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Dissertation No. 2132

Digital servitization

Organizing the firm and
working with the ecosystem

Alexey Sklyar

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2021

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Abstract

Traditionally, equipment sales were the main source of revenues for manufacturing firms. The situation has changed, and such firms are undergoing servitization when revenues are increasingly derived from services. In parallel, the digitalization of industries brings novel technologies to the forefront of manufacturers' agendas. With servitization and digitalization converging, many firms are now undergoing digital servitization. Both internal focus and external focus appear important for digital servitization; yet, the extant research remains scarce, explaining the need to further explore the phenomenon's intra- and inter-organizational sides. To this end, the present thesis aims to describe and analyze how manufacturing firms manage digital servitization internally and externally.

Building upon the academic literature in industrial marketing and related disciplines, this thesis leverages five appended papers as its empirical foundation. On the intra-organizational side, the empirical findings concern how firms can organize for digital servitization. Specifically, the findings point toward organizing the structure, where a particular emphasis lies on service and product units, especially alongside the spectrum of central/local and front-end/back-end roles and functions. Furthermore, the empirical evidence suggests that organizing the support for digital servitization requires an internal focus on data (together with relevant digital technologies and software), responsiveness, and agility.

On the inter-organizational side, the findings concern how firms can work with their ecosystems. First, working with the vision for digital servitization involves different ecosystem actors, where digitalization-related factors and the timing of relevant initiatives are of importance. Second, working with customers is associated with digital infrastructure for efficient service provision, digital competences of customers, and novel sources and types of value propositions. Third, working with partners requires large-scale, extensive collaboration around digital servitization initiatives, where both commercial and non-commercial actors play an important role. Moreover, the empirical evidence on the inter-organizational side suggests relevant capabilities when working with ecosystems.

In terms of theoretical implications, the present thesis contributes to business marketing research and cross-disciplinary servitization research, belonging to the growing stream of literature that studies intra- and inter-organizational sides of digital servitization. Finally, as managerial implications, this thesis offers suggestions for manufacturers on how to organize the structure and the support for digital servitization, as well as how to work with the external business environment.

Sammanfattning

Traditionellt sett har försäljning av utrustning varit den främsta inkomstkällan för tillverkningsföretag. I takt med att dessa företag genomgår tjänstefiering har situationen dock förändrats och tjänster har blivit en allt mer central inkomstkälla. Samtidigt genomgår tillverkningsindustrin en omfattande digitalisering, vilket påverkar företagens marknadsstrategier och erbjudanden. Tjänstefieringen och digitaliseringen samspelar, varpå många företag genomgår en digital tjänstefiering. Det har visat sig att internt såväl som externt fokus är av betydelse för den digitala tjänstefieringen, men trots det är forskningen knapphändig och det finns ett behov av att ytterligare undersöka fenomenets intra- och interorganisatoriska sidor. Med den bakgrunden syftar den här avhandlingen till att beskriva och analysera hur tillverkningsföretag hanterar digital tjänstefiering internt och externt.

Avhandlingen bygger på akademisk litteratur inom industriell marknadsföring och relaterade fält. Fem bifogade vetenskapliga artiklar utgör avhandlingens empiriska grund. Intraorganisatoriskt visar resultaten hur företag kan organiseras för att genomgå digital tjänstefiering. Resultaten rör specifikt företagsstruktur, med tyngd på tjänste- och produktenheter samt centrala och lokala roller och funktioner. Vidare tyder resultaten på att det krävs ett internt fokus på data (tillsammans med relevanta digitala teknologier och mjukvara), anpassning och agilitet för att organisera det stöd som behövs för digital tjänstefiering.

Interorganisatoriskt handlar resultaten om hur företag kan arbeta med andra aktörer i sina ekosystem. För det första involverar arbetet med en vision för digital tjänstefiering olika aktörer i ekosystemet. Här är olika faktorer kopplade till digitalisering och timingen av relevanta initiativ av betydelse. För det andra är kundarbetet sammankopplat med en digital infrastruktur för en effektiv tjänsteleverans, digital kompetens hos kunden och nya typer av värdeerbjudanden. För det tredje kräver samarbeten med olika partners ett omfattande arbete kring initiativ som rör digital tjänstefiering. Här spelar både kommersiella och icke-kommersiella aktörer en viktig roll. Vidare belyser resultaten relevanta förmågor för att kunna arbeta med ekosystem.

Avhandlingen bidrar teoretiskt till forskningen inom industriell marknadsföring och den tvärvetenskapliga forskningen om tjänstefiering. Den är en del av den växande litteratur som studerar intra- och interorganisatoriska sidor av digital tjänstefiering. Slutligen bidrar avhandlingen praktiskt genom att föreslå hur tillverkningsföretag kan organisera företagsstrukturen och stödet för digital tjänstefiering, liksom hur de kan arbeta med den externa affärsmiljön.

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Norrköping, February 2021

Alexey Sklyar

Appended papers

Paper I. Sklyar, A., Kowalkowski, C., Tronvoll, B., & Sörhammar, D. (2019) “Organizing for digital servitization: A service ecosystem perspective”, *Journal of Business Research*, Vol. 104, pp. 450-460.

My contribution: Leading the development work and writing, including the research idea and conceptual framework; participating in the data collection; leading the data analysis; leading the work with revisions and addressing the editors and reviewers’ comments.

Paper II. Sklyar, A., Kowalkowski, C., Sörhammar, D., & Tronvoll, B. (2019) “Resource integration through digitalisation: A service ecosystem perspective”, *Journal of Marketing Management*, Vol. 35 (11-12), pp. 974-991.

My contribution: Leading the development work and writing, including the research idea and conceptual framework; participating in the data collection; leading the data analysis; leading the work with revisions and addressing the editors and reviewers’ comments.

Paper III. Tronvoll, B., Sklyar, A., Sörhammar, D., & Kowalkowski, C. (2020). “Transformational shifts through digital servitization”. *Industrial Marketing Management*, Vol. 89, pp. 293–305.

My contribution: Participating in the development work, including the research idea and conceptual framework; participating in the data collection; leading the data analysis; leading the writing of sections Method and Findings and, during the revisions, of sections Discussion and Implications (including the relevant parts of the extended response letters); assisting the co-authors in writing the remaining sections and their critical revision.

Paper IV. Sklyar, A. (2021) “Digital service strategy and customer-facing units: The interplay of conditions behind strategy implementation support”. *Working paper*.

My contribution: Creating the research idea; developing the conceptual framework; participating in data collection; analyzing the data; writing the paper.

Paper V. Nenonen, S., Gummerus, J., & Sklyar, A. (2018) “Game-changers: dynamic capabilities’ influence on service ecosystems”, *Journal of Service Management*, Vol. 29 (4), pp. 569-592.

My contribution: Participating in the development work, including the research idea and conceptual framework; reviewing and incorporating the relevant literature on dynamic capabilities; operationalizing the notion of the capabilities’ hierarchy; designing and carrying out data analysis; writing and revising sections Methodology and Results for each (re)submission; assisting the co-authors in writing the remaining sections and their critical revision during the review rounds.

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Additional publications

Journal articles

Nenonen, S., Storbacka, K., Sklyar, A., Frow, P., & Payne, A. (2020). “Value propositions as market-shaping devices: A qualitative comparative analysis”. *Industrial Marketing Management*, Vol. 87, pp. 276–290.

Conference papers

Tóth, Z., Kowalkowski, C., Sklyar, A., Tronvoll, B., Sörhammar, D., Wirths, O. (2020), “A paradox theory approach to tensions in digital servitization: the case of the aerospace and maritime industries”, Spring Servitization Conference, Birmingham (UK).

Nenonen, S., Frow P., Payne, A., Sklyar, A., Storbacka, K. (2019), “The Role of Value Propositions in Market-Shaping Strategies: A Qualitative Comparative Analysis”, Naples Forum on Service, Ischia (Italy).

Tóth, Z., Kowalkowski, C., Sklyar, A., Sörhammar, D., Tronvoll, B., Wirths, O. (2019), “Digital Servitization through the lenses of Paradox Theory: Evidence from the Aerospace & Maritime Industries”, BMM-EMAC 2019, Berlin (Germany).

Tóth, Z., Kowalkowski, C., Sörhammar, D., Sklyar, A., Tronvoll, B., Wirths, O. (2019), “Digital servitization through the lenses of paradox theory – The evidence of tensions from the aerospace and maritime industries”, Spring Servitization Conference, Linköping (Sweden).

Tronvoll, B., Kowalkowski, C., Sklyar, A., Sörhammar, D. (2019), “Digital servitization among service ecosystem actors”, Naples Forum on Service, Ischia (Italy).

Kowalkowski, C., Sörhammar, D., Tronvoll, B., Sklyar, A. (2017), “The digital service journey: A service ecosystem perspective”, Frontiers in Service Conference, New York (USA).

Sklyar, A. (2017), “The Role of Service Ecosystems in Servitization: A Literature Review”, Spring Servitization Conference, Lucerne (Switzerland).

Sörhammar, D., Kowalkowski, C., Tronvoll, B., Sklyar, A. (2017), “A Service Ecosystem Perspective on the Digital Service Journey”, Naples Forum on Service, Sorrento (Italy).

Sklyar, A., Kowalkowski, C., Sörhammar, D., Tronvoll, B. (2016), “A Network Perspective on Servitization”, IMP Conference, Poznan (Poland).

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1. Introduction

In the past, equipment sales have traditionally been the main source of revenues for manufacturing firms. However, in many industries the situation has changed, with revenues being increasingly derived from services. For example, sales in Konecranes Oyj's service business exceeded sales of its cranes and lifting equipment business by around 6% (Konecranes, 2019), while Atlas Copco AB's compressor manufacturing business generated nearly half of its revenues from service (Atlas Copco, 2019). Such cross-industry developments are reflected in the academic research on *servitization*, which is defined as "the transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic" (Kowalkowski, Gebauer, Kamp, & Parry, 2017, p. 8).

In addition to servitization, manufacturing firms have been facing *digitalization*, which represents "a sociotechnical process of applying digitizing techniques to broader social and institutional contexts that render digital technologies infrastructural" (Tilson et al., 2010, p. 749). Among the main driving forces behind digitalization are digital-native firms such as Amazon and Google. Established around the turn of this century or even more recently, such companies rapidly became potential competitors for firms that for many decades had been operating in traditional industries, resulting in industry-wide disruptions (Crooks, 2017;

Wladawsky-Berger, 2017; Cornish, 2017; Ewing & Scott, 2017). Such developments have further intensified due to the unprecedented impact that the COVID-19 pandemic has had on industries worldwide (Geron, 2020; Kumar Singh, 2020; Romei, 2020).

To remain competitive and balance traditional revenue sources in response to such ongoing and potential disruptions, manufacturers have faced the urgency to invest in large-scale digitalization initiatives. For example, the industrial group Siemens has acquired more than 20 software firms for circa 13.5 billion dollars since 2007 (McGee, 2018). As a result, this world-leading manufacturer, as of 2018, also became one of the world's top 10 software firms, with 24,500 of its employees working with the software. Despite accounting for only 16% of total revenues in that same year, the organizational unit responsible for the software and related digitalization initiatives yielded 30% of Siemens' industrial profits. Such high-margin growth allowed this firm to balance the problematic revenue streams that are associated with its other, non-digital businesses.

With servitization and digitalization increasingly converging, many manufacturing firms are now undergoing *digital servitization*, defined in this thesis as the utilization of digital technologies for transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic. Representing a nascent and yet increasingly important area of research in the wider field of servitization studies (Raddats et al., 2019), digital servitization has become increasingly common among manufacturing firms (KPMG, 2018; Loten, 2020).

1.1. Digital servitization

For decades, traditional information and communication technologies, such as databases, enterprise resource planning systems, and customer relationship management systems, enhanced the operations of manufacturers and accompanied servitization (Vandermerwe & Rada, 1988; Neely, 2008). However, rapid technological development has led to the introduction and increasing adoption of novel technologies that allow for real-time data collection and analysis, as well as for the ease of sharing such data both within and outside of the firm (Kopalle et al., 2020). By leveraging such technologies, manufacturers can develop novel types of services, which become the source of new revenue opportunities across industries.

In the elevator manufacturing industry, where the profit margins of new equipment sales have reached 5-10% and those of servicing and maintenance have approached 25% (Shah, 2019), Otis Elevator Co. has focused on developing subscription-based digital services that are designed around its elevator-management system. By leveraging data analytics to alert of any unusual sensor readings, this firm nearly doubled its number of serviced elevators by expanding onto the competitors' equipment—with the ultimate goal of driving revenues and profitability. A rival firm, Thyssenkrupp AG, has focused on developing its employees' skills around predictive maintenance, big data, and artificial intelligence to offer cloud-based digital services that can predict equipment failures.

