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An agile co-creation process for digital servitization: A micro-service innovation approach

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ABSTRACT

In this paper, we explore how manufacturing firms and their customers co-create digital service innovations in an attempt to address the digitalization paradox. We present empirical insights from a case study of four manufacturers and their customer relationships. The results suggest that value co-creation in digital servitization is best managed through an agile micro-service innovation approach. Such an approach requires incremental micro-service investments, sprint-based micro-service development, and micro-service learning by doing to ensure customized and scalable digital service offerings. The proposed agile co-creation model provides insight into the phases, activities, and organizational principles of a micro-service innovation approach. Relational teams that pool knowledge from providers' and customers' strategic, technological, and operational areas are crucial to ensure successful cooperation and governance for agile co-creation. This paper offers insight into how companies engage in agile co-creation processes, with important recommendations for innovation in manufacturing firms in the era of digitalization.

1. Introduction

“We have traditionally been successful in developing solutions together with our customers, but we have to be faster now [in the digital era]. We tend to discuss too long and get stuck in the details of R&D [research and development]... We need to understand the importance of co-creation. We cannot come to the customer with a total solution; rather, we must work together in an agile way to progressively address the customer's needs as they evolve.” (Research director of a large provider of automation and process solutions discussing the path forward for their digital servitization initiatives.)

Proliferation of digital technologies enables radical changes in products, services, innovation processes, business models, and the very nature of business activities in industrial ecosystems that follow the logic of digital servitization (Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Sjödin, Parida, Jovanovic and Visnjic, 2020). We define digital servitization as *the transformation in processes, capabilities, and offerings within industrial firms and their associate ecosystems to progressively create, deliver, and capture increased service value arising from a*

broad range of enabling digital technologies such as the Internet of Things (IIoT), big data, artificial intelligence (AI), and cloud computing (Kohtamäki, Parida, Oghazi, Gebauer, & Baines, 2019; Parida, Sjödin, & Reim, 2019; Rindfleisch, O'Hern, Sachdev, 2017). For example, investing in smart and connected products (Iansiti & Lakhani, 2014; Porter & Heppelmann, 2014) combined with AI capabilities enables providers such as GE, Siemens, and ABB to offer enhanced digital customer services such as fleet management and site optimization by monitoring and analyzing the performance of a multitude of products.

To ensure continued competitiveness in the era of digital servitization, industrial business to business (B2B) providers must invest in innovation by developing new and increasingly advanced digital service offerings. However, digital service innovation is highly challenging for a number of reasons. First, technology is rapidly evolving, and companies often struggle to keep pace with the demand for complex digital system developments because it may extend beyond their existing capability base (Porter & Heppelman, 2014; Sjödin, Parida, Leksell, & Petrovic, 2018). Second, in digital servitization, innovation does not happen in internal R&D labs; it occurs at the point of customer contact, where value is realized through co-creation (Grönroos, 2011;

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Parida et al., 2019). Yet most B2B firms are not set up for co-creative innovation. Thus, despite investing considerable effort in developing digital services, many companies struggle to create real customer value, and both providers and customers risk failing to make a financial return on investment (Gebauer, Fleisch, & Friedli, 2005; Kastalli & Van Looy, 2013; Sjödin, Parida, & Kohtamäki, 2019; Suarez, Cusumano, & Kahl, 2013). Discussions with senior managers in the industry often raise questions along the lines of “are we digitalizing fast enough?” or “are we investing in the right things?” This pervasive complexity and uncertainty can lead companies into a digitalization paradox, where increasing revenues from digital services fail to deliver greater profits because of spiraling cost increases.

To address this paradox, many studies suggest that digitalization requires a different way of working to foster agility and greater involvement by customers and ecosystem actors in value co-creation (Ghezzi & Cavallo, 2018; Kock & Gemünden, 2016; Kohtamäki et al., 2019; Paluch et al., 2019; Parida et al., 2019; Raddats et al., 2019; Sklyar et al., 2019). Co-creation processes are collaborative activities by parties involved in direct interactions that aim to contribute to value for one or both parties (Grönroos, 2011). Yet little is known about the practicalities of how firms actually instill these principles of agility and how value co-creation can be better organized and managed in digital servitization. This study makes two key contributions to the digital servitization literature.

First, there is a need to further understand *how to organize agile and cost-effective processes for value co-creation in digital servitization*. Indeed, the research community still lacks detailed process-related understanding of how agility can be deployed in traditional manufacturing sectors, where linear approaches to innovation (e.g., stage-gate) still dominate. There is a need for an alternative agile digital service development approach to produce customer-focused, implementation-ready digital services (Bianchi, Marzi, & Guerini, 2018; Paluch et al., 2019) while injecting speed and effectiveness into the digital service co-creation process (Cooper & Sommer, 2018). Emerging research on the topic points to the need for a more stepwise and iterative approach that breaks complex systems into smaller, more manageable parts, leveraging modularity and platform approaches (Sjödin et al., 2018; Cenamor, Sjödin, & Parida, 2017). For example, fully exploiting digital technologies (e.g., AI, analytics, virtual prototyping, and operational process simulation) for digital service innovation requires new ways of working to enable experimentation, exploration, and fast fail approaches.

Second, there is a need to further understand *how to manage co-creation of value with the customer by involving numerous cross-functional actors*. Many studies indicate that digitalization can transform the role of customers, opening the way to a more customer-centric approach. Yet detailed explanations of how such processes are handled are virtually non-existent (Paluch et al., 2019; Story, Raddats, Burton, Zolkiewski, & Baines, 2017). Clearer governance structures are important to secure accountability, reduce role ambiguity, and focus decision-making power within the customer relationship across the phases of co-creation (Arrikka-Stenroos et al., 2012; Sjödin, Parida, & Wincent, 2016). For example, the roles and responsibilities of various cross-functional actors may change as the use of digital technologies transcends functional and organizational boundaries (Sklyar et al., 2019). Thus, delineating the order and composition of innovation activities as well as the roles for both parties in each phase of the co-creation process is particularly valuable to understand the relational dynamics in digital servitization (Story et al., 2017).

This study contributes to the growing body of literature on value co-creation and digital servitization of manufacturing industries by providing an in-depth account of how value co-creation processes in digital servitization unfold between providers and customers. Specifically, this study answers the following question: How can firms co-create digital service innovations with their customers to cope with the digitalization paradox and reap the benefits of digital servitization? Our findings

contribute by characterizing the causes of the digitalization paradox as high investment, lower-than-expected revenues from digital services, and unexpected increases in delivery costs. The major implication is that to deal with the digitalization paradox, firms should adopt an agile co-creation process following a micro-service innovation approach.

2. Theoretical background

2.1. Digital servitization and the digitalization paradox

Digitalization involves the use of digital technology to provide new value-creating and revenue-generating opportunities (Parida et al., 2019), and it typically goes “hand in hand with adopting a servitization strategy” (Parida, Rönnberg Sjödin, Lenka, & Wincent, 2015, p. 41). The emerging literature on digital servitization captures this trend (Holmström & Partanen, 2014; Porter & Heppelmann, 2014; Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2017). Digitalization is both a driver and an enabler of servitization (Parida et al., 2019; Vendrell-Herrero et al., 2017) and may enable new forms of innovation and business models in manufacturing firms (Sjödin, Parida & Kohtamäki, 2016). For example, digitalization is currently enabling companies to move from product-centric models to digital service-oriented offerings with higher value-generating potential (Adrodegari & Saccani, 2017; Ardolino et al., 2018). Digitalization changes customers’ value propositions and alters how (i.e., through processes and capabilities) a company creates and captures value through co-creation with customers to meet their evolving needs (Iansiti & Lakhani, 2014; Lenka, Parida, & Wincent, 2017). Typically, product providers adopt a digital servitization strategy to differentiate themselves from competitors (Opresnik & Taisch, 2015) and to explore new revenue streams in collaboration with customers (Parida et al., 2019). The opportunities to expand revenue streams increase when companies synchronize products, services, connectivity, and data analytics into product-service-software systems (Kohtamäki et al., 2019; Martín-Peña, Díaz-Garrido, & Sánchez-López, 2018; Schroeder, Ziaee Bigdeli, Galera Zarcos, & Baines, 2019). Based on this discussion, we define digital servitization as *the transformation in processes, capabilities, and offerings within industrial firms and their associate ecosystems to progressively create, deliver, and capture increased service value arising from a broad range of enabling digital technologies*.

