexible (e.g., agile methods). Traditionally, industrial companies installed Stage-Gate-driven innovation approaches for their product innovation. The problem is that practitioners apply these approaches in a rigid and linear manner to mitigate the high financial risks of product innovation. Stage-Gate approaches are efficient when developing predefined outcomes. However, these approaches are too rigid and do not work when they have to cope with the intangible nature of digital service innovation.

Agile methods, on the other hand, evolved to develop intangible outcomes that are hardly describable at the beginning of the innovation process. Although agile methods suit digital service innovation in theory, they do not meet the practical requirements of industrial companies. Beyond software development, most industrial companies are not familiar with the application of agile methods in their organizations. Furthermore, agile methods do not provide enough guidance to ensure, in a consistent manner, the success-

ful innovation of digital services. Instead, industrial companies need innovation approaches that roughly guide practitioners through their implementation and that ensure appropriate risk mitigation. Consequently, the boundaries of a suitable digital service innovation process are determined by a combination of presenting guidance, allowing iterations and creativity in the process, and including digital service-specific elements.

This study's digital service innovation process unites these requirements. The three innovation modes (identification, conceptualization, and implementation) separated by gates refer to its Stage-Gate character. The clearly defined modes are similar to the stages defined by Cooper (2001). In addition, the gates allow management to review and steer the ongoing digital service innovations toward an alignment with the corporate strategy. Furthermore, the detailed design of the process modes incorporates agile methods and digital service specifics. The process steps of the identification mode relate to Design Thinking. The identification mode and Design Thinking create an initial understanding of the issues that must be addressed. Eventually, both approaches close by evaluating possible solutions to overcome the identified challenges. This is followed by the conceptualization mode's reference to Scrum. At many industrial companies, software development already follows Scrum-driven approaches. Based on these experiences, the companies are eager to extend Scrum's application to process designs and infrastructure development. Thus, Scrum is well suited for implementing the conceptualization mode. Thereafter, the implementation mode (and the last process steps of the conceptualization mode) leverage Lean Startup. Multiple test cycles of the new digital service combined with its improvement implement the key characteristics of Lean Startup.

In sum, the digital service innovation governance and process models help industrial companies overcome organizational barriers. More specifically, by using the management framework, the firms can overcome structure and governance-related obstacles to digital service innovation (*cf.* Stähle, 2020).

6.3 Theoretical implications

The results of this dissertation make a valuable contribution to research and expand the existing literature in two ways: First, the management framework adds new insights to the servitization literature and, more specifically, to digital service innovation. Second, it augments academia's understanding of dynamic capabilities operationalized through digital service innovation at industrial companies.

The literature proposes various approaches to pursue digital service innovation (Gustafsson et al., 2020). However, most of these approaches do not comply with digital

service-specific requirements (Biemans et al., 2016). Typically, researchers indicate routines or process steps relevant to digital service innovation. However, their consistency and level of detail are insufficient (Bullinger et al., 2003; Troilo et al., 2017). Also, their characteristics draw heavily on generic process descriptions and linear procedures (Alam & Perry, 2002; Edvardsson & Olsson, 1996; Kindström & Kowalkowski, 2009). By proposing a new digital service innovation approach, this study consolidates and advances the previous findings. Besides consolidating the previous process models, the study adds service-specific elements to the management framework's digital service innovation process. Moreover, conducive artifacts and required actors are directly linked to each activity in the process.

From a steering perspective, most digital service innovation approaches do not include and align with the required management mechanisms. The introduced governance model provides the necessary alignment between the operations and management levels. Therein, existing project and IT governance mechanisms are leveraged to provide operational and managerial guidance within digital service innovation. Also, artifacts and actors are defined within the governance model. In conclusion, this holistic conception of digital service innovation leads to a new understanding that complements the previous state of the literature.

Finally, the defined management framework contributes to the dynamic capabilities view (DCV). In general, the literature defines digital service innovation as a dynamic capability (Teece, 2018). Following this approach, academia exposed many routines that allow firms to pursue digital service innovation (Stähle, 2020). However, the dynamic capabilities are rooted in organizational processes that, in turn, are constituted by routines, artifacts, and actors (Feldman & Pentland, 2003). Therefore, proposing routines for digital service innovation is not exhaustive and do not define digital service innovation as a dynamic capability.

This study addresses this imperfection with the defined management framework. The management framework operationalizes the high-level dynamic capabilities (sensing, seizing, and transforming) in two steps. Sensing and seizing are implemented through the digital service innovation process. Transforming relates to the governance model of digital service innovation. Supporting artifacts and actors complement both the governance and process models. Thereby, this study presents a comprehensive understanding of digital service innovation as a dynamic capability.