In the construction equipment industry, where new equipment sales considerably fluctuate along with market cycles, Caterpillar Inc. has also aimed to benefit from more stable revenue sources that are associated with digital services (Tita, 2015; Hufford, 2019). To this end, the firm began to consolidate its digital services within a single organizational unit, as well as leverage the data science expertise of collaborating data analytics firms to reduce failures and improve the efficiency of its product offerings. With the increasing number of the firm's machines connected to the cloud, customers are then offered remote monitoring services as part of service agreements.

The examples above demonstrate that to develop and offer digital services to customers, manufacturers require both an internal focus (e.g., changing organizational structure and developing digital skills among employees) and an external focus (e.g., collaborating with external partners and expanding the competences toward competitors' equipment). Expanding upon these empirical examples, the following two sections, from an academic perspective, outline the importance of both the intra- and inter-organizational sides of digital servitization.

1.2. Internal focus of digital servitization

The internal focus of digital servitization concerns its intra-organizational side and corresponds to one of the main service research priorities around organization and employee issues (Ostrom, Parasuraman, Bowen, Patrício, & Voss, 2015). Organizing the structure, or aligning organizational structure (Lee, Kozlenkova, & Palmatier, 2015) and strategy, was found to be important in servitization studies when either local managers might receive decision-making authority to support local presence (Neu & Brown, 2005), or, on the contrary, firms might centralize their decision-making authority to improve global efficiency (Vendrell-Herrero,

Gomes, Bustinza, & Mellahi, 2018; Davies, Brady, & Hobday, 2006). Furthermore, previous research has demonstrated how product and service organizations become separated during servitization (Oliva et al., 2012), examined the role of local units to support service provision (Kowalkowski, Kindström, & Brehmer, 2011), and studied how firms choose between the internal and external development of service functions (Salonen & Jaakkola, 2015).

The internal focus also concerns organizing the support for digital servitization. Previous research found that managerial support is critical for manufacturers that are transitioning toward services (e.g., Gebauer & Kowalkowski, 2012), whereas the lack of a service-oriented mindset and the difficulties in creating it are among the main barriers to servitization (Hou & Neely, 2013). Such an increased focus on services is typically required for manufacturing firms that are moving toward service provision (Oliva & Kallenberg, 2003), such as when (re-)building relationships with other firms (Edvardsson, Holmlund, & Strandvik, 2008). Having a product-oriented mindset has also been acknowledged as a hurdle that is encountered by servitizing firms (Kowalkowski, Windahl, Kindström, & Gebauer, 2015), such as when different organizational cultures hinder knowledge transfer (Möller & Svahn, 2006). Overall, the internal support of servitization strategies plays an important role when manufacturers make the transition toward service provision.

Therefore, the issues of organizing the structure and support have been extensively studied for servitization, which emphasizes the importance of an internal focus. Yet, the extant research on *digital servitization* remains scarce, which explains the need to explore the intra-organizational side of digital servitization.

1.3. External focus of digital servitization

In addition to an internal focus, the earlier examples about the elevator and construction equipment industries (see section 1.1) highlighted the importance of the external focus of digital servitization, such as when Caterpillar Inc. leveraged the data science expertise of collaborating data analytics firms to reduce failures and improve the efficiency of its product offerings. Extant academic research has focused on various inter-organizational aspects of servitization (e.g., Spring & Araujo, 2013; Hakanen & Jaakkola, 2012), including relationships with customers and other actors (Weigel & Hadwich, 2018; Ziaee Bigdeli et al., 2018).

Studies suggest that digital servitization takes place in ecosystems (Kohtamäki et al., 2019; Huikkola et al., 2020; Sjödin et al., 2020) that represent—in line with recent industrial

marketing research (e.g., Aarikka-Stenroos & Ritala, 2017; Zhang & Watson, 2020)—dynamic and co-evolving business systems of interdependent actors. Particularly relevant for digital servitization, the ecosystems approach emphasizes technological advancements as being key for continuously increasing inter-organizational complexity (Aarikka-Stenroos & Ritala, 2017; Leminen et al., 2020; Penttilä et al., 2020).

With digitalization triggering new configurations of relationships among actors (Yoo, Boland, Lyytinen, & Majchrzak, 2012), it becomes all the more critical to understand ecosystem dynamics for novel forms of service provision (Eloranta & Turunen, 2015). For instance, decreasing costs related to hardware and software lead to the growing adoption of digital technologies, which further advances collaboration (and competition) between actors in the ecosystem (Kowalkowski & Ulaga, 2017). However, collaborating with other actors around the firm's novel strategies remains potentially problematic (Weigel & Hadwich, 2018; Kohtamäki et al., 2019). Thus, with extant research emphasizing the importance of an external focus at the intersection of servitization and digitalization, there is a need to further explore the inter-organizational side of digital servitization.

1.4. Research purpose and questions

Despite the importance of both an internal and external focus, working with the intra- and inter-organizational sides of digital servitization remains challenging for many manufacturers, as is well-documented for General Electric (Crooks, 2016; Lohr, 2016, 2018; Mann & Gryta, 2020). Starting in 2014, this firm made multi-billion-dollar investments in various digitalization initiatives to expand the original focus on servicing its products toward larger-scale incorporation of cloud-based software, data analytics and artificial intelligence. With such initiatives, General Electric's goal was to become a "digital-industrial" firm and one of the world's top software companies. Yet, numerous issues inhibited General Electric from achieving this goal: internally, the firm experienced challenges around the organizational structure, processes, and support from managers and employees, among others; externally, there were issues involving, for instance, interactions with customers, value propositions, and partnerships with other firms. Facing these and other issues, General Electric ultimately changed its strategy that had become widely perceived as being unsuccessful (e.g., Mann & Gryta, 2020), which represents an example of the potential challenges surrounding the internal and external sides of digital servitization.

Against this backdrop, which suggests high academic and practitioner relevance of digital servitization, the research remains only nascent: as Raddats et al. (2019) emphasize, exploring digital servitization represents one of the key research priorities for scholars since digital technologies could radically affect service delivery. Therefore, given that the extant literature contains only a limited number of empirical studies on digital servitization, there is a critical need for further research (e.g., Kamp & Parry, 2017). To this end, the present thesis aims *to describe and analyze how manufacturing firms manage digital servitization internally and externally*.

The purpose is addressed by two research questions:

RQ1: How can firms organize for digital servitization?

As indicated above, an internal focus is important for firms that are aiming to transform toward the increased provision of digital services. In this regard, Raddats et al. (2019) highlighted the urgent need for research on how digital technologies might enable new service offerings and business models. Hence, due to the profound effects of digitalization, the intra-organizational side of digital servitization requires further attention from academic studies, which necessitates the examination of how firms can organize for digital servitization.

RQ2: How can firms work with their ecosystems for digital servitization?

Servitization studies have been increasingly looking beyond single firms and individual supplier-customer relationships. Yet, despite the critical role of an external focus, the inter-organizational side of digital servitization has only received limited attention in empirical studies and, therefore, demands further research (Kamp & Parry, 2017; Raddats et al., 2019). In this regard, examining how firms can work with their ecosystems for digital servitization is an important question that this thesis aims to address.

1.5. The appended papers' contributions

The present thesis comprises five appended papers, as demonstrated in Table 1. For the thesis overall, each paper is connected to the first research question, the second research question, or both. Through such connections, the papers' contributions collectively address the purpose of the present thesis.

Table 1. Contributions of the appended papers

Paper	Design	Key contributions	Link to RQs
I. Sklyar, A., Kowalkowski, C., Tronvoll, B., & Sörhammar, D. (2019). Organizing for digital servitization: A service ecosystem perspective. <i>Journal of Business Research</i> , 104, 450–460.	Multiple-case study	Identifies processes (embeddedness, centralization and integration) that are underlying digital servitization in service ecosystems and that are associated with intra- and inter-firm change.	RQ1 RQ2
II. Sklyar, A., Kowalkowski, C., Sörhammar, D., & Tronvoll, B. (2019). Resource integration through digitalisation: a service ecosystem perspective. <i>Journal of Marketing Management</i> , 35(11–12), 974–991.	Single-case study	Demonstrates that technology increasingly becomes an operant resource that is key to changing resource integration patterns within digitalized service ecosystems, where actors are connected through strong and weak ties.	RQ2
III. Tronvoll, B., Sklyar, A., Sörhammar, D., & Kowalkowski, C. (2020). Transformational shifts through digital servitization. <i>Industrial Marketing Management</i> , 89, 293–305.	Single-case study	Identifies three strategic shifts that need to be accomplished toward digital servitization: planning → discovery; scarcity → abundance; hierarchy → partnership. Key role of organizational identity, dematerialization and collaboration.	RQ1 RQ2
IV. Sklyar, A. (2021). Digital service strategy and customer-facing units: The interplay of conditions behind strategy implementation support. <i>Working paper</i>	Survey	Identifies configurations of conditions behind customer-facing units' support for digital service strategies. In addition, identifies configurations behind the lack of such support.	RQ1
V. Nenonen, S., Gummerus, J., & Sklyar, A. (2018). Game-changers: dynamic capabilities' influence on service ecosystems. <i>Journal of Service Management</i> , 29(4), 569–592.	Survey	Identifies dynamic capabilities that lead to success in influencing service ecosystems. In turn, the success leads to increased services ecosystem size and efficiency.	RQ2

Table 1 further demonstrates that each paper, besides relying upon different research designs, provides a different contribution for addressing the overall purpose of this thesis. For example, Paper I uses a multiple-case study to provide insights into both the intra- and inter-organizational sides of digital servitization, whereas Paper V relies on a survey research design to study how ecosystems can be influenced through specific capabilities.

1.6. Thesis outline

The present thesis is structured in the following way. Chapter 2 provides a theoretical background, emphasizing the literature that is relevant to digital servitization. In turn, Chapter 3 provides a methodological discussion, with a focus on the research process, research design, data analysis, and research quality. Chapter 4 summarizes the findings of the five appended papers, also briefly outlining each paper's contributions. A discussion of the findings is provided in Chapter 5, followed by Chapter 6, which discusses theoretical and managerial implications, limitations, as well as offers suggestions for future research.

2. Theoretical background

The present chapter provides the theoretical background of this thesis. First, an overview of the relevant literature on servitization and digitalization is offered, followed by a discussion of the research on digital servitization. Next, to provide the foundation for the empirical research on the intra-organizational side of digital servitization, this chapter outlines the extant research on the internal side of servitization. In turn, to provide the foundation for the empirical study of the inter-organizational side of digital servitization, this chapter concludes by outlining the research on the external side of servitization.

2.1. Servitization and digitalization

Manufacturing firms, instead of equipment sales, are increasingly deriving revenues from services, which is reflected in the academic research on servitization. In parallel, manufacturing firms began facing digitalization, which has been further propelled by the COVID-19 pandemic's cross-industry effects (e.g., Rapaccini et al., 2020). With servitization and digitalization increasingly converging, many manufacturing firms are now undergoing digital servitization, which represents a nascent and yet increasingly important research area. The present section briefly outlines the extant research on servitization and digitalization, followed by an overview of digital servitization research.

2.1.1. Servitization

Servitization, which is defined as the transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic (Kowalkowski et al., 2017), represents a strategic priority for service research (Ostrom et al., 2015). Several typologies and frameworks regarding service offerings have been suggested in the literature. The most common distinction concerns product-support services (such as traditional after-sales services) and process-oriented services (such as process optimization) (Eggert et al., 2014). Also, the research often distinguishes between input- and output-based offerings, that is, whether the supplier promises to perform a deed (e.g., to improve customer access to the supplier's equipment) or to achieve performance (e.g., to perform processes on the customer's behalf) (Uлага & Reinartz, 2011). Such offerings are based on different revenue mechanisms, where traditional production logic is largely applicable for input-based offerings and service logic mostly concerns output-based offerings (e.g., Grönroos & Voima, 2013).

Forces that are both internal and external can be seen as drivers of servitization (Fischer et al., 2012), such as higher homogeneity among offerings, customers' increased price sensitivity, and decreased switching costs (i.e., commoditization, see Reimann et al., 2010). Although servitization holds significant potential for firms, the extant research points toward challenges in achieving service profitability amid a product-dominant setting (e.g., Fang et al., 2008). For example, the "service paradox" occurs when investments in the service and solutions business do not result in expected returns (Gebauer et al., 2005). Among other issues, such lack of profitability appears to be linked to processes and platforms for product development that are not suitable for services and solutions (Ostrom et al., 2010). Also, servitization often requires closer collaboration between functions within the firm and its geographically distant units, and increased interactions with different actors, such as customers (Kindström & Kowalkowski, 2009; Uлага & Loveland, 2014).