Digital servitization creates both opportunities and challenges for companies. Digital opportunities arise at a speed that many companies are unable to cope with in their traditional innovation processes. Many companies struggle with rapid digital innovation because it requires a change in managing provider-customer relationships by adopting new and innovative co-creation approaches (Iansiti & Lakhani, 2014). At its core, digitalization has the potential to affect the different stages of the co-creation process in ways that are complex and causally ambiguous due to the vast array of enabling technologies and the multitude of ways in which they can augment product and service performance (Barrett, Davidson, Prabhu, & Vargo, 2015; Hasselblatt, Huikkola, Kohtamäki, & Nickell, 2018; Iansiti & Lakhani, 2014). Companies can thus find themselves facing a digitalization paradox, where increasing revenues from digital services fail to deliver greater profits because of rampant cost increases. Undoubtedly, digital technologies enhance quality and improve efficiencies, but, equally, service costs are driven higher by the growing availability of more advanced solutions and capabilities, which demand higher entry investment and maintenance costs (Porter & Heppelman, 2014).

In the context of these challenges, research on digital servitization has investigated issues such as growth trajectories (Coreynen, Matthyssens, & Van Bockhaven, 2017), platforms (Cenamor et al., 2017), capabilities (Lenka et al., 2017; Sjödin et al., 2016; Story et al., 2017; Jovanovic, Raja, Visnjic, & Wiengarten, 2019), exploitation of big data (Opresnik & Taisch, 2015), business models (Parida et al., 2019), and supply chain interdependencies (Vendrell-Herrero et al., 2017).

However, the literature offers little insight into how firms can manage co-creation processes with customers for digital service innovation.

2.2. Co-creation in digital servitization relationships

Building on service logic perspectives, we stress the importance of understanding value co-creation processes to innovate and offer successful digital service solutions. These co-creation processes involve the customer as a co-creator of value and the provider as a value facilitator (Grönroos & Voima, 2013; Sjödin et al., 2016; Vargo & Lusch, 2008). As digital servitization does not take place in a vacuum and firms are not islands unto themselves, companies must have the capacity to co-create new digital service innovations in collaboration with customers and the broader ecosystem (Kohtamäki et al., 2019; Sjödin, 2019). For example, Sandvik (mining equipment provider) is extending its internal capabilities by partnering with IBM (AI analytics) and Newtrax (positioning) to create digitally optimized and automated underground mining solutions in collaboration with customers. The service-dominant logic literature uses various terms for this process such as co-creation, co-production, co-innovation, and even co-design (Kohtamäki & Rajala, 2016; Payne, Storbacka, & Frow, 2008). As the literature affirms, value is in exchanges, it lies in usage, its worth is experienced, it is what the customer is willing to pay, and it is co-created between the customer and the provider (Grönroos, 2011; Vargo & Lusch, 2008). Following this logic entails a significant shift in roles and responsibilities for the actors engaged in co-creation. Embracing value co-creation in digital servitization would thus mean “understanding the customers’ practices and how customers combine resources, processes, and outcomes in interaction, where the service provider shifts from a mere facilitator to a co-creator of value” (Grönroos & Voima, 2013, p. 141). However, value co-creation also creates relational complexities and possibilities for value destruction (Echeverri & Skälén, 2011; Sjödin, Parida, & Lindström, 2017; Reim, Sjödin, & Parida, 2018) as well as role ambiguities (Sjödin et al., 2016) for unclear digital services. For example, Aarikka-Stenroos and Jaakkola (2012) describe the need for both customers and providers to enact new roles (e.g., co-implementer) when engaging in value co-creation. Essentially, value co-creation implies that the provider and customer both take an active role in creating value through direct interaction to realize the promise of digital servitization. Thus, the nature of the interaction between the buyer and seller is transformed from a transaction-based to a relationship-based collaboration. These emerging co-creation processes in digital servitization require further consideration.

2.3. Agile co-creation processes in digital servitization

A common theme in the literature is that the nature of innovation, technologies, and markets has changed to such an extent that traditional new product and service development processes no longer work (Cooper & Sommer, 2018; Paluch et al., 2019). The traditional stage-gate approach applied by many servitizing firms emphasizes the importance of detailed, upfront planning to avoid wasting resources during subsequent execution phases. However, such processes discourage experimentation; they are too rigid, planned, and linear to handle the dynamic and innovative projects (Cooper & Sommer, 2018) that are prevalent in the context of digital servitization.

In contrast, many scholars argue that the new digital landscape requires more agile and co-creative innovation processes because companies need to cope with a constantly evolving digital landscape (Cooper & Sommer, 2018; Parida et al., 2019; Sjödin et al., 2018). Like Qumer and Henderson-Sellers (2006), we define agility as the ability to accommodate and adapt to changes in a dynamic environment. Being

agile means applying previous knowledge while continuing to learn from current experience to deliver high-quality products or services under budget constraints and in short timeframes. Hence, agility encompasses the features of flexibility, velocity, learning, response to change, and leanness in close collaboration with customers, which are increasingly important in the digital era (Campanelli & Parreiras, 2015; Ghezzi & Cavallo, 2018; Paluch et al., 2019; Sjödin et al., 2018).

As manufacturing firms shift toward digital servitization, agile innovation processes inspired by the software industry may provide the necessary flexibility to avoid the digitalization paradox. Agile project management (Beck et al., 2001) focuses on two concepts: (1) risk minimization through short iterations of defined deliverables and (2) direct co-creative communication with partners in the development process. These principles provide important guidelines for digital service innovation to enable multiple short planning and execution cycles shaped by customer feedback and rapid change (Ghezzi & Cavallo, 2018; Paluch et al., 2019; Sjödin et al., 2018). More specifically, the agile project management approach has important principles that can inspire digital service innovation processes such as valuing the centrality of individuals and their interactions (Lenka, Parida, Sjödin, & Wincent, 2018; Sjödin, Frishammar, & Thorgren, 2019), the incremental delivery of working software solutions, co-creation with customers rather than contract negotiation, and positive responses to change as opposed to following set plans (e.g., Beck et al., 2001; Cram & Newell, 2016; Paluch et al., 2019). Agile methods may be particularly appropriate in the context of digital servitization because such projects are often structurally complex, uncertain, heavily time limited, and highly important to strategic stakeholders.

Value co-creation is a central yet somewhat overlooked component of agile innovation (Paluch et al., 2019; Sjödin et al., 2018). Nambisan, Lyytinen, Majchrzak, and Song (2017) argue that digital technologies favor more fluid and complex boundaries (at the spatial, technological, and organizational levels) in the innovation process. The organization of such processes largely remains an unresolved issue (Paluch et al., 2019), especially in the context of digital servitization. Multiple organizational functions and roles should be deployed to effectively implement an agile approach. The organization must work as an entity, collaborating with other companies and suppliers to adapt to emerging digital opportunities (Sjödin et al., 2018; Sklyar et al., 2019). For example, Sjödin et al. (2016) highlight the need to involve multiple customer roles in the development cycle and stimulate joint learning both before and after delivery. Nevertheless, organizational composition and the specific roles in terms of customer involvement are a new area of inquiry.