The dynamic capabilities view is still an evolving theory that sparks controversies in academia. A major aspect to consider is the standardized definition and implementation

of dynamic capabilities. Barney (1991), in particular, highlights the necessity of capabilities to meet the VRIN (valuable, rare, imperfectly inimitable, and non-substitutable) characteristics when building competitive advantages. However, the implementation of a standardized management framework would not meet these criteria as all companies would pursue digital service innovation the same way. However, Eisenhardt & Martin (2000) contend that "since the functionality of dynamic capabilities can be duplicated across firms, their value for competitive advantage lies in the resource configurations that they create, not in the capabilities themselves. Dynamic capabilities are necessary, but not sufficient, conditions for competitive advantage" (p. 1106). Hence, academia should propose operationalizable implementations of dynamic capabilities, adapted by firms to their specific contexts. In response, this study operationalizes the dynamic capability of digital service innovation so that this capability is ready for implementation by industrial companies through the management framework.

Furthermore, Schreyögg & Kliesch-Eberl (2007) question whether capabilities can be dynamic. They argue that dynamic and ordinary capabilities are mostly implemented identically in the firms' organizations. If the case, this would obviously hinder the dynamic character of the firms' capabilities. The proposed management framework overcomes this risk by including a continuous deployment and review cycle in the digital service innovation governance model.

Finally, it is concluded that the defined management framework contributes comprehensively to the literature by proposing an aligned advancement of digital service innovation as a dynamic capability.

6.4 Limitations and future research

This dissertation makes a fundamental contribution to digital service innovation, in both practice and theory. However, this work does not come without certain limitations to its design and implementation. These limitations provide leeway for future research. The future research pathways are proposed to further expand on this dissertation and on the current understanding of digital service innovation at industrial companies.

The most important limitations of this work reside in the applied qualitative research method that contains several design weaknesses. For example, the analyzed sample size is relatively small, thus narrowing the insights to a specific group of industrial companies. The selected group provides cross-sectoral observations from companies operating in an industrial business-to-business logic. The case sample only comprises incumbent industrial companies. All case organizations are headquartered or based in European

countries and their study participants only come from management levels, resulting in homogeneous boundaries of the analyzed cases. Since only static and external observations fuel the conducted investigations, the collected data focus on the case companies. Finally, qualitative analyses underlie biases throughout the entire research process. They start with the specific case selection and end with the findings' consolidation (Suri, 2011).

Nevertheless, the analyzed case companies and research method more than adequately serve the research purpose. The objective was to garner comprehensive insights in order to develop, explain, and justify a new digital service innovation approach. The applied research method enabled the required in-depth data collection and synthesis. Future research, however, could enhance the current understanding by analyzing a broader set of companies in the industrial sector and beyond. Thus, the characteristics of the companies should be more heterogeneous, specifically to drive the generalizability and validity of the normatively defined management framework.

Furthermore, the dynamic capabilities view, which was applied as the theoretical approach, sets the conceptual boundaries for the conducted research. Although it is one of the dominant research perspectives in service innovation, it is not beyond criticism. The dynamic capabilities view is still an emergent theory and its generic nature sparks many controversies. Academia questions the extent to which dynamic capabilities are implementable and can contribute to the performance of firms. Nonetheless, its comprehensive perspective on organizational capabilities and its strong innovation focus suit the objectives of this dissertation. This does not prevent future research from applying other organizational theories, beyond the dynamic character, to build digital service innovation frameworks. Future quantitative studies could draw causal relationships between the optimal design of digital service innovation and firm performance.

This dissertation was based on systematic literature reviews. While these reviews are the favored approach to determine the academic status quo, the identified literature directs the final results. While the reviews and additional analyses used for this dissertation were methodically conducted in a circumspect manner, the possibility that important contributions to digital service innovation may have been missed cannot be ruled out. However, extensive forward and back research and updates of the evident literature minimized the risk of existing but unknown or unfamiliar academic contributions.

Finally, this dissertation provides a significant step toward improving digital service innovation at industrial companies. The management framework itself provides thematic inspiration for future research. Future studies should further convince academia

to support industrial companies in improving their innovativeness regarding digital services. The importance of this type of offering is likely to increase on a continuous basis, boosting the competitive advantage of firms.

6.5 Conclusion

Increasing challenges in the historical markets of industrial companies accelerate the need for substantial competitive advantages. Hence, these companies seek to readjust their competitive advantage by offering digital services and overcoming ill-defined organizational capabilities.

This dissertation helps incumbent industrial companies to pursue digital service innovation by defining required organizational capabilities. The findings lead to a comprehensive management framework comprising of digital-service-specific governance and process models. Each model is composed of clearly defined routines, artifacts, and actors that make the management framework ready to deploy and implement in practice.

In summary, this dissertation supports industrial companies in identifying and setting the organizational preconditions for successful digital service innovations. The management framework aligns the mostly rigid and linear working organizations with agile innovation approaches contributing to digital services. Also, the results enhance the general service innovation literature by adding an implementable digital service innovation approach. Finally, the dynamic capabilities view is operationalized by linking previously evident routines with high-order dynamic capabilities through organizational processes.

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