A major enabler of new service offerings is digital technology, which allows for competition in increasingly complex markets (Coreynen et al., 2017). The core product might become complemented and substituted by such services (Cusumano, Kahl, & Suarez, 2015). An example is asset efficiency services, such as remote monitoring and software customization, which are often driven by data and analytics (Uлага & Reinartz, 2011). Once digital services are developed, the marginal cost of producing them and growing the service operations appears minimal (Vendrell-Herrero et al., 2017). Considering the growing importance of digital technologies, servitization needs to be considered in view of digitalization.

2.1.2. Digitalization

Recent technological advances, such as those related to big data, the Internet of things, and cloud computing, have affected industrial firms in previously unseen ways (Ng & Wakenshaw, 2017; Rymaszewska, Helo, & Gunasekaran, 2017). Such advances allow for the connecting of firms, systems, products, and services to a rapidly growing extent (Hsu, 2007) and are associated with substantial strategic investments in the relevant initiatives (Ustundag & Cevikcan, 2018).

While the terms *digitization* and *digitalization* might be used interchangeably to describe this phenomenon, the present thesis distinguishes these two concepts. The former, digitization, represents a process of “converting analog signals into a digital form [with] the potential to remove the tight couplings between information types and their storage, transmission, and processing technologies” (Tilson, Lyytinen, & Sørensen, 2010, p. 749) or, more succinctly, decoupling of “the information from the technologies (or devices) that store, transmit, or process it” (Lusch & Nambisan, 2015, p. 160). In turn, digitalization represents the sociotechnical processes that accompany digitization (Lusch & Nambisan, 2015)—that is, “applying digitizing techniques to broader social and institutional contexts that render digital technologies infrastructural” (Tilson et al., 2010, p. 749).

Despite the continuous and rapid development of technologies, digitization has been undergoing commoditization (Carr, 2003). In contrast, the same process does not apply to digitalization. With digital technologies becoming increasingly pervasive (Yoo et al., 2012; Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013), digitalization might exert highly dynamic and disruptive effects on firms’ operations and permeate entire organizations. Such processes concern transformations of established business models (Svahn, Mathiassen, & Lindgren, 2017), novel ways of value creation and capture (Ng & Wakenshaw, 2017), and customization that fundamentally affects the quality of offerings and customer relationships (Rust & Huang 2014). With digitalization substantially affecting organizations’ products, services, and operations, there is growing pressure for firms to recruit employees whose competences allow for leveraging the benefits of digitalization (Svahn et al., 2017).

Beyond individual firms, digitalization often facilitates the rapid transformation of inter-organizational relationships (Eloranta & Turunen, 2015). More specifically, digitalization enables actors to increase the efficiency of communication and cooperation via digital infrastructures (Tilson et al., 2010), improves trust and coordination among ecosystem actors

(Nambisan, 2013) and affects knowledge sharing (Lyytinen, Yoo, & Boland, 2015). Advanced technologies transform actors' established configurations (Storbacka, Brodie, Böhmman, Maglio, & Nenonen, 2016) both within and between organizations, which is needed to respond to changing environments (Parida, Oghazi, & Cedergren, 2016) and thus requires an external focus.

2.1.3. Digital servitization

Concepts such as the Internet of things and big data have been identified as being among the most promising avenues for marketing and service research (Ng & Wakenshaw, 2017; Ostrom et al., 2015). Scholars acknowledge the synergistic effects of an interdisciplinary approach (e.g., Lusch, Vargo, & Tanniru, 2010) for studying such digitalization-related issues as the potential of big data for value creation in the service context (Ostrom et al., 2015). With novel technologies enhancing firms' operations, new services and solutions are increasingly associated with software, remote monitoring, and data analytics (Ulaga & Reinartz, 2011; Coreynen et al., 2017), while costs of scaling up digital services become minimal, thus enabling novel business models (Vendrell-Herrero et al., 2017). In this regard, digitalization appears closely interconnected with servitization strategies (Parida, Rönnerberg Sjödin, Lenka, & Wincent, 2015), which is increasingly referred to as *digital servitization* (e.g., Kohtamäki et al., 2019; Raddats et al., 2019)—the latter is defined in this thesis as the utilization of digital technologies for transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic.

While digital technologies enhance firms' servitization strategies and enable their offerings and operations toward a competitive advantage (Ardolino et al., 2018), both intra-firm and inter-firm aspects become important in this process. Digital servitization appears to involve considerable degrees of internal organizational change. For example, digitalization enables back-end operational efficiency and transparency, enhances front-end interaction and integration (Coreynen et al., 2017), and is associated with the changing roles of organizational units for handling back-end and front-end activities (Cenamor et al., 2017). Simultaneously, digital servitization also involves changing the organizational mindset, which corresponds to the mentality and culture that is supporting the transformation (Parida, Sjödin, & Reim, 2019). From the inter-firm perspective, digital technologies enable increasingly important processes that span the boundaries of servitizing firms (Story, Raddats, Burton, Zolkiewski, & Baines, 2017; Kohtamäki et al., 2019). For example, new digital tools enable connectivity between

actors and allow for the analysis of large volumes of data at the inter-firm interface of servitization, which results in changes to relationships between actors and to how value is created and captured (Kamp & Parry, 2017; Sjödin et al., 2020).

Overall, despite recent developments in research on digital servitization, insights into how firms can successfully work internally and externally with digital servitization remain limited (Raddats et al., 2019; Kamp & Parry, 2017). To provide the theoretical foundation for the empirical research on the intra- and inter-organizational sides of digital servitization, the subsequent sections will outline the relevant servitization research that concerns internal and external focus, respectively.

2.2. Internal focus of servitization

To provide a foundation for the empirical research on the intra-organizational side of digital servitization, this section outlines the extant research on the internal focus of servitization, which corresponds to the service research priority of organization and employee issues for successful service (Ostrom et al., 2015). Servitization represents a complex process, with the implementation of relevant strategies often challenging or done reactively instead of proactively (Benedettini, Swink, & Neely, 2017; Böhm, Eggert, & Thiesbrummel, 2017). With traditional product-centric structures and mindsets often acting as obstacles, servitization typically requires organizing the structure (e.g., Fischer et al., 2012; Raja, Chakkol, Johnson, & Beltagui, 2018) as well as organizing the support through appropriate internal orientation (e.g., Gebauer & Kowalkowski, 2012).

2.2.1. *Organizing the structure*

When it comes to organizing the structure, the intra-organizational side of servitization typically concerns central/local and front-end/back-end roles and functions, as well as their connections to service and product units.

A strong local presence and the ability to address local market differences and customer preferences are important if the (service) business is local, while centralized decision-making helps to achieve global efficiency when there is less need for local adaptation (Kowalkowski et al., 2011). Decision-making can be considered centralized when authority is concentrated in the upper levels of the organizational hierarchy or within a single unit (Lee et al., 2015). If local customer relationships are of importance and managed at the lower levels within the

firm's hierarchy, centralization can lead to dissonance within the firm; on the contrary, when more decision-making authority is granted to managers at the lower levels, they become better able to work with customers due to their proximity (Neu & Brown, 2005). However, successful manufacturers might also re-centralize their decision-making processes (Vendrell-Herrero et al., 2018), where a central coordination unit at the level of headquarters is introduced to ensure better coordination between product and service units.

As for product and service units, manufacturers that are successful in developing a service business typically create organizations that are responsible for service development, sales, and operations that are separate from product organizations (Oliva & Kallenberg, 2003). Such structuring enables services that are no longer seen as being secondary to products, providing more service focus of employees and managers (Oliva et al., 2012). However, conflicts between product and service units (e.g., Vendrell-Herrero et al., 2018) can challenge the joint activities of these units and diminish the resulting synergistic benefits. While intra-firm collaboration might also involve various functions, units, and geographic locations (Neu & Brown, 2005), firms can create new structures that are reconfigurable around customer-specific needs. Such structures might consist of customer-facing front-end units, back-end product and service units, and a strategic center acting as a coordinating, decision-making unit (Davies et al., 2006; Raddats & Burton, 2011) that increases expertise decision centralization (Vendrell-Herrero et al., 2018).

While some research suggests separating product and service units (Oliva & Kallenberg, 2003) and creating front-end and back-end units (Kowalkowski et al., 2011), different design configurations can co-exist within a firm (Raja et al., 2018). In digital servitization, there is evidence of a front-/back-end split, where the benefits of digitalization are leveraged through new roles that are assumed by the relevant units (Cenamor et al., 2017). Specifically, responsibility for activities that pertain to the modular product-service architecture might be assigned to back-end units, whereas responsibility for tailoring offerings toward specific customers might be assigned to front-end units (Cenamor et al., 2017). Overall, whereas the extant research has predominantly studied how firms can organize the structure for servitization, there is a need for further empirical examination regarding organizing the structure for digital servitization.

2.2.2. Organizing the support

In addition to structuring the firm, organizing the support for servitization appears equally important. Achieving internal (i.e., managerial and employee) support is almost always crucial for the implementation of new marketing strategies (Hayati et al., 2018) and particularly of customer-focused service strategies (Cadwallader et al., 2010). Although such strategy commitment is critical for organizing the support, achieving it can be challenging (Hayati et al., 2018).

Being key to internal support, the importance of mindset is suggested for manufacturing firms that are transitioning toward services, where the lack of service-oriented mindset and the difficulties of creating it are among the main barriers to servitization (Hou & Neely, 2013; White et al., 1999). While employee and managerial issues play an important role in servitization, research has mainly focused on the distinction between product and service mindset or culture (e.g., Oliva & Kallenberg, 2003), although there are indications that more specific facets come into play. For example, Gebauer et al. (2010) mention entrepreneurial and innovation orientations as being part of the service-oriented culture. In a similar vein, Barnett et al. (2013) point to a mindset that is flexible and not averse to risks as being important for servitization. In turn, Ostrom et al. (2010) mention that creating a learning organization by leveraging the knowledge of employees and customers appears important for developing and maintaining a service culture; the importance of learning is also pointed out as one of the possible enablers of servitization (Kowalkowski et al., 2015).

The literature on servitization further points to the importance of shared beliefs and vision (e.g., Frankenberger et al., 2013), such as a shared understanding of the market across business units (Gebauer & Kowalkowski, 2012). On a related note, the literature also finds important the issues around the market, customer, and competitor orientations (Gebauer et al., 2011; Gebauer & Kowalkowski, 2012). Furthermore, long-term orientation is mentioned as part of the organizational mindset that is needed for servitization (Kindström & Kowalkowski, 2014) as well as for changing corporate culture (Gebauer & Kowalkowski, 2012). In turn, organizational inflexibility is among the barriers to servitization (Kindström & Kowalkowski, 2014). Whereas the above literature focuses on servitization, the aspects of organizing the support for digital servitization remain to be further examined by the extant research. Coupled with the need to understand how to organize the structure for digital servitization, further research is needed on the intra-organizational side of digital servitization.

2.3. External focus of servitization

Having outlined the research on the intra-organizational side, the present section turns to the research on the external focus of servitization, to provide the foundation for the empirical study of the inter-organizational side of digital servitization.

Whereas the majority of servitization research has traditionally had a firm-centric perspective, servitization can be viewed as relational processes that involve interdependence and adaptation (Tuli et al., 2007; Kamp & Parry, 2017). Such an inter-organizational perspective emphasizes business relationships within a network of actors (Håkansson & Snehota, 1995; Gadde et al., 2003; Raddats et al., 2017). For a manufacturer to provide services, it is important that the firm collaborates with its customers, which facilitates a better understanding of market conditions and customers' needs (Neu & Brown, 2005). Furthermore, the complexity of advanced services and solutions requires more extensive collaboration with other actors (Weigel & Hadwich, 2018; Ziaee Bigdeli et al., 2018). Overall, a network might comprise suppliers, customers, intermediaries, and other actors. Different network configurations affect performance, with factors at play such as customer centricity, relationships between actors, and the level of shared vision (Frankenberger et al., 2013).

While knowledge transfer and information sharing between actors play an important role in the development of offerings (Liu & Hart, 2011; Weigel & Hadwich, 2018), the interests of various parties might substantially affect the results of this process (Biggemann et al., 2013). The outcomes can be further affected by relationship strength or actors' positions in the network (Windahl & Lakemond, 2006; Ziaee Bigdeli et al., 2018). Whereas an increase in service provision is positively linked to stronger inter-organizational relationships (Bikfalvi et al., 2013), the ease of collaborating with other actors about the firm's service portfolio depends on factors such as whether the actors are powerful, if there is competition for the same customer relationships, or if similar servitization initiatives are being pursued (Salonen & Jaakkola, 2015).