In the current era of digital servitization, traditional innovation processes must be replaced with flexible and iterative agile co-creation processes. We advocate a new innovation approach focused on engaging in co-creation and eliminating unnecessary bureaucracy to overcome the digitalization paradox (Cooper & Sommer, 2018; Parida et al., 2019). This study explores the shaping of such processes to improve firms’ ability to govern digital innovation, react faster to changes, improve focus, flexibility, and productivity, and instill iterative work processes that draw on continuous interactions with customers as the digital service innovation moves toward realization.

3. Methods

3.1. Research approach and case selection

This paper presents an exploratory multiple case study of providers and their customers to investigate how firms can co-create digital service innovations with their customers to cope with the digitalization

paradox and reap the benefits of digital servitization. Case studies enable multiple observations of complex relational processes (Eisenhardt, 1989; Eisenhardt & Graebner, 2007) and are particularly useful for developing new insights into theoretically novel phenomena (Edmondson & McManus, 2007) such as how providers and customers co-create digital service innovations in digital servitization.

Our sample comprised globally active Swedish B2B providers and customers engaged in digital servitization relationships. Cases from four industries (manufacturing, telecommunications, energy, and mining) were selected to enhance the generalizability of our findings. This case selection provided an opportunity to contrast various industrial perspectives on relational processes. Building on recommendations by Glaser and Strauss (1967), we used theoretical sampling to select cases that would illustrate how companies manage innovation in digital servitization (Eisenhardt & Graebner, 2007; Suddaby, 2006). Unlike in other studies that have ignored the customer perspective, in this study, we followed Tuli, Kohli, and Bharadwaj (2007) example by collecting dyadic data (i.e., data from both the customer perspective and the provider perspective) on innovation processes. These data enabled us to gain a deeper understanding of the interactive relationships in the digital servitization context (Yin, 2009).

Several factors motivated the selection of these cases at the time of the study. First, the providers were actively working with innovation in digital servitization (e.g., AI-enabled optimizations) and had several successful collaborations with customers. For example, Solutioncorp had a solid record of delivering digital services that have optimized machine operation by up to 25%. Second, these firms had been developing digital services over time, with notable development of routines and processes, thereby allowing us to learn from the experiences of leading companies. For example, Constructcorp described a comprehensive approach toward working with key customers to develop new digital services. Third, we selected cases where we had established good contacts with both the provider and the customer in the relationship. These good contacts led to the collection of detailed descriptions of the innovation trajectory and in-depth information about the relationship and its key activities.

3.2. Data collection

Data were gathered primarily through individual, in-depth interviews with participants from providers and customers that were active in digital servitization innovation. We developed a semi-structured interview tool and interviewed numerous managers from the customer side and the provider side of the relationship. We organized separate interviews with each participant.

In total, we conducted 38 interviews with key informants. The informants were selected because they were actively involved in the relationship. Interviewees were identified by snowball sampling, where key informants were asked to recommend people who had an active role in different phases of the relationship (Sjödin et al., 2016; Sjödin, 2019). The interviewees included business developers, R&D managers, project managers, production managers, product managers, and maintenance and technical support staff. These interviewees gave us a wider understanding of the cases from varying perspectives. Table 1 summarizes the cases and the positions of the interviewees within each company.

The respondents were asked open-ended questions with the support of an interview guide. The guide was developed based on themes about digital servitization, value co-creation between providers and customers, and how business relationships start and evolve over time. For example, respondents were asked to consider questions relating to broad themes such as: How do you develop digital service innovations? How do personnel at the customer and personnel at the provider interact in development? What activities are critical to enable digital service innovation? How are different roles involved in the process? In seeking answers to these overarching questions, we encouraged

Table 1
Overview of co-creation relationships, companies, and respondents.

Case	Co-creation relationship description	Company pseudonym	Industry	No. employees	Interviewees
R1	Co-creation relationship to connect and integrate equipment for digital fleet management and site optimization	Constructcorp (Provider) Minecorp (Customer)	Construction equipment Mining	7800 5700	6 (2 key account managers; 2 business development managers; head of service center; portfolio manager) 9 (chief procurement officer; head of procurement development; 3 procurement managers; R&D manager; automation manager; technology development engineer; maintenance manager)
R2	Co-creation relationship to connect and integrate information from Energycorp's overall production and distribution network to visualize system performance and identify improvements	Solutioncorp (Provider)	Power & automation technology	7800	8 (digitalization manager; product manager; digital lead; 2 key account managers; service researcher; IT platform development manager; collaborative operations center director)
R3	Co-creation relationship to develop an automation solution and mine optimization platform	Energycorp (Customer) Mineq (Provider) Zinkcorp (Customer)	Energy & utilities Mining equipment Mining	700 43 346 1500	3 (2 IT project leaders; strategy manager) 3 (2 automation managers; project manager) 6 (site manager; 2 IT managers; head of procurement; mill manager; mine manager)
R4	Co-creation relationship designed to innovate using the latest technology and digital solutions and continuously improve network operations	Connectcorp (Provider) Telecorp (Customer)	Telecom equipment Telecom	12,700 17,700	7 (business model researcher (3); head of strategy and business development; commercial management director; business operations manager; key account manager) 2 (business development manager; contract manager)

informants to base their answers not only on the relationships under study but also on their broader experience (e.g., from other relationships) so that empirical comparisons could be made. Follow-up questions were used to clarify points and obtain additional details, which enabled further exploration of relevant cases. The interviews took approximately 60 to 120 min each and were held face to face or via online conference calls. Interviews were recorded and transcribed, and transcripts provided the basis for the data analysis.

We triangulated our data by applying multiple data collection techniques, including multiple interviews and a review of documents (Jick, 1979). We performed document studies, reviewing company reports, agreements, and project documents to validate and provide context to our respondents' views, thus enabling empirical triangulation. To increase reliability and enhance transparency as well as the possibility of replication, a case study protocol was constructed along with a case study database. The database included case study notes, documents, and analysis.

3.3. Data analysis

Like Clark, Gioia, Ketchen, and Thomas (2010) and Van Maanen (1979), we followed an interpretive research approach, which “gives voice in the interpretation of events in a first-order analysis to the people actually experiencing those events” (Clark et al., 2010p. 403). The data analysis was based on a thematic analysis approach, which provides ways to identify patterns in large, complex data sets (Braun & Clarke, 2006). Moreover, thematic analysis offers a means of effectively and accurately identifying links within analytical themes. Through a series of iterations and comparisons, themes and overarching dimensions can be identified so that an empirically grounded model can be developed. Accordingly, we followed a three-step process similar to that described in the literature (Braun & Clarke, 2006; Gioia, Corley, & Hamilton, 2013).

The first step in our data analysis was an in-depth analysis of the

raw data (i.e., the interview transcripts). This analysis consisted of reading every interview several times, highlighting phrases and passages related to the overarching research purpose of understanding how firms co-create digital service innovations with customers. By coding the common words, phrases, terms, and labels mentioned by respondents, we identified first-order categories of codes that reflect the views of the respondents in their own words.

The second step of the analysis was to further examine the first-order categories to detect links and patterns among them. This iterative process yielded second-order themes that represent theoretically distinct concepts created by combining first-order categories. These themes relate to causes of the digitalization paradox and processes or routines to deal with it. In accordance with validity considerations raised in the literature, the themes were further refined using insights from the literature and data from interviews and secondary sources such as company documents, presentations, and magazines (Kumar, Stern, & Anderson, 1993). Fig. 1 provides examples of illustrative quotations for the second-order themes relating to the identification of digitalization needs. We performed this step in the data analysis together, thoroughly discussing the data structure.

The next step involved the generation of aggregate dimensions that represented a higher level of abstraction in the coding. Here, we used insights from the literature to form more theoretically rooted dimensions. Thus, the aggregate dimensions built on the first-order categories and second-order themes to present a theoretically and practically grounded categorization. Fig. 2 shows the entire data structure that resulted from the data analysis.

As a final step, we theorized about the logic and linkages across aggregate dimensions, second-order themes, and first-order categories. This practice of comparing cases allowed us to further refine our data structure and generate an overall model (see Fig. 3) to explain how innovation processes unfold by linking various roles, phases, activities and principles that emerged from the data analysis.