Recent research increasingly suggests that servitization, in particular when it is enabled by digital technologies, takes place in ecosystems (e.g., Kohtamäki et al., 2019; Huikkola et al., 2020; Sjödin et al., 2020). The term "ecosystem," which this thesis uses interchangeably with the term "network," appears to be largely in line with the rich literature on business networks in marketing and management research and can describe a dynamic and co-evolving business system of interdependent actors (e.g., Aarikka-Stenroos & Ritala, 2017; Zhang &

Watson, 2020). Explaining the usefulness of the ecosystems approach in industrial marketing, recent studies point toward this approach's emphasis on the technological advancements and digitalization that is behind continuously increasing inter-organizational complexity (Aarikka-Stenroos & Ritala, 2017; Leminen et al., 2020; Penttälä et al., 2020), which appears particularly relevant for digital servitization (Kohtamäki et al., 2019).

In parallel, the research has paid increasing attention to capabilities, that is, "a firm's abilities to perform productive activities or produce market offerings important to customers" (Raddats et al., 2017, p. 383). There has been a growing focus on capabilities both in the general marketing literature (e.g., Day, 1994; 2011) and in the industrial marketing literature (e.g., Mitrega, Henneberg, & Forkmann, 2018), including servitization research (Ulaga & Reinartz, 2011; Spring & Araujo, 2013). With capabilities considered critical for the strategic shift toward the service orientation of manufacturing firms (Fischer et al., 2010), the extant research studied capabilities for managing service innovation (den Hertog, van der Aa, & de Jong, 2010), explored how capabilities (co-)evolve (Gebauer, Paiola, & Edvardsson, 2012), and identified microfoundations that are associated with capabilities (Kindström et al., 2013), among other contributions.

While the intra-firm perspective has traditionally been the focus of servitization studies on capabilities, the literature has paid growing attention to the capabilities in the inter-organizational setting (Spring & Araujo, 2013). For example, extant studies emphasize the importance of capabilities concerning customers (Tuli et al., 2007) and suppliers (Huikkola & Kohtamäki, 2017), broader partnering and relational capabilities (Kowalkowski, Witell, & Gustafsson, 2013; Baines & Lightfoot, 2013), and capabilities developed through interactions between actors (Raddats et al., 2017). Overall, for service offerings to be effective and efficient, specific capabilities might need to be developed by different actors (Story et al., 2017). Furthermore, the literature on capabilities suggests that a firm is not only influenced by its ecosystem but is also able to influence it through its capabilities (e.g., Teece, 2007).

With digitalization further extending the scope of service provision beyond single-firm boundaries, digital technologies substantially impact the external focus of servitization and relevant capabilities in ecosystems (e.g., Eloranta & Turunen, 2015), which warrants further research on the inter-organizational side of digital servitization (Kamp & Parry, 2017; Kohtamäki et al., 2019). Against this theoretical background, the present thesis will empirically examine how firms can work with their ecosystems for digital servitization.

3. Methodology

The present chapter outlines the methodological aspects of this thesis. First, the research process is described, with a focus on each of the five appended papers and the associated research projects. Next, the chapter provides details on the research design underlying each of the papers, followed by a discussion of the data analysis approaches used. The chapter continues with a discussion of research quality and ends by presenting the ethical considerations. In contrast to the rest of the thesis, the following sections are partially written from the first-person perspective in order to clarify the author's own contributions and methodological choices.

3.1. Research process

Research work on the present thesis began in 2016. With the initial idea of a thesis proposal in mind, I focused on literature readings and attending doctoral courses. This work allowed me to outline a preliminary topic for the thesis proposal. While Figure 1 outlines the overall research process, the following subsections provide more details on the subsequent research process and the related work with individual research projects and papers.

Figure 1. Research process

3.1.1. Papers I, II, and III, and the associated research project

In Q1/2016 I joined the research project initiated by my supervisors (Value Creation in Innovative Service Systems: A Research Project on the Dynamics of Service Transition Processes in Industrial Networks), while simultaneously carrying out preliminary literature readings and attending doctoral courses of a general nature. Based on the growing knowledge obtained from these readings and courses, my research interest began to move toward digitalization-related aspects of servitization. This specific focus was explained by my personal interest in the topic, the reviewed literature's strong emphasis on the need for additional research specifically on *digital* servitization, and the particular richness of the collected data in relation to the topic. As a result, the research problem became more defined, and the preliminary research questions were formulated while planning the papers that would ultimately constitute the thesis.

Within the research project, I participated in the interviews and other data collection events conducted by my supervisors (for example, meetings with the case firms' representatives). Although I was unable to take part in such activities when they took place abroad, I participated if they were carried out online or in Sweden. While the interview guide was originally developed and then adapted to each respondent, I was encouraged to formulate questions that appeared to be relevant to my thesis. Similarly, I was encouraged to pose these questions during the interviews, and to ask any follow-up questions that appeared relevant.

Such close involvement in the data collection improved my empirical understanding of the studied phenomenon and allowed me to obtain valuable industry-specific insights, contributing to my work on the present thesis.

Table 2 outlines the details of the conducted interviews and also demonstrates how the interview data was used in each paper. All interviews were recorded and subsequently transcribed; the latter task was both one of my main responsibilities in the research project and a major enabler behind my thesis work. Specifically, the transcription was carried out with the aim of preserving as much of the originally recorded verbal and non-verbal material as possible. As a result, my work involved multiple re-listening sessions for each interview, with the exact amount varying due to factors such as the recording's technical quality, the clarity of the respondent's speech, and the use of industry-specific terminology and abbreviations. Such close involvement with the data during transcription further enhanced my empirical understanding of the studied phenomenon and improved my skills for working with qualitative data, therefore additionally contributing to the thesis-writing process.

Due to the large volume of collected data, my main responsibilities also included creating and continuously maintaining a case study database in NVivo software, in which I consolidated the interview data together with the supplementary materials from other data collection events (for example, notes from meetings). Hence, the database became the key source of aggregated materials for data analysis and the subsequent writing of Papers I, II, and III. While all project team members were involved in data coding, my direct responsibility for the case study database was yet another major enabler behind the thesis work: continuous and prolonged engagement with the aggregated data enhanced my data analysis capabilities, further improving my skills for working with qualitative data in general. Such additional in-depth insights into the data also helped me when synthesizing the collected materials in different formats (for example, as texts describing the documented events or as diagrams depicting event timelines). Although it never replaced the work with data codes and related analysis, the creation of such synthesizing documents and their subsequent multiple iterations further added to my empirical understanding of the studied phenomenon, thus helping with my work on the present thesis.

The work on Paper I (co-authored) lasted between Q3/2016 and Q1/2019, finishing with the study's publication. While I was directly involved in all decisions regarding the study's research design, my role in the paper was to lead the development work and writing, including the conceptual framework and data analysis. My role was also to lead the work involved in

revisions and rewriting, in addressing the editors' and reviewers' comments, and in writing the extended response letter for each revision round.

Table 2. Collected interview data for Papers I, II, and III

Informant	Time per interview (hours and minutes)			
Case A (interview data used for Paper I)				
Coordinator of Service Development	01:24			
Global Service Product and R&D Manager	01:24			
Global Service Product Manager	01:03	00:41	01:03	01:04
Head of Global Service Product and R&D	01:25			
Innovation & Venture Program Manager	01:30	01:03		
Project Information Manager	01:29			
Project Manager	01:30			
R&D Project Manager	01:36			
Remote Support Operations Manager	00:38			
Service Product Manager	01:30	01:43	01:03	
Vice President, Service Owner	00:28	00:37		
Case B (interview data used for Papers I, II, and III)				
Analyst (Customer Service)	01:12	02:08		
Analyst (Customer Service)	01:12	02:08		
Business Development, Global Service	00:30	01:00		
Executive Business Unit Manager	00:54			
Global Product & Portfolio Manager (Digital Solutions)	01:28			
Global Sales & Business Development	01:42			
Global Technical Support Manager	01:30	01:00		
Global Technical Support Manager	01:49			
Information Manager & Global Product Manager	02:33			
Integrated Operations Program Manager	01:28			
New Energy Efficiency Manager	01:35			
Product Manager	00:53			
Project Manager	00:23			
Project Manager	01:47			
Sales Engineer (IT)	00:30			
Senior Vice President (Collaborative Operations)	01:08	01:27	03:30	00:30
Senior Vice President (Customer Segment)	01:54			
Senior Vice President (Global Operations)	01:39			
Senior Vice President (Information & Control)	01:24			
Service Manager	01:01	00:13		
Service Manager (Local Region)	01:26			
Service Sales Manager Merchant	00:30			
Technical Advisor	01:20			
Technology Manager	00:23			
Vice President (Customer Segment)	01:30	01:00		
Vice President (Digital Services)	01:08	01:00	03:20	
Vice President (Head of Global Services)	01:08	01:38		
Vice President (Local Region)	01:41			
Vice President (Service)	01:41			
Corporate functions, relevant for Cases A and B (interview data used for Papers I, II, and III)				
Embedded Systems Coordinator	01:26			
Project Manager, Corporate Research	01:30			
Senior Scientist (Industrial Software Systems)	01:30			
User Experience & Industrial Design	01:30			

Source: Adapted from Paper I, p. 458.

The work on Paper II (co-authored) lasted between Q1/2017 and Q1/2019, finishing with the study's publication. Similar to Paper I, my role was to lead the development work and writing, including the conceptual framework and data analysis. My role was also to lead the work involved in revisions and rewriting, in addressing the editors' and reviewers' comments, and in writing the extended response letter for each revision round.

The work on Paper III (co-authored) lasted between Q1/2018 and Q1/2020, finishing with the study's publication. While I was directly involved in all the decisions regarding the study's research design, my main responsibility was to lead the data analysis and, for the initial submission, the writing of the "Method" and "Findings" sections. With the editors' and reviewers' comments focusing on the discussion and implications of data analysis, my role during the revision was also to lead the rewriting of the "Discussion" and "Implications" sections. (For these sections, my role was also to lead the work on the extended response letter for each revision round.) For the paper's remaining sections, I continuously discussed the progression of the work with the co-authors, contributed to drafting and critical revision during the two review rounds (including two extended response letters), and gave the final approval for each (re)submitted version.

3.1.2. Paper IV and the associated research project

In Q3/2018, I joined the second research project initiated by my supervisors. Within the project, I participated in the data collection by taking part in the meetings with the focal firm's representatives and, subsequently, in designing a survey—the project's main data collection method.

The survey responses were the main source of data for the single-authored Paper IV, the work on which has been ongoing since Q1/2020. While the research project and the survey's dependent variables were focused on the concept of service orientation, I chose a different focus for Paper IV. Having reviewed the literature and identified a clear and relevant gap, my research idea was to study the implementation of service strategies enabled by digital technologies (i.e., digital service strategies) and, specifically, the interplay of conditions behind customer-facing units' support for such strategies. Based on the reviewed literature, I developed a conceptual framework proposing that the outcome—support for digital service strategies—is linked to an interplay of several conditions (for example, technology orientation).

Since the reviewed literature suggested that the studied phenomenon is complex, I applied the configurational approach due to its focus on causal complexity in terms of

conjunction (an outcome is typically linked to a combination of conditions instead of a single condition), equifinality (different combinations may be linked to the same outcome), and asymmetry (the combinations linked to the outcome's presence typically do not mirror those linked to the outcome's absence). The approach further distinguishes between conditions that are necessary and sufficient: a condition is necessary if, whenever the outcome is present, the condition is also present; in turn, a condition is sufficient if, whenever the condition is present, the outcome is also present.

As discussed extensively in Frösén et al. (2016) and Salonen et al. (2020), none of the traditional data analysis methods are able to fully capture the causal complexity as suggested by the configurational approach. For example, although regression analysis can be applied to partially examine conjunction through interaction effects, it cannot address other notions behind causal complexity—equifinality, asymmetry, and the distinction between necessity and sufficiency. As a result, I used fuzzy-set qualitative comparative analysis (fsQCA) which is considered highly suitable for capturing all aspects associated with causal complexity. For data analysis, I selected only those variables from the dataset that were supported by the conceptual framework and, once the analysis was complete, drafted the paper.

3.1.3. Paper V

The work on Paper V (co-authored) lasted between Q3/2016 and Q2/2018, finishing with the study's publication. My work with the study was not part of a formal research project, instead being a standalone informal collaboration with two researchers. A pre-existing relationship with both researchers that had been established during my master's degree studies enabled my involvement in the collaboration. Despite digital servitization being outside the scope of Paper V, its focus on capabilities for influencing ecosystems provided a good fit with the overall research problem and the purpose of the thesis. Specifically, the paper offered relevant conceptualizations and empirical evidence on how firms can work with their ecosystems, which (as discussed earlier) appears to be highly relevant for the present thesis.

Except for data collection carried out prior to the collaboration, I was directly involved in the decisions regarding the paper's research design and positioning, for example when building the conceptual model. In terms of the paper's theoretical foundation, I was responsible for reviewing the literature on dynamic capabilities (except for its links to the literatures on service-dominant logic and institutional work) and then incorporating the relevant materials

into the study. In developing the conceptual model, my specific contribution was to operationalize the notion of the hierarchy of capabilities as mediating effects.

With the paper's methodology, I was responsible for designing and carrying out data analysis, as well as for reporting and interpreting its results. Specifically, exploratory factor analysis (EFA) in SPSS software was employed for construct purification, and hypotheses were then tested with partial least squares structural equation modeling (PLS-SEM) in SmartPLS software. The choice of EFA was due to the sample size, which was less suitable for conducting confirmatory factor analysis. In addition to the same rationale as for EFA, the choice of PLS-SEM was due to the method's suitability for exploratory studies, the lack of assumptions regarding the normal distribution of data, and the ability to achieve high levels of statistical power for complex models.

For the initial submission, I was responsible for writing the "Methodology" and "Results" sections. During the two rounds of revision, I was also responsible for addressing the editors and reviewers' comments for the two sections. This role included both revising the paper and drafting relevant parts of the extended response letter for each revision round. For the paper's remaining sections, my main responsibilities included incorporating (1) the dynamic capabilities literature, (2) the methodology, and (3) the empirical findings. In addition, I continuously discussed the progression of the work with the co-authors, contributed to drafting the remaining sections and their critical revision during the two review rounds (including two extended response letters to editors and reviewers), and gave final approval for each (re)submitted version.

3.2. Research designs

A case study research design was chosen for Papers I, II, and III. Such a design allows the studied phenomena to be examined in depth, while also combining several qualitative methods (Bryman & Bell, 2011), and is widely used in business research in general (Eisenhardt & Graebner, 2007) and industrial marketing research in particular (Dubois & Gibbert, 2010). Specifically, Paper I draws upon a case study research design with two cases (Cases A and B in Table 2) describing two firms from the same multinational corporation but representing different industries, whereas Papers II and III rely on a case study design with a single case (Case B in Table 2). The former enabled digital servitization initiatives to be compared between the cases, while the latter allowed for an even closer examination of the case identified as being

particularly information-rich for the studied phenomenon. Combining these two approaches within the present thesis allowed for a more in-depth understanding of the phenomenon. This is important, since digital servitization represents a novel phenomenon that requires theory building, with case studies being well-suited to achieving this goal (Eisenhardt & Graebner, 2007). Furthermore, the overall complexity of the studied phenomenon (i.e., at the intersection of digitalization and servitization, as well as involving intra- and inter-organizational sides) necessitates both a comparative (in Paper I) and an in-depth (in Papers II and III) examination of the research problem (Bryman & Bell, 2011).

In turn, Paper IV's research design is built around the configurational approach and the associated fuzzy-set qualitative comparative analysis (fsQCA). Widely used in management research and increasingly employed in marketing studies, the configurational approach is used due to the expected interplay of conditions that form configurations (i.e., combinations of such conditions) connected to the outcome of interest (Ragin, 2008; Schneider & Wagemann, 2012). Developed based on the reviewed literature, the paper's conceptual framework was then applied to the survey data from approximately 500 respondents from customer-facing units within a world-leading manufacturing corporation.

Finally, Paper V is a quantitative, survey-based study. The adopted research approach is typically used to explain the relationships between variables (Creswell, 2012), when the formulated research hypotheses are tested through quantitatively measured variables and with "numeric data from a large number of people using instruments with preset questions and responses" (Creswell, 2012, p. 13). Specifically, the data was collected through an online questionnaire from respondents within firms that influenced their ecosystems across different industries.

3.3. Data analysis

With minor differences, data analysis was carried out similarly in Papers I, II, and III. The process involved the comparison and interpretation of interview transcripts and other data sources such as notes from meetings. The process began by establishing first-order codes, which were then re-coded to reduce the number of codes, yielding first-order categories. After the relationships between these categories had been identified, second-order themes were formulated, which were then arranged into aggregate themes at a higher level of abstraction. To illustrate this process, Figure 2 depicts the coding structure from Paper I.

Figure 2. Example of coding structure

Source: Paper I, p. 453.

In turn, Paper IV's data analysis was carried out through fuzzy-set qualitative comparative analysis (fsQCA) with 'QCA' package in R. As a methodological approach that represents an alternative to traditional statistical methods, fsQCA allows for the examination of configurations of conditions behind an outcome, the identification of multiple causal pathways simultaneously leading to the same outcome, the examination of the different

pathways leading to either the presence and the absence of the outcome, and separate testing for sufficiency and necessity (Ragin, 2008).

Finally, Paper V's data analysis was carried out with (1) exploratory factor analysis (EFA) in SPSS software for construct purification and (2) partial least squares structural equation modeling (PLS-SEM) in SmartPLS software for hypothesis testing. EFA was chosen over confirmatory factor analysis due to the relatively small sample size. In turn, compared to covariance-based SEM, the main disadvantage of PLS-SEM as a variance-based approach was (at the time of writing Paper V) the lack of well-established goodness-of-fit criteria. However, the former could be compensated for by evaluating path coefficients and coefficients of determination (Hair et al., 2017). Furthermore, the choice of PLS-SEM for data analysis was due to the method's suitability for exploratory studies, the lack of distributional assumptions as a nonparametric method, and high levels of statistical power even for relatively small samples and complex models (Hair et al., 2017). Due to the incorporation of several mediators, the relevant effects were assessed based on the guidelines for multiple mediation analysis in PLS-SEM (Hair et al., 2017), allowing for simultaneous testing within a single model.

3.4. Quality of research

The quality of Papers I, II and III was jointly assessed using the criteria from Bryman & Bell (2011) and Storbacka, Polsa, and Sääksjärvi (2011). The results of the assessment are presented in Table 3.

For Paper IV, quality of research was ensured by following the guidelines on best practices for conducting fuzzy-set qualitative comparative analysis (fsQCA) research (Greckhamer, Furnari, Fiss, & Aguilera, 2018). Specifically, while developing the conceptual framework, the outcome of interest was explicitly defined, the conditions were selected based on the extant theory, the number of selected conditions did not exceed the maximum recommended amount linked to the sample size, and the sample was deemed theoretically relevant to study the outcome.

Table 3. Quality of the research

Criterion	Evaluation
Credibility (internal validity)	<ul style="list-style-type: none"> • <i>Prolonged engagement</i>: active interaction with the case firms spanned an extended period of time. • <i>Triangulation across sources</i>: both primary and secondary sources used. • <i>Triangulation across methods</i>: interviews were audio recorded (subsequently transcribed) and supplemented with notes taken during the interviews. • <i>Triangulation across researchers</i>: all the researchers involved in data collection also participated in coding. • <i>Debriefings by peers</i>: the preliminary research was presented at academic conferences. • <i>Member checks</i>: the researchers' interpretations of the phenomenon were discussed with the respondents throughout the study.
Transferability (external validity)	<ul style="list-style-type: none"> • <i>Triangulation through purposive sampling</i>: theoretical sampling was applied.
Dependability (reliability)	<ul style="list-style-type: none"> • <i>Observation over time and explanation of change</i>: the selected cases were studied over an extended period of time.
Confirmability (objectivity)	<ul style="list-style-type: none"> • <i>Triangulation across data collection by researchers</i>: the researchers' interpretations of the phenomenon were discussed with the respondents throughout the study, as well as between the researchers.
Integrity	<ul style="list-style-type: none"> • <i>Construction of rapport and trust</i>: active interaction with the case firms spanned an extended period of time, resulting in informants exhibiting openness and an interest in the study. • <i>Good interviewing technique</i>: the interviews were based on a specifically designed interview guide. • <i>Safeguarding informant identity</i>: the respondents were informed about the study and were guaranteed anonymity.
Utilization (applicability)	<ul style="list-style-type: none"> • <i>Relevance for firms</i>: the researchers' interpretations of the phenomenon were discussed with the respondents throughout the study, with the purpose of ensuring the compatibility of the analysis with the practitioners' perceptions of the phenomenon, thus ultimately achieving high managerial relevance. • <i>Relevance for participants</i>: informants exhibited openness and an interest in the study.

The quality of research for Paper V was ensured in several ways. First, an exploratory factor analysis was conducted for construct purification. To deal with missing values, principal components analysis with oblique factor rotation and mean replacement was employed. Thus, items with low communalities, non-significant factor loadings, and significant cross-loadings were eliminated prior to PLS-SEM analysis.

Second, Harman's one-factor test (Podsakoff & Organ, 1986) was used to test for common method variance, which is considered problematic when either a single factor appears or one factor accounts for the majority of variance. No major issues were discovered in relation to common method variance.

Third, the mediating effects were assessed within a single PLS model, improving the quality of the study. Specifically, Zhao et al.'s (2010) guidelines were used instead of Baron and Kenny's (1986) traditionally used approach. The latter requires three relationships to be significant in order to establish mediation: (1) between the independent variable and the mediator; (2) between the mediator and the dependent variable; and (3) between the independent and dependent variables when the mediator is omitted from the model. By contrast, Zhao et al. (2010) argued that the significance of an indirect effect is enough to claim that mediation exists. Since the PLS model in the study contained several mediators, an extension of Zhao et al.'s (2010) guidelines was used for multiple mediation analysis in PLS-SEM. As a result, all relationships were tested simultaneously within a single PLS model.

Fourth, the quality of PLS-SEM measurement and structural models was evaluated based on the guidelines from Hair et al. (2017), concluding that indicator reliability, composite reliability, convergent validity, and discriminant validity were achieved. Collinearity issues in the structural model were not detected. When evaluating R^2 values, the model's predictive power was deemed moderate, while the predictive relevance of the model was achieved as suggested by Q^2 values.

3.5. Ethical considerations

Prior to data collection for Papers I, II, and III, ethical considerations were discussed during meetings with the case firms' contact persons, and were subsequently implemented during and after the data collection. For example, informed consent was obtained from each respondent, emphasizing that participation in interviews and other data collection events was voluntary. Furthermore, any details revealing the identity of individual respondents within the collected data were anonymized for sharing with any third parties (including the case firms) that were not involved in carrying out the project work. Thus, the anonymity of individual respondents was achieved at all stages of the research process, which allowed for more revealing insights. Also, the names of the case firms were not revealed following requests from the firms' contact persons that were formalized in separate agreements.

For Paper IV, ethical considerations were also considered for data collection and analysis. Following the agreement with the firm, the anonymity of individual respondents was ensured when collecting and analyzing survey responses. Similarly, for Paper V, the individual survey responses were handled in ways that preserved the anonymity of the respondents. Overall, the described measures brought the present thesis into line with the established ethical considerations.

4. Summary of findings

The present chapter outlines the empirical findings of this thesis and is structured around the five papers that constitute the thesis. The chapter begins by summarizing the findings of Paper I, “Organizing for digital servitization: A service ecosystem perspective” (published in *Journal of Business Research*). The chapter continues with the summary for Paper II, “Resource integration through digitalisation: A service ecosystem perspective” (published in *Journal of Marketing Management*). Next, the findings are presented for Paper III, “Transformational shifts through digital servitization” (published in *Industrial Marketing Management*). The summary is then provided for Paper IV, “Digital service strategy and customer-facing units: The interplay of conditions behind strategy implementation support” (working paper). The chapter concludes with the findings from Paper V, “Game-changers: dynamic capabilities’ influence on service ecosystems” (published in *Journal of Service Management*). In addition to the empirical findings, the chapter briefly outlines each paper’s main theoretical contributions.

4.1. Paper I: Organizing for digital servitization: A service ecosystem perspective

Paper I is an empirical study of change processes and associated organizing activities for digital servitization. The study applies an ecosystem perspective to examine intra- and inter-firm change related to two industrial firms (Cases A and B in Table 2) from the same multinational corporation but representing different industries. For illustrative purposes, the ecosystems of the focal firms are depicted in Figure 3. The ecosystem of the first firm (Case A, labeled “Apparatus” in Paper I) appears in the top part of the figure, while the bottom part depicts the ecosystem of the second firm (Case B, labeled “Oceana”). Compared to the first firm, customers of the latter were more external to the multinational corporation (for example, including system builders and asset owners), and the second firm’s ecosystem was more complex overall since it also included system designers, standards organizations, government institutions, and industry organizations.

While both firms were considered successful within the corporation in terms of strategic initiatives and relied on shared corporate strategies, they exhibited major differences in organizing for digital servitization. The data were mainly collected through interviews with 44 managers and during other data collection events such as meetings. Due to the firms belonging to the same multinational corporation, multiple informants exhibited knowledge of both firms, thus offering valuable insights into the studied phenomenon.