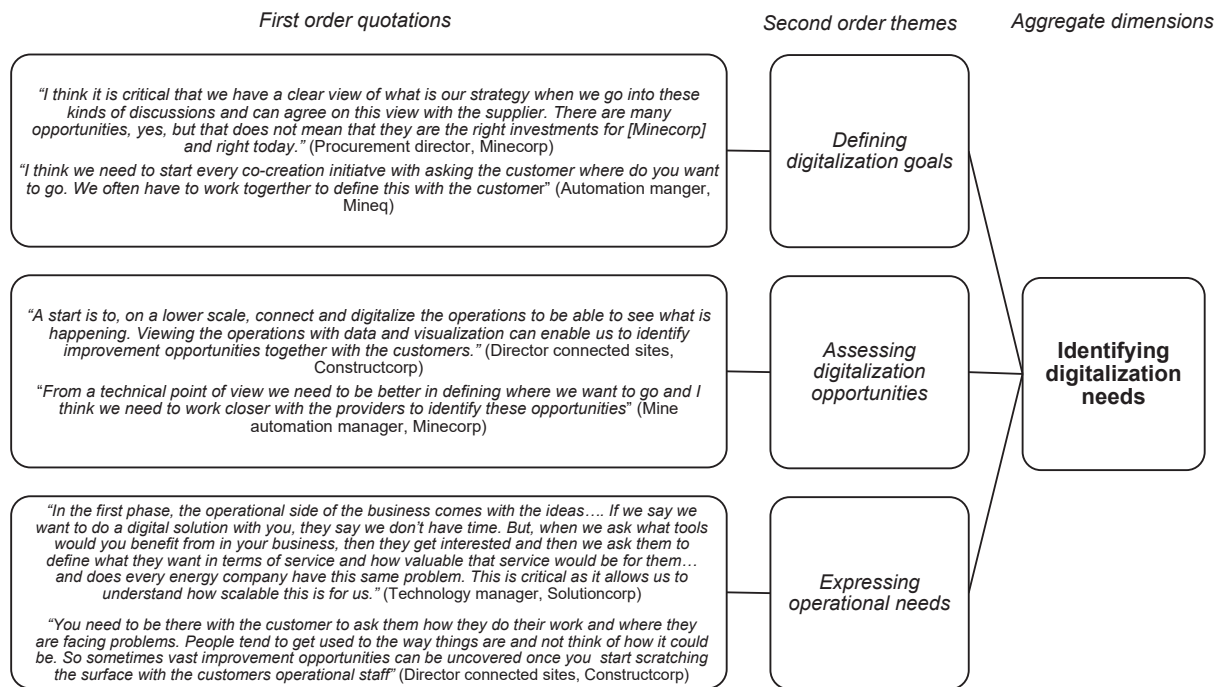


Fig. 1. Examples of Phase 1 supporting quotations for second-order themes.

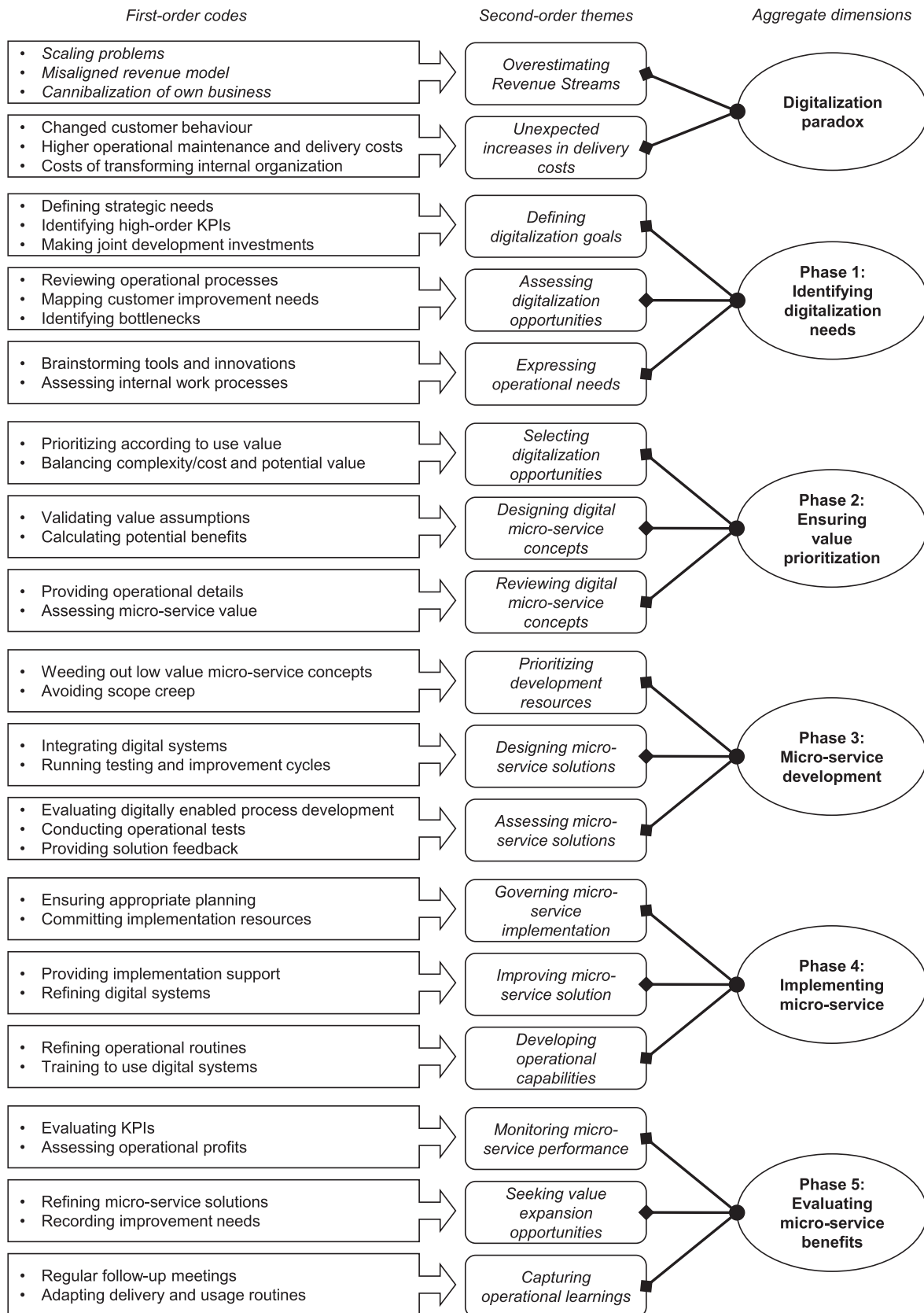


Fig. 2. Data structure.