The paper’s results highlight that, first, the intra-firm change mostly involved activities related to centralization and integration. The former included increasingly centralized decision-making and strategies for scaling up digital servitization. Similarly, the core digital competences were centralized to ensure their local availability, while digital tools and resources were shared across units to increase transparency and enable large-scale digital servitization initiatives. Closely connected to centralization, scalability of the employed digital technologies became a major driver of digital servitization across the units.

In turn, the integration included the creation of digital service centers that unified the critical technology and assumed the customer-facing, front-end role. When it comes to back-office functions, these were similarly integrated to improve data and information flows across the units. At the same time, service and product organizations collaborated to facilitate the transformation (for example, toward joint R&D goals). Importantly, both centralization and integration were closely associated with the firm-wide administrative heritage (for example,

power balance between local and central units). Digital servitization was also facilitated by the software becoming increasingly independent from a single firm’s offerings, and instead being integrated with a growing number of third-party products and services.

Figure 3. Ecosystems of the focal firms
Source: Paper I, p. 454

Second, the results demonstrate that the interfirm change mostly involved organizing activities related to embeddedness in the firms’ ecosystems. Such activities were associated with transforming global rules and regulations, digitalization-related critical incidents within the industry, and novel initiatives of players with previously traditional roles. As a result, the dynamism and complexity of digitalization demanded improved coordination and closer

collaboration between the firms. Simultaneously, creating an overarching vision for digital servitization outlined its benefits for stakeholders across the firms, which resulted in the transformation being promoted and accepted within the industry. Finally, the creation of digital platforms enhanced trust and interactions between the firms through knowledge and information sharing.

The paper's theoretical contributions are twofold. First, centralized decision-making was found to be of importance for digital servitization due to shared digital platforms and tools (including customer-facing). Second, changed roles of back- and front-end units were found to be associated with stronger intra-firm integration, enabling digital servitization.

4.2. Paper II: Resource integration through digitalisation: A service ecosystem perspective

Paper II is an empirical study that examines how resource integration among strongly and weakly tied actors transforms the ecosystem from a pre-digitalized to a digitalized state. Focusing on the case of an industrial firm that is undergoing digital servitization in the maritime industry (Case B in Table 2), the data were mainly collected through 40 in-depth interviews with managers and during other data collection events such as meetings.

The paper's findings highlight that, first, digitalization of the focal firm's ecosystem is associated with the growing role of digital services and software, with the underlying digital infrastructure becoming increasingly important for interactions between actors and enabling the scalability of digital services through improved connections within the ecosystem. Importantly, software is increasingly integrated toward third-party offerings available in the ecosystem, instead of being confined to the hardware of a single supplier.

Second, the findings demonstrate the increased number and importance of weak ties within the ecosystem, associated with the digitalization of the latter. In close relation to the novel role of weak ties, the changed scalability of digital services allowed such offerings to be extended across customer segments. At the same time, continuous information links between ecosystem actors were established, and software interfaces were integrated across previously unconnected suppliers, also highlighting the growing importance of weak ties.

Third, the findings suggest digital technology's novel role as that of an operant resource, which is closely linked to modified resource integration patterns within the

Furthermore, onshore centers could monitor entire offshore units, allowing the data to be collected directly from its sources and then stored in the cloud. Offshore operations became fully transparent to onshore units, as well as internally: the customer portal resolved the information disconnect within offshore units, enhancing the decision-making efficiency of the relevant actors.

The paper's theoretical contributions are twofold. First, the article is the first known study to empirically connect the discourses on operand/operant resources and resource integration patterns, contributing to the research on ecosystem dynamics. Second, the paper is an addition to the nascent research area connecting service-dominant logic and strong and weak ties literatures. By uncovering major differences between the ecosystem's pre-digitalized and digitalized states in terms of technology, strong and weak ties, and resource integration patterns, the findings demonstrate the role of technology in both increasing the pattern complexity and facilitating its coordination within the ecosystem.

4.3. Paper III: Transformational shifts through digital servitization

Paper III is an empirical study examining strategic organizational shifts which underpin digital servitization. Focusing on the case of an industrial firm in the maritime industry (Case B in Table 2), the data were mainly collected through in-depth interviews with 33 respondents and other data collection events such as meetings.

The paper's results highlight that, first, digital servitization involves the shift related to the focal firm's identity, which transforms from being more planning-oriented to more discovery-oriented. Here, the legitimization of the transformation efforts both within and outside the firm facilitated success, for example by leveraging a white paper as a key mechanism for change. Simultaneously, the employee mindset of agility that answers the demands of digital servitization became a critical success factor, being associated with the fast-paced development life cycle of software and digital infrastructure.

Second, the results suggest that digital servitization involves a shift related to dematerialization, with a transformation from a state of scarcity to one of abundance. The increasing data-centricity resulted in major changes to service innovation, employee competences, and sales- and efficiency-related processes. Simultaneously, critical importance

was attached to data-related opportunities around data ownership, business models, data quality, and scalability of software behind digital offerings.

Third, the results demonstrate that digital servitization involves a shift related to collaboration, with a transformation from hierarchy to partnership. Multi-actor coupling was found to be important in relation to this shift, such as when the focal firm increasingly collaborates with external partners to leverage their specialized competences. At the same time, aspects related to value propositions came to be of critical importance, with digital offerings increasingly at the center of attention for both customers and suppliers. The three shifts are represented in Figure 5.

Figure 5. Transformational shifts for digital servitization

Source: Paper III, p. 300.

The paper's theoretical contributions are three-fold. First, the strategic shifts behind digital servitization are linked to organizational identity, dematerialization, and collaboration. Second, the paper emphasizes the role of the focal firm's network (ecosystem) for successful digital servitization. Third, a change in the firm's identity, especially when it comes to an agile mindset and ways of working, is found to be critical for matching the needs of digital servitization.

4.4. Paper IV: Digital service strategy and customer-facing units: The interplay of conditions behind strategy implementation support

Paper IV (working paper) is an empirical study of the interplay of conditions behind customer-facing units' support for digital service strategies—that is, service strategies enabled by digital technologies. With the survey data from service operations units (270 respondents) and service sales units (264 respondents) within a world-leading manufacturing corporation, the paper applies a configurational approach to study support for a digital service strategy. Drawing on the extant literature, the paper proposes a conceptual framework with six conditions—technology orientation, customer orientation, responsiveness, agility, problem-solving, and rule-bending—suggesting that the outcome is predicted by their complex interplay and not by the individual conditions as such. Fuzzy-set qualitative comparative analysis (fsQCA) is used as the main method for data analysis.

The paper's results highlight that, first, there are seven alternative configurations of conditions for customer-facing units' support for the digital service strategy: if a unit exhibits all conditions outlined in any of the configurations, then the unit will also exhibit the outcome. This finding is in line with the notions of conjunction and equifinality as part of the configurational approach.

Second, the results provide no exactly matching configurations between service operations and service sales units, indicating that different configurations of conditions enable support from the former in comparison to the latter. However, for each of the configurations for service operations units there is a similar, although not identical, configuration to those for service sales units.

Third, the results also uncovered six alternative configurations of conditions for the lack of support for the digital service strategy: if a customer-facing unit exhibits all the conditions outlined in any of the configurations, then the unit will also exhibit a lack of support. This finding is in line with the notion of asymmetry as part of the configurational approach.

Fourth, in terms of the lack of support, the results provide no exactly matching configurations between service operations and service sales units, indicating that different configurations explain the lack of support from the former in comparison to the latter. However, no configurations for the lack of support were similar between the two types of units.

The paper's theoretical contributions are two-fold. First, the paper addresses the gap in the literature on marketing strategy implementation about what drives the customer-facing units' support for digital service strategies, and adds novel insights to the growing but so far limited strategy implementation literature with a focus on customer-facing employees and customer-facing units. Second, the study contributes to the research on servitization by offering insights into distinctions and similarities between service operations and service sales units when implementing digital service strategies, and into what drives each unit type's support and lack of support for such strategies.

4.5. Paper V: Game-changers: Dynamic capabilities' influence on service ecosystems

Paper V is an empirical study exploring which dynamic capabilities are associated with influencing the firms' ecosystems. The paper proposes a conceptual model introducing such capabilities as organized into higher and lower orders. Based on a sample of 106 respondents from firms across different industries, the paper applies partial least squares structural equation modeling (PLS-SEM) for hypothesis testing.

The findings demonstrate that, first, only two capabilities are directly associated with success in influencing ecosystems. Specifically, the capabilities of visioning and of influencing explicit institutions have a significant effect on the dependent variable.

Second, the findings show that one capability has an indirect (mediated) effect on the success in influencing ecosystems. Specifically, the capability of timing is affecting the dependent variable through the capability of influencing explicit institutions, where the latter acts as a mediator.

Third, the remaining capabilities are found to have neither direct nor mediated effect on success in influencing ecosystems. This finding applies to four capabilities: articulating value proposition; engaging with commercial actors; engaging with non-commercial actors and understanding implicit institutions; and understanding actor resources and infrastructures.

Fourth, the findings suggest a significant effect of success in influencing ecosystem on the increased ecosystem size and efficiency. The results of the analysis are depicted in Figure 6, where significant relationships (as discussed above) are marked with values for path

coefficients. The abbreviations correspond to the aforementioned capabilities and dependent variables.

Notes: Non-significant relationships are depicted with dashed arrows. ^aThe direct effect from visioning to SISE was not hypothesized separately; ^bAfter the factor analysis, the hypothesized construct “engaging with other actors” was separated into “engaging with commercial actors” (ECA) and “engaging with non-commercial actors and understanding implicit institutions” (ENCAUI). ***p*<0.05; ****p*<0.01

Figure 6. Structural model results¹

Source: Paper V, p. 581.

The paper’s theoretical contributions are two-fold. First, the study conceptualizes and empirically tests dynamic capabilities associated with influencing the firm’s ecosystem, thus extending the focus of the dynamic capabilities beyond the firm’s boundaries. Second, the finding that some capabilities do not exhibit any effect on the dependent variable suggests alternative explanations to the proposed conceptual model, such as that the hypothesized relationships might become visible in a longitudinal study.

¹ UARI—understanding actor resources and infrastructures; AVP—articulating value proposition; ECA—engaging with commercial actors; ENCAUI—engaging with non-commercial actors and understanding implicit institutions; IEI—influencing explicit institutions; SISE—success in influencing service ecosystems; ISESE—increased service ecosystem size and efficiency.

5. Discussion

Drawing from the five appended papers, this chapter provides a discussion of the present thesis' findings. Structured around the two research questions formulated in the Introduction, this chapter is divided into two sections: the first discusses the empirical evidence on the intra-organizational side of digital servitization, while the inter-organizational side is discussed in the second section.

5.1. Internal focus: How firms can organize for digital servitization

Due to the critical role of digital servitization's internal focus, this thesis began by pointing toward the importance of the first research question, "How can firms organize for digital servitization?" Aggregating the empirical evidence from the appended papers, this section discusses the findings on the intra-organizational side of the studied phenomenon by, first, examining how firms can organize the structure for digital servitization and, second, how firms can organize the support for digital servitization.

5.1.1. Organizing the structure

As demonstrated by the empirical evidence, one of the focal points of the intra-organizational side of digital servitization concerns organizing the structure, with a particular emphasis on service and product units and especially alongside the spectrum of central/local and front-end/back-end roles and functions.

The findings suggest that while service and product units need to closely collaborate toward joint digital servitization initiatives (e.g., through a unit that connects service and product development), the development of a global digital service strategy appears to have further enabled service units in driving digital servitization (Paper I, p. 455). International customers expect commonality and standardization across local markets (Kowalkowski et al., 2011), which requires more control and intra-firm integration. Under such conditions, when service units came to have a unified strategy that involves sufficient resources, it became possible to overcome the strong resistance of product units—to the extent of developing and offering digital services that were independent of the firm's products. Either adaptable to competitors' equipment or entirely software-centric and thus not requiring any equipment, such services seem to have further driven digital servitization. Although service offerings in general typically bring more stable revenues for servitizing firms, expanding the operations of digital services beyond the firm's equipment (and turning such services into being software-centric) has allowed for scaling up the service business to a greater extent.

The empirical evidence further suggests that digital servitization had concerned organizing the structure alongside the spectrum of central/local and front-end/back-end roles and functions (Paper I, pp. 455-456). Centralized action toward digital servitization initiatives appeared important for overcoming potential resistance inside the firm. In terms of service and product centrality, front-end and back-end roles received different emphasis in the two cases, which is in line with the notion that different configurations can be present in firms (Raja et al., 2018). The existing research also suggests that systems integrators need a central entity to coordinate and support the coupling of product and service—back-end—units and the local customer-facing—front-end—units (Davies et al., 2006; Raddats & Burton, 2011). The empirical evidence suggests that with key digital competences concentrated in central units, the latter assumed back-end roles and focused on digital tools and training that would support local units in service provision. Such digital tools became critical for ensuring transparency and enabling benchmarking and information exchange among the otherwise disconnected (or not connected continuously and in real-time) local units.

In turn, the local units received front-end roles such as adapting digital services to each local market customer's needs. These findings are aligned with the extant literature's observation that localization activities are performed by front-end units (e.g., Cenamor et al., 2017). Specifically, the extant literature on organizational design suggests that servitizing firms typically require stronger emphasis on local service (Fischer et al., 2012). Furthermore, research indicates that, for increased service provision, firms should decentralize their decision-making authority to lower levels of the firm's hierarchy (Neu & Brown, 2005; Eggert et al., 2014). In contrast, as evidenced for digital servitization, a notable aspect of the interaction between central and local units has concerned local customer relationships (Paper I, p. 456). Enabled by digital technologies, the central units could, with greater ease, monitor and even control such relationships. In parallel, a more centralized interaction with customers appeared as an enabler for cooperation around digital servitization at an increasingly higher management level. Thus, the empirical evidence is supportive of the centralization of decision-making authority to achieve not only global efficiency but also a better ability to address customer needs.

5.1.2. Organizing the support

In addition to organizing the structure, another focal point of the intra-organizational side of digital servitization concerns organizing the support, which requires an internal focus on data (as well as relevant digital technologies and software), responsiveness, and agility.

An internal orientation within the firm toward data and relevant digital technologies and software appears critical for organizing the support for digital servitization. As the evidence suggests, understanding the need to maintain and upgrade digital infrastructure became essential for the uninterrupted provision of digital services (Paper III, pp. 297-298). With such infrastructure in place and functioning, the firm was able to collect data and then leverage it toward digital servitization. Due to a vast number of data sources, extensive employee skills were required for data collection and analysis—and the mindset recognizing that such activities would be crucial for the service business. Closely related, employees and management needed to correctly approach the scalability of the software that is behind digital services, since the data volume and number of software users substantially differed between industrial and consumer markets.

Overall, the findings are in line with the extant research suggesting the importance of innovativeness for servitization (e.g., Gebauer et al., 2010). Furthermore, the importance of an

internal orientation toward data (and relevant digital technologies and software) is also aligned with the evidence that a core condition behind customer-facing units' support for digital servitization was being on the leading edge of new technologies, planning ahead in order to develop technical skills for the future, and predicting the potential of new technology (Paper IV, pp. 20-21, 41). Thus, complementing the literature's notion that technology represents an important enabler for service strategies (Huang & Rust, 2017; Antioco et al., 2008; Cadwallader et al., 2010), the present findings emphasize the key role of an internal focus on data and relevant digital technologies as well as software for digital servitization.

Furthermore, responsiveness within a firm appears to be important for organizing the support for digital servitization. As indicated by the empirical evidence, a willingness to learn new approaches to operations was important due to digitalization-related market changes (Paper III, pp. 297-298), which corresponds to the cross-industry adoption of novel ways of operating comparable to firms such as Google and Microsoft (Denning, 2018). By promoting an internal mindset that is compatible with digital servitization, one of the case firms was able to respond to such changes and develop novel digital services. For example, addressing growing industry-wide concerns around cyber security, the firm relied upon its newly developed data expertise and offered cyber security services; similarly, the growing importance of data ownership within the industry prompted the firm to focus on solving data ownership issues (Paper III, p. 299). Also, the demands to maintain and upgrade digital infrastructure for the provision of digital services appear connected to the firm's willingness to adopt the new ways of working with such infrastructure. The relative importance of the focus on responsiveness is further emphasized by the evidence that another core condition for customer-facing units' support for digital servitization was responding to changes in the market and competitors' actions, as well as adopting new ways of doing work (Paper IV, pp. 20-21, 41). Thus, while the extant research suggests the importance of learning (Ostrom et al., 2010) and market and competitor orientations for servitization (Gebauer et al., 2011; Gebauer & Kowalkowski, 2012), digital servitization appears to require that firms become ever more responsive to potentially disruptive market changes that are due to digitalization.

Finally, agility within the firm appears important for organizing the support for digital servitization. As indicated by the empirical evidence, there was a need to continuously alter the direction of digital servitization efforts and to make changes on a much shorter time horizon (Paper III, pp. 297-298). Due to strong digitalization-driven demands around software and digital infrastructure, agility appeared imperative for digital servitization; specifically, an agile

mindset—like that of a digital-native Google—was instrumental for addressing short development life cycles of software and digital infrastructure. The relative importance of such a focus on agility is further emphasized by the evidence that yet another core condition for customer-facing units’ support for digital servitization was the ability to quickly change priorities and to easily and quickly make decisions when dealing with customers (Paper IV, pp. 20-21, 41). Thus, while the extant research suggested the importance of flexibility (Barnett et al., 2013) and “agile incrementalism” for servitization (Kowalkowski et al., 2012), digital servitization appears to require agility within the firm that reflects the increasingly fast pace of digitalization (see also Sjödin et al., 2020).

5.2. External focus: How firms can work with the ecosystem for digital servitization

Due to the critical role of external focus of digital servitization, the present thesis began by pointing toward the importance of examining how firms can work with their ecosystems. Addressing the second research question of this thesis: “How can firms work with their ecosystems for digital servitization?”, this section discusses findings on the inter-organizational side of the studied phenomenon. While section 5.1 followed the order outlined in the “Theoretical background” chapter, this section’s structure instead draws from the aggregated empirical evidence of the appended papers, which were employed to develop the three overarching themes that capture the findings across the studies. Specifically, this section is structured around three focal points: working with the vision; working with customers; and working with partners.

5.2.1. *Working with the vision*

As is demonstrated by the empirical evidence, one of the focal points of the inter-organizational side of digital servitization concerns how firms can work with a vision. The findings suggest that one of the case firms created the vision for digital servitization that directly involved other actors in the firm’s ecosystem (Paper I, p. 455). Among the first in its industry, the firm recognized that data-related issues and changing data ownership expectations were becoming critical for service-centered business models. Similarly, the firm realized the value of the digitalization-driven rapid increase in the number of data sources, as well as correctly assessed the scalability of the software behind digital services for industrial market applications.

However, due to many customers and partners initially lacking support for digital servitization, creating a vision became essential for promoting the relevant initiatives toward the ecosystem.

To explicitly articulate the benefits of digital servitization, the firm employed a white paper as a key mechanism of promoting the vision (Paper I, p. 455). Co-authored by representatives of the firm's various units, the white paper not only aimed to build internal support for digital servitization; more importantly, it allowed for the conveying of the vision for digital servitization toward other actors. Also, to articulate the benefits for the ecosystem's actors, the white paper emphasized the expected role of digital services as well as the underlying software and digital infrastructure. For example, digital services became scalable across customer segments (instead of being developed for and confined within a single customer or customer segment), and interactions between ecosystem actors were increasingly mediated by digital technology (Paper II, p. 986). By promoting its vision, the firm became known as an industry pioneer for digital servitization, to the extent that standards organizations sought the firm's expertise when formulating new industry-wide rules and regulations around digital services (Paper I, p. 455).

The described evidence points toward the importance of capabilities of visioning and timing, which enable firms to influence their ecosystems (Paper V, pp. 574, 591). Visioning describes the firm's ability to create a vision for the ecosystem's development, to articulate this vision in a way that inspires external actors, and to create and promote initiatives that are beneficial also for external actors. In turn, timing describes the firm's ability to be among the first to recognize the value of new resources and that major changes are to occur in the market, to accurately assess the speed of such changes, as well as to plan for new initiatives in a way that leverages their timing. While visioning and timing positively affected the success in influencing the ecosystem of firms that are not undergoing digital servitization (Paper V, p. 582), the empirical evidence on the inter-organizational side of digital servitization appears in line with this finding.

Overall, the present findings are in line with the extant research that suggests the importance of creating a (long-term) vision and of timing initiatives for servitization, as well as the need for relevant capabilities (Frankenberger et al., 2013; Gebauer & Kowalkowski, 2012; Kindström & Kowalkowski, 2014; Raddats et al., 2017; Baines et al., 2017). Adding to the research, the findings suggest that digitalization-related factors are of the essence when working with the vision for digital servitization in the ecosystem. Therefore, a firm first needs to recognize the importance of such factors, which might be challenging for a pioneer in its

industry. The evidence further suggests that to work with the ecosystem, firms need to create a vision around other ecosystem actors. Importantly, the vision's emphasis on digital services needs to be connected to the underlying software and digital infrastructure. Working with the vision might also strengthen the firm's reputation among organizations, such as standard-setting bodies, enabling the firm to influence rules and regulations around digital servitization.

5.2.2. Working with customers

As demonstrated by the empirical evidence, another focal point of the inter-organizational side of digital servitization concerns how firms can work with customers. The findings suggest that efficient digital service provision necessitates entirely novel digitalization-related competences from customers, and one of the case firms was therefore extensively supporting its customers in acquiring relevant knowledge and skills regarding digital services (Paper III, p. 297). Also, the firm was driving the development of the digital infrastructure that is critical for efficient service provision (Paper II, p. 986). Such infrastructure became indispensable for the ecosystem, allowing a continuous exchange of real-time information both on the customer side and within the ecosystem overall.

Furthermore, the case firm focused on the value that is created by digital services and customized value propositions that are based on in-depth customer knowledge (Paper III, p. 300). By evaluating the digital needs and maturity of each customer, the firm leveraged the modularity of offerings to deliver operational excellence and cost reductions through its digital services and related digitalization initiatives. Importantly, data-related unique selling points were extensively used toward differentiation, while information provision and the elimination of information disconnect were increasingly seen among the core benefits associated with digital services (Paper II, pp. 981-983). Moreover, the firm extended the scope of its digital services toward third-party equipment and built a unique network of third-party software interfaces (Paper III, pp. 299-300), which enabled novel value propositions that were lacking at the time within the competitors' ecosystems.

The described evidence on working with customers points toward the importance of capabilities for understanding actor resources and infrastructures and for articulating value propositions, which can enable firms to influence their ecosystems (Paper V, pp. 575, 591). The former describes the firm's ability to analyze what kind of competences and infrastructure its customers (as well as other ecosystem actors) need for the new initiatives to be successful. In turn, the latter describes the firm's ability to create a well-defined value proposition that is

understood by customers, to communicate the total value of the firm's offerings, and to systematically evaluate opportunities to redefine such offerings.

Overall, the present findings appear to be in line with the extant research that suggests the importance of customer focus (Neu & Brown, 2005; Frankenberger et al., 2013) and of working with customers for servitization that is coupled with the need for relevant capabilities (Kamp & Parry, 2017; Huikkola et al., 2020). The evidence also supports the notion that, for service provision to be successful, customers need to develop new competences (Story et al., 2017; Raddats et al., 2017) and that working with customers around service offerings demands a good understanding of such needs (Spring & Araujo, 2013; Weigel & Hadwich, 2018). Adding to the extant research, the findings suggest that among the most critical customer competences for digital servitization are those induced by digitalization and that development of such competences is often challenging, which necessitates support from more digitally savvy parties. Also, the evidence highlights the importance of understanding that customers and the entire ecosystem need digital infrastructure to ensure the provision of digital service offerings. Developing such infrastructure therefore appears critical for working with customers and, in general, when working with the ecosystem for digital servitization.

Furthermore, extant studies point toward the key importance of customer value when developing service offerings and that interaction with customers is crucial for value creation (Kamp & Parry, 2017; Raddats et al., 2017; Spring & Araujo, 2013). The present findings further add evidence to the research that value propositions for digital servitization need to be articulated with a close connection to digitalization-driven factors. Specifically, the knowledge of customers' digital needs and digital maturity appears to be a key source behind adapting modular offerings for customer value maximization. The evidence further suggests that core value propositions in digital servitization appear to be based on data and on the information that results from data analysis. Such value propositions can leverage the digital infrastructure for eliminating information disconnect (Paper II, pp. 981-983) or can rely upon a network of software interfaces that extends the scope of digital service offerings (Paper III, pp. 299-300). Overall, digitalization plays a key role for novel sources and types of value propositions and, more broadly, for working with customers as part of the external focus of digital servitization.