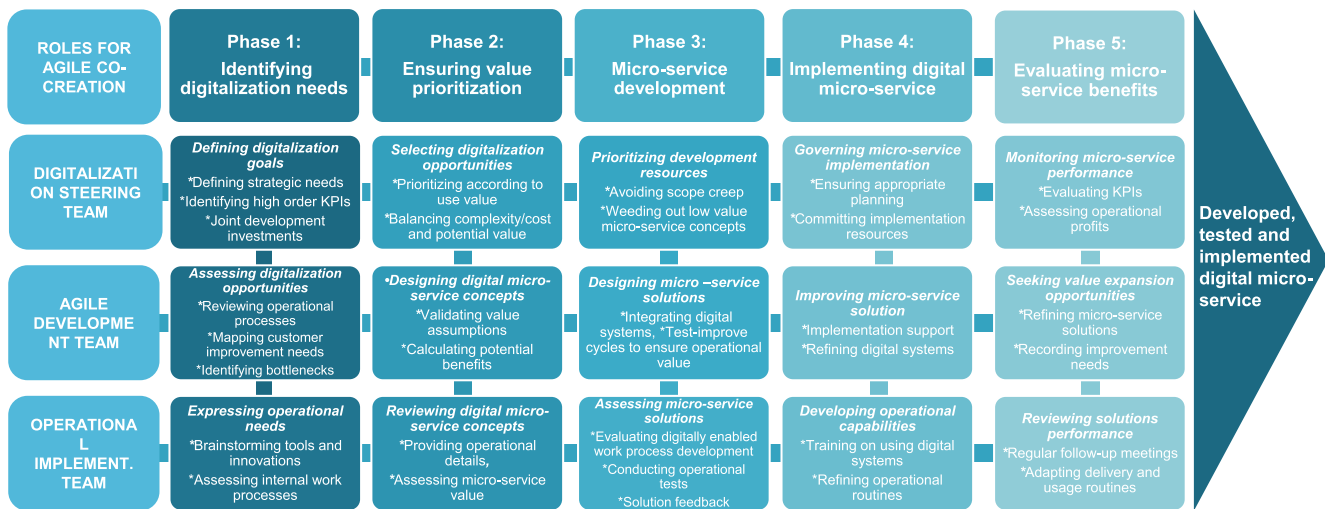


Fig. 3. Key activities for different roles across the phases of the agile co-creation process.

4. Findings

4.1. Identifying the causes of the digitalization paradox

We sought to understand how firms can co-create digital service innovations with customers to cope with the digitalization paradox. We first searched for the causes of the digitalization paradox and then mapped how companies coped with these challenges through an agile co-creation process (presented in the following sections). Our respondents agreed that they were invariably faced with the dilemma that the greater revenue from such services would not be enough to recover their investment in developing digital service innovations. We call this dilemma *the digitalization paradox*.

One key cause for the digitalization paradox is *overestimating revenue streams*. In other words, initial projections of the sales that a new digital service will generate are often hugely overstated. This overestimation may occur for several reasons. First, firms investing heavily in digital services risk cannibalizing their existing business model. For example, a digital service designed to ensure optimal use of equipment can reduce wear and breakdown, thus reducing spare part sales and ad hoc maintenance revenue, which have traditionally been core income streams for many manufacturing firms. Furthermore, because of overly complex technological solutions, the revenue model is often misaligned with the customer, so the price for the digital service is too high for the perceived value it generates (i.e., customers are unwilling to pay). For example, many firms would develop increasingly sophisticated and costly digital platforms to track their products, introducing numerous advanced functionalities that customers may not use. Finally, digital services can be difficult to scale because they require a high degree of customization of multiple interdependent systems to create value for customers. Thus, providers may face the challenge of devoting too many internal resources to developing digital solutions that are tailored to specific customers and then being unable to sell these solutions to other customers. A service development manager from Solutioncorp explained the importance of carefully considering the scalability of digital services to avoid overestimating potential revenue streams and ensure future profitability:

“It is a thin line what you should do scalable and what you should do custom made ... because not everything is scalable, and if you just manage selling to one or two customers, it is not going to be sustainable in the long run.”

The second cause of the digitalization paradox is the *unexpected increase in delivery costs*. This problem relates to the cost structure of

new digital services and can arise for a number of reasons. Overall, the lack of substantial physical investments (e.g., additional machines) means that many firms tend to view digital services as a cheap way of creating additional customer value at a low cost. However, considerable unexpected costs can emerge. First, actually being able to deliver digital services incurs a considerable cost in developing new capabilities in both back-end and front-end units because working with digital services is not part of the organization’s everyday business. For example, creating routines and tools for service technicians to use digital platforms can require considerable investment in understanding user needs and customization. Second, digital services such as fleet management or outcome-based contracts can also create unexpected cost increases because customer behavior can change if customers seek to exploit the provider’s responsibility for maintaining an element of their processes (i.e., opportunistic behavior). Finally, many firms report that digital systems require greater operational management and maintenance costs than expected because software and sensors must be updated regularly as technology changes and customer demands increase. Because of high customization, such changes can be costly. For example, a key account manager at Constructcorp described the importance of avoiding the higher delivery costs incurred by simultaneously maintaining too many diverse platforms:

“What is critical is that we have one common platform where we can have an integration layer, so we don’t create multiple platforms. If we have too many platforms to solve the customer problems, then you sit with all that back-office cost just weighing you down, and you can’t profit from the value on the customer side.”

4.2. Agile co-creation process phases for developing digital services

Our findings reveal a five-phase agile co-creation process for developing digital services. An important characteristic is the iterative and agile way of working with micro-services to enable multiple short planning and execution cycles governed by customer and operational feedback and rapid change. As described by our informants a micro-service in the context of digital servitization is a focused digital service functionality which does one thing and does it well. Accordingly, micro services lends itself to a continuous delivery of increasingly more sophisticated digital servitization solutions. For example, Constructcorp described developing a weight loading micro-service which on its own had substantial effects in reducing fuel costs, and traffic congestion but coupled with other micro services over time such as positioning and traffic awareness enabled more a more effective site management.

The process is governed by interactions between three separate teams of key people from both the provider and the customer. The *digitalization steering team* exercises the vital function of reviewing and selecting innovative ideas and steering co-creation for investments that align the provider's and the customer's interests. This team primarily consists of senior managers from both sides of the partnership who are strongly committed to the relationship to derive mutual benefit from digital transformation. The *agile development team* maintains overall responsibility for testing and validating digital service potential and corroborating digital service concepts involving development staff (i.e., R&D and business development) from both organizations. Finally, the *operational implementation team* plays a key role in directing operational implementation and appraising optimization opportunities. These actions are carried out by key people involved in operational implementation such as service technicians and implementation managers from the provider, as well as key end users and their managers from the customer. In each phase, the joint teams have specific roles and activities as described below. Fig. 3 presents the key activities conducted by the strategic, technological, and operational teams during the process.

4.2.1. Phase 1: Identifying digitalization needs

A starting point for the co-creation process is jointly working toward the identification of needs. A key activity in this phase is *defining digitalization goals*, which is a vital role of the digitalization steering team. This team primarily consists of senior managers from both sides of the partnership who seek to forge a mutually beneficial relationship through digital transformation. The starting point is to create a framework with strategic goals that the technical and operational teams can further hone and pursue. For example, Energycorp has identified three areas that digitalization investments should target: optimizing the flow of district heating, developing high-value-adding services to end-consumers, and performing preventive maintenance of the infrastructure. Based on an understanding of common goals, key performance indicators (KPIs) are thus identified. These KPIs are often financially oriented to ensure that investment generates the expected returns through improved operations, cost savings, higher productivity, and new business opportunities over a two-to-three-year horizon. Finally, a strategic decision is taken by the steering team regarding the funds that should be allocated to the provider and customer sides. In several cases, both companies tend to match each other's funds to show their commitment to the collaboration and to share the risks. A technical manager at Solutioncorp described their approach:

“The business team is responsible for setting the strategic needs and conducting a business analysis; this is a critical first step ... We are not technology driven or data driven in our approach; we are business driven. We are highly focused on what type of business value can be generated and how fast will the return on investment be. If it is a good case, then we push it through and take it to the development team that has the detailed understanding.”

Based on an understanding of the goals and investment possibilities, the agile development team is tasked with *assessing digitalization opportunities*. The technical teams from both sides start by scrutinizing the operational processes that are currently in place. This task often entails examining the customer's processes beyond the specific product or service offered by the provider and taking a holistic perspective, where system-level complexities are fully understood. The goal is to broaden the horizons of the team so that members can see new possibilities and opportunities that may not be accessible in normal operations. This operational learning is complemented by listing the customer's improvement needs. These lists are first prepared separately by each team and later merged into a common list of problems. However, the needs should be further weighted based on the framework outlined in the steering group's strategic goals and KPI requirements. This step ensures that the problems are aligned with the business expectations of top management and are not heavily biased toward mere technological

problem solving. As a director of key accounts at Constructcorp recounted,

“The customer is interested in seeing how much fuel my fleet consumes day by day and reducing it ... We need to listen to the customer from this perspective—how we do things properly to help move in this direction. My focus has been to look at the process—to look at the business from a customer point of view—and then we might end up in technology anyway, but we need to start at a higher level to see how we can improve their operations.”

In this early phase, the involvement of the operational team tends to be limited, but it is important that their views and perspectives are still captured by *expressing operational needs*. Commonly, operations can produce long lists of needs and issues to be solved. Expanding the scope of needs with operational insight ensures that the provider can evaluate which potential software tools or innovations can be applied to address the problems at hand. For example, assessing internal work processes for operational teams are vital steps for successful need identification. Team members from both sides must be willing to share and build on each other's competencies. For example, a manager for automation sales at Mineq reported the following:

“We interact with a lot of people to understand the operational needs, primarily the production management and the maintenance staff. It can be 20 people we need to work with, and it is important to involve them so they have a say from the start.”

4.2.2. Phase 2: Ensuring digitalization value prioritization

Successful co-creation processes require value prioritization between providers and customers to select the most promising opportunities. During this phase, the steering group focuses on *selecting digitalization opportunities*. The team is faced with the challenge of balancing the complexity-related cost with expected returns. When digital service solutions are being developed for the first time, it is often challenging to estimate the likely extent of value generation. In addition, the provider's definition of what is valuable may not align with that of the customer. For example, a provider may typically view optimizing the operation of a particular equipment as a clear value but this may not increase the overall throughput of the customer site if other equipment or issues are constraining throughput. Thus, some detailed discussions and negotiations are needed on both sides to define a value to the identified needs and to select one to address in further development. A project manager from Solutioncorp described the importance of selecting clear ideas for micro-service concepts with value-creation potential:

“We have said that nothing leaves [phase 2] unless the steering teams can see that it creates value. So, for ideas that don't have an attractive return on investment or an increased revenue stream, then it's a no-go at the moment.”

The next step involves the technology team engaging in *designing digital micro-service concepts*. The value assumption held by the steering group needs to be realized through concept design and further validated based on technological feasibility. This requires breaking down the desired micro-service features (i.e., product backlogs) and presenting an early concept for how these can be realized. An assessment of what new technological applications would be accessible off the shelf and what would need customized development is required. A key consideration is to simplify by including only concept features that have a direct correlation with customer value. For example, a key account director at Constructcorp described the company's approach to finding potential solutions for important customer needs:

“We need to know how we generate value for our customer. What do they earn money on? What is their business model? You need to understand the customer's process and what his biggest problem

areas are. We start by identifying 10 to 50 different customer issues, choose one of them, and start to build the value proposition. How can we make that? How can we solve that issue?”

The operational team must engage in *reviewing digital micro-service concepts* with regard to implementing and using the solution once the technology team has given its approval. A key consideration is to involve multiple internal and external stakeholders in discussions and develop an iterative working relationship between team members from both sides to ensure that value calculation is appropriate. Thus, providing operational details on use requirements and the changes needed in internal processes while assessing the value of the concept is essential. As the manager for automation sales at Mineq recounted,

“In this phase, we start to do the work with the automation and machine guys to optimize the management of the fleet, and we involve the maintenance to look at what we can do with service contracts. During the whole process, we constantly had meetings with the production staff to discuss different solutions ... How would you like this or this? These are vital customer inputs that we get through constant back and forth.”

4.2.3. Phase 3: Micro-service development

The real development work starts in this phase as new functionalities are developed and tested through multiple iterations (i.e., scrums). While the overall focus is set, the steering group continues to play a major role in *prioritizing development resources* to weed out micro-service concepts or features that add limited value. Our informants remarked that the key issue to keep in mind throughout the project is how the micro-service will create true customer value. The logic is that dedicating scarce development resources and key digitalization competencies to the wrong issues may well lead to limited payoffs and vast opportunity costs because other higher impact digital services could have been developed instead. A technology development manager at Solutioncorp illustrated this idea:

“If the water guys want to have all households with pink houses in a separate color on the digital map, we need to ask why is that? If they say that it would look nice, then you can’t have it. Because there is no business case either for us or for them; it’s a fancy feature that doesn’t help create value ... We need to keep a check on this because we know that we have a limited amount of time that we can spend on this digitalization initiative, and we would rather invest those hours in some place where we find money and concrete benefits.”

For the technology team, this is the most intensive phase because it is responsible for *designing micro-service solutions* iteratively. A key challenge is that the requirements are likely to change quickly or are not completely known at the start of development. If needed, new requirements are added, and existing requirements may be modified, defined in more detail, or even deleted. Changes of service features, requirements, and processes are an integral part of the whole micro-service development cycle. Thus, requirements are not frozen early on. Instead the final set of requirements is developed iteratively with inputs from both provider and supplier members. Leveraging digitalization requires integration of digital systems and the cleaning and categorizing of data from different often highly unstructured sources. Accordingly, commitment from actors exercising key roles is crucial in getting this integration to function because a considerable amount of work could be needed in testing and improvement cycles (i.e., scrums) to ensure operational value. A technology development manager at Solutioncorp described the importance of these resource commitments:

“You need a customer who is willing to adapt and invest the time required to map out their data and the digital environment because it requires a large commitment from them.”

The operational team plays a key role in *assessing micro-service solutions* in this phase. For example, assessing the micro-service could relate to evaluating how the new solutions under development would affect work processes or to conducting operational implementation tests. A key account manager at Connectcorp described how the joint operational team was evaluating various applications of AI and automated solutions to focus on tasks that could add value to their work:

“As we work with solutions, we need to find new working methods for optimizing performance. We believe that analytics can help us by automating simpler tasks and freeing up time for more complex problems ... A typical problem is to know what incidents we should act on and which we should leave be.”

4.2.4. Phase 4: Implementing micro-services

During implementation, the steering group focuses on *governing micro-service implementation*. Informants emphasized that the key to success in micro-service implementation is ensuring appropriate planning and committing sufficient implementation resources from both organizations’ operations. A sales manager for automation at Mineq described how important it was to get the buy-in from the organization during implementation:

“It is one thing to buy a system, and it is one thing to actually really use it, and that takes true vision and commitment from top management. You need to set plans and commitment from the organization to work with digitalization continuously.”

For the technology team, this implementation phase focuses on *improving micro-service solutions*. Key activities are providing implementation support and refining the underlying technological systems for the micro-service. Implementation must be organically organized by encouraging daily face-to-face communication among team members and different disciplines as well as operational teams (i.e., end users) to gain the best possible understanding and ensure immediate feedback. Improvements can be identified by evaluating micro-service usage during implementation. Remote monitoring is often preferred but depending on the complexity and size of investments, active on-site involvement may be needed. A site management director at Constructcorp described this scenario as follows:

“With a large implementation, the costs can easily get out of hand, so we like to get involved in managing that implementation more intensely—maybe have a guy on-site who can interface with the customer when something gets off the track. Creating this service operations support is really important.”

For the operational team, this is an important phase for *developing operational capabilities*. Basic components of this activity would entail training on how to use digital systems and systematic approaches to refining work processes and routines. Activities encompass skills-based training, knowledge-based education, and operational experience for frontline staff to ensure that they effectively use the micro-service within their roles. For example, how to calibrate and monitor a weight loading solution over time. This insight can be further captured as formalized routines during implementation. For example, Solutioncorp developed a system for identifying the location of water leakages which required new routines for maintaining systems and ensuring their use by Energycorp’s water technicians. As a manager for automation sales at Mineq reported,

“The end-user operational team is very close to us throughout the implementation process, and in commissioning solutions, we work close together to teach them. We have very good e-learning and try to train them to be automation experts. We do e-learning, commissioning training, and then classroom training and in-situ training in our test mine.”