5.2.3. Working with partners

As demonstrated by the empirical evidence, the inter-organizational side of digital servitization also concerns how firms can work with partners. The findings suggest that one of the case firms

was actively developing external partnerships for specialized competences in digital servitization (Paper III, p. 299), such as competences on data analysis and cloud infrastructure that were absent within the case firm. The scale of such partnerships was extensive due to substantial digitalization-related demands for the ecosystem (Paper II, p. 986). Furthermore, the firm leveraged collaboration with other ecosystem actors toward the above-mentioned extension of digital services' scope toward any equipment type. As a result, software became increasingly independent of any single supplier's hardware, which led to the widespread integration of software interfaces across suppliers and brought additional benefits for the entire ecosystem. Specifically, suppliers could become more competitive by broadening the functionality of their offerings beyond the levels of their competitors that are operating in other ecosystems, while other partners could benefit from more value created by such software-based synergies. Importantly, the case firm was also extensively collaborating with universities on joint R&D projects on digital services (Paper III, p. 299). For example, algorithms developed in such projects were subsequently integrated into the software that is underlying the firm's offerings, while the data analytics experts were employed simultaneously at the firm and universities. Moreover, collaborating universities were closely involved with evaluating the quality of the data that is behind digital services.

The described evidence on working with partners points toward the importance of capabilities for engaging with commercial and non-commercial actors, which can enable firms to influence their ecosystems (Paper V, pp. 576, 578). These capabilities describe the firm's ability to have a good understanding of the ecosystem's players, and to form relationships with new commercial partners, such as suppliers and distributors, as well as with non-commercial partners such as research institutes and (non-)governmental organizations.

Overall, the present findings appear to be largely in line with the extant research that suggests the importance of working with partners for servitization and the need for relevant capabilities (Raddats et al., 2017; Weigel & Hadwich, 2018). The findings also support the notion that leveraging competences that are available across partners enables servitization and allows the manufacturer and collaborating firms to gain a competitive advantage (Ziaee Bigdeli et al., 2018). Adding to the extant research, the findings suggest that working with ecosystems for digital servitization requires specialized digitalization-driven competences that are leveraged through large-scale, extensive partnerships. Moreover, competitive advantage and other benefits for the ecosystem actors can be achieved through working with partners, which

enables software-based synergies and thus extends the scope of service offerings—the latter appearing particularly relevant for digital servitization.

Furthermore, extant studies typically point toward collaboration with other firms as being important for successful servitization (e.g., Weigel & Hadwich, 2018). The present findings further add to the research, with evidence that working with the ecosystem for digital servitization involves close collaboration not only with other firms—that is, the working with commercial actors—but also close collaboration on the digital service side with organizations such as universities—that is, working with non-commercial actors. For digital servitization, the latter appears to be important because of the high demand for advanced digitalization-related knowledge and competences that remain scarce in the industry (Paper I, p. 456) and might instead be found within non-commercial, knowledge-intensive organizations, which is in line with the notion that advanced services typically demand knowledge-intensive competences (Kamp & Parry, 2017). Closely related to this, the critical importance of data for digital servitization pressures manufacturers to ensure third-party validation of data quality (Paper III, p. 299), and the evidence suggests that non-commercial organizations might become important partners to achieve this goal. Overall, since digitalization leads to the substantially increased complexity in ecosystems (Paper II, p. 986), manufacturers require working closely with partners—both commercial and non-commercial—as part of the external focus of digital servitization.

6. Conclusion

This final chapter concludes the present thesis that aimed to describe and analyze how manufacturing firms manage digital servitization internally and externally. The chapter begins by outlining this thesis' theoretical contributions and implications in connection to the previously discussed findings. Next, this chapter outlines managerial implications. Finally, limitations and suggestions for future research are provided.

6.1. Theoretical contributions and implications

First, by examining the internal focus of digital servitization, the present thesis provides findings on how firms can organize the structure for digital servitization; it hence contributes empirical evidence to the scarce business marketing research on digital servitization (e.g., Kamp & Parry, 2017; Kohtamäki et al., 2019; Sjödin et al., 2020) and to the larger servitization research that spans disciplines (Raddats et al. 2019). Specifically, structuring was found to occur around service units thus enabling novel types of service offerings, where coordinated digital service strategies unify the activities of local units. Such structuring around service units allows for overcoming the resistance of product units, as well as for developing digital services that, for example, can be connected to competitors' equipment. Ultimately, novel service

offerings are associated with scaling up service operations. The findings further indicate that structuring for digital servitization occurred around central/local and front-end/back-end roles and functions. In line with the extant research that suggests the need for a strong central entity in servitization (Davies et al., 2006; Raddats & Burton, 2011), centralized action toward relevant initiatives appears important for the growth of the digital service business. Specifically, central units concentrate key digital competences and can assume mostly back-end roles, while focusing on digital tools that enable service provision by local units. In turn, the local units receive mostly front-end roles, such as adapting digital services to the local customer needs (e.g., Cenamor et al., 2017). Notably, in contrast to the extant studies that point toward assigning decision-making authority to lower-level managers (Neu & Brown, 2005; Eggert et al., 2014) the central units can also leverage the digital tools to control local customer relationships, which in turn enables supplier-customer cooperation at a higher management level and further drives digital servitization initiatives.

Second, by examining the internal focus of digital servitization, the present thesis offers findings on how firms can organize the support for digital servitization. Suggesting the importance of an internal focus on data (including relevant digital technologies and software), responsiveness, and agility, this thesis contributes further empirical evidence to the growing business marketing research on digital servitization (e.g., Kohtamäki et al., 2019; Sjödin et al., 2020) and to the cross-disciplinary servitization research (Raddats et al. 2019). Supporting the extant studies on the importance of innovativeness for servitization (Gebauer et al., 2010), the findings suggest that in the context of a vast amount of data sources, digital servitization necessitates extensive employee skills for data collection and analysis, coupled with a mindset that recognizes the importance of such activities for service provision. Similarly, being key for service strategies that are enabled by digital technologies (Huang & Rust, 2017; Antioco et al., 2008; Cadwallader et al., 2010), technology orientation appears in the empirical evidence as a core condition of customer-facing units' support for digital servitization. In turn, while the extant studies suggest that learning (Ostrom et al., 2010), as well as market and competitor orientations, are important for servitization (Gebauer et al., 2011; Gebauer & Kowalkowski, 2012), this thesis points toward a focus on responsiveness for addressing digitalization-related (and potentially disruptive) market changes, as well as for the adoption of novel ways of doing work (e.g., Denning, 2018) that enable the development and provision of digital services. On a related note, responsiveness appears in the evidence as another core condition of customer-facing units' support for digital servitization. Finally, with the extant studies pointing toward

flexibility (Barnett et al., 2013) and “agile incrementalism” as being important for servitization (Kowalkowski et al., 2012), the focus on agility allows continuously altering efforts for digital servitization to meet the demands and increasingly fast pace of digitalization, such as to address the short development life cycles of software and digital infrastructure (see also Sjödin et al., 2020). The findings of this thesis suggest that agility also represents a core condition for customer-facing units’ support for digital servitization.

Third, by examining the external focus of digital servitization, the present thesis offers findings on how firms can work with their ecosystems for digital servitization. Pointing toward the importance of working with the vision, with customers, and with partners, this thesis provides further empirical insights into the business marketing literature on digital servitization (e.g., Kamp & Parry, 2017; Sjödin et al., 2020), as well as on the capabilities that are associated with technology-driven servitization in the inter-organizational setting (e.g., Huikkola et al., 2020; Kohtamäki et al., 2019; Raddats et al., 2017). Supporting the evidence on the importance of a long-term vision and of timing the initiatives for servitization (Frankenberger et al., 2013; Gebauer & Kowalkowski, 2012; Raddats et al., 2017; Baines et al., 2017), the present thesis further suggests that digitalization-related factors appear important when working with the vision for digital servitization, together with the timing of relevant initiatives. In addition to the involvement of different ecosystem actors and the emphasis on digital services (including the underlying software and digital infrastructure), working with the vision might enable firms to influence rules and regulations around digital servitization. Furthermore, this thesis extends the evidence on the importance of customer focus for servitization and the need for relevant capabilities (Neu & Brown, 2005; Story et al., 2017; Weigel & Hadwich, 2018), where working with customers involves supporting their digitalization-related competences, which also require digital infrastructure for efficient digital service provision. On a related note, while extant studies emphasize customer value that is associated with service offerings (Kamp & Parry, 2017; Raddats et al., 2017; Spring & Araujo, 2013), digitalization plays a key role for novel sources and types of value propositions: leveraging data-related unique selling points is linked to customer value that, for example, can also result from digital services’ extended scope toward third-party equipment. Finally, supporting the evidence around partnering for servitization and the need for relevant capabilities (Raddats et al., 2017; Weigel & Hadwich, 2018; Ziaee Bigdeli et al., 2018), this thesis further suggests that working with partners involves large-scale, extensive collaboration around digital servitization initiatives and requires digitalization-driven competences. Due to software-based synergies that result from such

collaboration, partners become more competitive and receive additional advantages. In addition to collaboration with firms (e.g., Weigel & Hadwich, 2018), digital servitization appears to also benefit from partnering with non-commercial actors (such as universities), which can provide advanced knowledge and competences that otherwise might be absent within the industry.

6.2. Managerial implications

First, the present thesis offers managerial implications for how manufacturers can organize the structure for digital servitization. If service units are assigned firm-wide initiatives, it appears possible to develop digital service strategies that extend beyond the influence of product units. For example, when digital services are connected not only to the firm's but also to competitors' products, the firm might extend its amount of serviced equipment and meet previously unaddressed customer needs. It seems that a manufacturer can then compete with software firms and other organizations that increasingly enter industrial markets with digital service offerings. Furthermore, if back-end functions are assigned to central units, it appears that local units can receive increased support by carrying out front-end responsibilities such as adapting digital services to local customer needs. Centrally developed and offered digital tools and infrastructure might also bring additional efficiency to the interactions within the firm.

Second, managerial implications are being offered for how manufacturers can organize the support for digital servitization. In this regard, acquiring skills to collect and analyze data is important, as well as developing associated competences around digital technologies and software. Cultivating a mindset inside the firm that would be aligned with such a focus appears to be equally helpful. Increasing the number of employees who are proficient at addressing digitalization-related issues might also be beneficial for achieving support for digital servitization initiatives within the firm. Besides responding to the often-disruptive changes within the market that are caused by digitalization, manufacturers can adopt novel ways of working that can reflect such changes and enable service operations. However, learning how to continuously adjust and adapt initiatives to the increasingly fast pace of digitalization might be challenging for firms that are often focused on long-term planning.

Third, this thesis offers managerial implications for how manufacturers can work with the external business environment for digital servitization. If a manufacturer creates a vision that appeals not only internally but also to other relevant organizations (as exemplified by the

case firm's white paper that promoted digital servitization), these organizations can join and further enable digital service initiatives. However, if the manufacturer is among industry pioneers when introducing a compelling vision, the initial recognition of the importance of digitalization-related factors might appear challenging for the firm. Finally, by working with customers as well as both commercial and non-commercial partners, it appears that firms can create value that would not only distinguish the digital service offerings but can also lead to the external environment becoming more attractive in comparison to that of competitors.

6.3. Limitations and suggestions for future research

The present thesis has three main limitations that, in turn, point toward opportunities for further research. First, the qualitative data employed in this thesis (see Papers I, II, and III) concerns the ecosystems of two industrial firms that are from the same multinational corporation. Although the firms represent different industries and exhibit major differences in their approach to digital servitization, collecting data that concerns ecosystems of other manufacturers would allow for the examination of whether the findings are applicable across contexts. Similarly, while the sample for the fuzzy-set qualitative comparative analysis (see Paper IV) was drawn from the service operations and service sales units of a single manufacturing corporation, expanding the analysis toward other firms might provide additional insights into the studied phenomenon.

Second, among the capabilities discussed in sections 5.2.1-5.2.3, only visioning and timing were associated with success in influencing the ecosystem for firms that are not undergoing digital servitization (see Paper V). However, the empirical evidence on digital servitization suggests that all the discussed capabilities (to various extents) can be employed to work with ecosystems. A possible explanation relates to how digital servitization requires more varied capabilities to work with ecosystems compared to cases where this phenomenon is absent. Therefore, since partial least squares structural equation modeling was carried out with the sample where digital servitization was outside of the study's scope (see Paper V), re-testing the conceptual model with the data on digital servitization would appear helpful for further research.

Third, the present thesis relies upon studies that involve different research designs, such as case studies and surveys. Due to the complexity of the examined phenomenon, employing a variety of approaches appeared helpful for shedding light on digital servitization from different

perspectives. In turn, future research could potentially benefit from approaches that were not employed in this thesis. For example, conducting experiments is increasingly accepted in business marketing research and thus has the potential for further studies on digital servitization. Beyond working with different research designs, scholars could also examine tensions that arise when firms shift from a product-centric to a service-centric logic while facing digitalization. The complexity of digital servitization that involves the internal focus and, in particular, the external focus is expected to be driving such tensions. The emphasis of the present thesis on inter- and inter-organizational aspects appears particularly relevant in this regard and therefore can be extended in future studies on the tensions that are involved in digital servitization.

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