4.2.5. Phase 5: Evaluating micro-service benefits

The final phase of the agile co-creation process entails the evaluation of the benefits of digitalization and the achievement of goals. In this phase, the steering group focuses on realizing value by *monitoring micro-service performance*. This monitoring includes following up on the KPIs that were set at the start. These follow-ups are regular to ensure that value is created as per the joint goals and that benefits are captured by both sides. An important task is to assess the operational profitability based on implementation of the digital micro-service. A site management director at Constructcorp described the importance of constantly measuring performance from the perspectives of both parties:

“The customer is only going to pay every month if he gets value out of it ... Therefore, we need to monitor, and if the KPIs are not being met, we need to take action because, otherwise, the customer may cancel the contract. So, it should be in both parties’ interest to look after achieving those KPIs; it should be a common objective.”

The intention of the technology teams during this final phase is primarily to focus on *seeking value expansion opportunities*. Here, an important area is exploring ways to ensure not only learning from implementation of the solution but also identifying new opportunities for the next iteration of micro-service development (i.e., new issues to solve). Often, the developed micro-service becomes the norm, which places a huge demand on providers to regularly seek ways to create value through increasingly sophisticated micro-services. In addition, digital services require regular refinement, which can be seen as simple incremental development to generate additional value. Increased access to longitudinal operational data provides opportunities for further refinement through AI and machine learning. Close collaboration is still required. A key account director from Constructcorp described the importance of continuously working closely with the customer to improve performance:

“You need to have an extremely good relationship with these guys. I mean, you have to have frequent face-to-face meetings, ensuring you are close to the operators because you are working with [changing] behaviors.”

Besides the actual operation itself, there is the key role of reviewing solution performance to *capture operational learning*. These reviews usually require face-to-face monthly meetings to ensure that the solution works as expected and that early warning signs are responded to before they become problematic. Continuous delivery and use of the micro-service enables opportunities for learning and refining routines

for both sides. Regular meetings provide assurance to customers that the provider is committed to continuously adapting technological systems and work processes to ensure greater operational benefits. An automation manager at Mineq described how they would maintain operational engagement through regular follow-up meetings:

“We organize monthly and bimonthly operations meetings, where we are present ... We get good insights on how the system is working and what needs to improve ... We also get the opportunity to sell new functionalities ... Also, these meetings are very important for us to keep the customer engaged and working continuously with the system over time.”

5. An agile co-creation process for digital servitization: A micro-service innovation approach

This chapter brings together our findings to present a process model of agile co-creation for digital servitization (see Fig. 4). The model describes the foundation of a micro-service innovation approach for agile co-creation as a means of coping with the digitalization paradox. In essence, the empirical results reveal how providers can implement and use the agile co-creation process with customers (i.e., a rapid stepwise process of co-creation). This approach means that providers and customers focus their attention on progressively addressing one customer need at a time rather than developing complex full-scale digital service solutions. For example, instead of developing a complete site management solution (solving multiple needs), the parties would divide this solution into discrete needs and focus on progressively solving the most pressing needs by developing micro-services. The full site management solution would thus emerge over several cycles of micro-service development, each adding a distinct value proposition to the overall solution.

Three overarching principles underpin the micro-service innovation approach: *incremental micro-service investments*, *sprint-based micro-service development*, and *micro-service learning by doing*. According to our respondents, these principles truly reflect the flexibility, pace, and customer focus required in digital servitization. Below, the principles are described in further detail.

First, digitalization steering teams tend to cope with the uncertainty surrounding the creation of new digital offerings by making *incremental micro-service investments*. Indeed, our informants reported that digital services cannot and should not be planned as one large initiative; it is an iterative process in which providers and customers must agree on

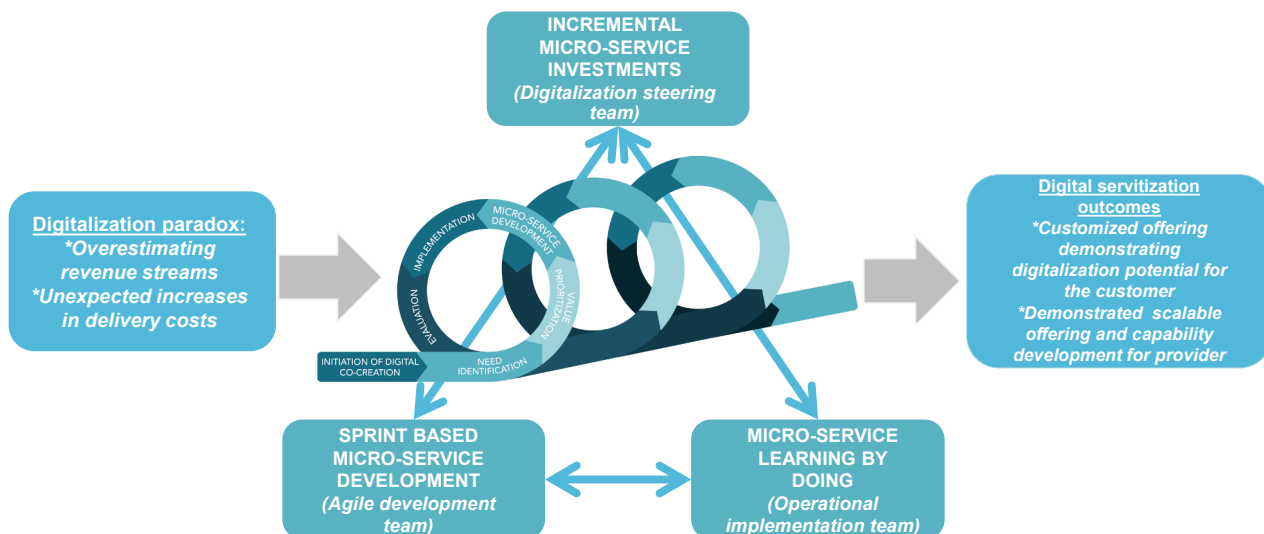


Fig. 4. An agile co-creation process for digital servitization: A micro-service innovation approach.

and prioritize initial opportunities to exploit digitalization together. This process involves making a series of small bets with the potential for large gains, employing a jointly negotiated investment strategy, and following recurring investment loops. By setting small, realizable goals and making small investments, providers can develop trust and commitment from customers and legitimate their innovation processes while reducing risk. After the first initial micro-service development cycle is completed, the process is repeated indefinitely to identify and prioritize new needs that should be targeted and met. There are several benefits to the micro-service approach. Modularity means that the overall systems are easier to understand, develop, test, and make resilient to changing conditions. In addition, scalability is increased. Because micro-services are developed and implemented independently of each other, they can be scaled independently, simplifying commercialization. A technology manager at Solutioncorp succinctly described how this approach of making quick iterations through micro-services is an optimal way of dealing with digitalization investment opportunities:

“With digital services, we need to eat the elephant in small bites.”

Second, the technology development team should employ a *sprint-based micro-service development* approach with clear and useable outputs at the end of each cycle (i.e., proof of concept). The focus is on quick, iterative development of discrete micro-services (e.g., a route optimization service). Each sprint follows an iterative process model of step-by-step development, implementation, and testing of improvements to advance quickly and then modify the details of the micro-service solution based on experience. The requirements and features of the micro-service are continuously evolving and being prioritized. The essence of this approach is the acceptance that customer problems cannot be understood in total or fully defined up front; instead, the focus must be on how to maximize the team’s ability to deliver micro-services quickly to allow for adaptation to changing customer requirements and instill flexibility in the innovation process. Indeed, quickly weeding out failing or low-value-adding micro-service concepts or features is important to avoid wasting resources. A key account manager from Constructcorp described the essence of this principle:

“You need really tight relationships with the customer to truly understand their dilemmas and not only think that you understand it. You need to have joint sprints to be able to deliver value in a very agile and quick manner from a business perspective and from a technology perspective.”

Finally, the agile co-creation process is firmly rooted in the operational implementation team’s role in continuously applying, testing, and refining solutions to enable *micro-service learning by doing* and stepwise capability development. As our respondents indicated, digital services become truly revolutionary only after a process of learning by doing and incremental improvement of the underlying routines of the operational staff of both providers and customers to enable capability development. Merely having a breakthrough digital service innovation is not enough. Micro-services must be tested in operational environments to allow companies not only to explore ways to refine routines for using the current micro-service but also to identify new opportunities for the next iteration of micro-service development. Operational capability development can involve experimentation through the search for productive service routines, testing and eliminating bad routines to discover good ones. The main elements of this approach include implementing solutions, reflecting on the outcomes, and learning from operational experience to progressively develop digital service delivery skills, user capabilities, and procedural knowledge. As a director of connected sites at Constructcorp remarked,

“It’s not only about the services we deliver. For me, it is more about the capabilities we build when implementing and refining these systems over time.”

The benefits of following the principles of the micro-service

innovation approach is the creation of customized, modular, and scalable offerings. By creating such offerings, the potential of digitalization is realized by customers as their needs are progressively met through the development of an increasingly comprehensive digital solution consisting of multiple micro-services that build on each other. Focusing on quickly implementing customized micro-services that target specific needs demonstrates the value of digitalization for customers and creates trust for further co-creation. For providers, the micro-service approach enables progressive development, testing, and commercialization of modular and scalable micro-service offerings for paying customers. Over time, a more comprehensive portfolio of micro-services is developed, enabling the provider to configure more complex solutions using micro-service modules. A final benefit is the ongoing focus on capability development as micro-services are quickly implemented and new routines for service delivery can evolve through learning by doing.

6. Discussion

This study investigated how firms can co-create digital service innovations with their customers to cope with the digitalization paradox and reap the benefits of digital servitization. The major implication is that to deal with the digitalization paradox, firms should adopt an agile co-creation process following a micro-service innovation approach.

6.1. Theoretical contributions

This study makes three theoretical contributions. First, we contribute by *constructing an empirically grounded agile co-creation process model* through which digital service innovation occurs in the context of digital servitization. Prior studies on servitization have presented several process models for the co-creation of services and service innovation (e.g., Aarikka-Stenroos & Jaakkola, 2012; Sjödin et al., 2016; Tuli et al., 2007). However, empirical results suggest that linear development processes are not sufficient in the fast-paced digital servitization environment (e.g., Cooper & Sommer, 2018; Paluch et al., 2019). Our model illustrates an alternative *micro-service innovation approach* built on quick, iterative development and adapted to changing innovation requirements that inject greater flexibility into the innovation process. Recent studies suggest that new agile development opportunities are increasingly emerging as firms pursue strategies that use digital technologies to innovate in their offerings (Ghezzi & Cavallo, 2018; Paluch et al., 2019; Parida et al., 2019). In line with this novel view, our study shows how firms can inject agility, speed, and effectiveness into the digital innovation process.

Despite emphasis on the collaborative nature of value creation (Grönroos, 2011; Parida et al., 2019; Sjödin et al., 2016; Vargo & Lusch, 2008), the literature provides scarce elaboration on the joint activities, principles, and phases of value co-creation for digital servitization. The proposed micro-service innovation approach is built on three principles: *incremental micro-service investments*, *sprint-based micro-service development*, and *micro-service learning by doing*. These principles are implemented in digital servitization through an iterative five-phase agile co-creation process. This process is repeated iteratively through incremental micro-service investments, which enable progressively higher value generation. In contrast to some earlier conceptualizations in the servitization literature (e.g., Sjödin et al., 2016; Tuli et al., 2007), our findings indicate that the co-creation process does not progress in a linear fashion. Instead, the activities are highly iterative and may occur in parallel or in a variable order. Key benefits of this approach include greater speed and risk minimization by focusing on short iterations of defined deliverables and co-created value propositions through direct co-creative engagements with customers in the development process (Ghezzi & Cavallo, 2018; Paluch et al., 2019). Thus, the value propositions made by the provider are interactively aligned with the needs and requirements of the customer to develop digital services, enabling value capture for both parties (Sjödin et al., 2020). In contrast, the value

co-creation literature commonly assumes that providers make a value proposition, and customers realize value by using what they are offered (Vargo & Lusch, 2008). Our data show that, in the context of digital servitization, customers may exert a considerable influence on the formulation of the value proposition by negotiating and contributing their own resources to the process of co-creation from an early stage.

Second, this study contributes by *identifying key roles and activities across multiple organizational levels of both providers and customers to co-create value in digital servitization*. Historically, research has focused on a more generalized and overarching level, whereas detailed explanations of such relational processes are less common (Aarikka-Stenroos & Jaakkola, 2012; Sjödin et al., 2016). We suggest that providers and customers may best facilitate the value co-creation process by organizing joint teams such as the digitalization steering team, the agile development team, and the operational implementation team. Each team has distinct roles and activities to perform in each phase of the process, and we provide a detailed analysis of their roles in facilitating progress from ideation, to development, and ultimately to implementation of digital micro-service innovations. These findings contribute to the literature by providing empirically grounded conceptualizations of value-creation roles, whereas previous discussion has largely been confined to the overall relational level (e.g., Grönroos, 2011; Sjödin et al., 2016; Vargo & Lusch, 2008).

Third, this study contributes by *advancing our understanding of the causes of the digitalization paradox*. Indeed, industry has dedicated considerable efforts to offering digital services, but many companies still fail to create real customer value. This situation reflects a failure on the part of both providers and customers to achieve a financial return on investment in fast-changing digital developments (Gebauer et al., 2005). Thus, the increasing revenues from digital services fail to deliver higher profits because of the associated costs. This situation is referred to in this study as the digitalization paradox. In studying the causes of the digitalization paradox, our results point to the sources of failure such as overestimating revenue streams and increased delivery costs that can potentially lead to value co-destruction and lower profits (Echeverri & Skålen, 2011).

6.2. Managerial implications

The study has some important implications for managers engaged in digital servitization and co-creative digital service innovation processes. The first is to *eat the elephant in small bites following a micro-service innovation approach*. In the era of rapid digital innovation, agility is a central issue when organizing co-creation. To succeed in digital servitization, it is important to avoid internal bureaucracy in innovation (e.g., traditional stage-gate), which traps providers in rigid, slow development processes that are unable to keep pace with technological changes and new customer requirements. This situation leads to the risk of making offerings obsolete even before formal commercialization. The key to successful digital servitization is to engage in multiple short and agile planning and execution cycles governed by customer inputs to develop simple data-driven digital micro-service solutions. This way of working creates a continuous agile development process comprising micro-service innovations that are tailored to paying customers. This approach offers an effective alternative to committing everything to investing in a large complex digital service system that can become outdated or overpriced before it is fully developed. The study highlights the critical role of micro-services as part of the agile innovation process. This concept of micro-services reflects the agile incrementalism of *fail fast and learn quickly*.

The second managerial implication is to *increase multirole participation in digital servitization*. It is important to view co-creative innovation processes as participative processes that engage cross-

functional competencies from the strategic, technological, and operational levels to contribute to co-creation. Personnel from top management, sales, marketing, production, and logistics can bring fresh perspectives to digital innovation. There are several examples of partnerships where, on a strategic and technical level, collaboration is strong and deployment of key competencies is good but where solutions have failed because of deficiencies in implementation (i.e., lack of involving operational staff) and in understanding the different roles in the value-creation process.

The third managerial implication is to *develop digital servitization capabilities progressively*. Digitalization creates massive opportunities. At the same time, however, frustration can arise with the number of choices and high complexity in a difficult-to-grasp and prolonged process of change. Our research shows that companies can reduce this complexity by breaking down the digital servitization process into steps to gradually foster new skills over time by making incremental micro-service investments and focusing on learning by doing. Each co-creation cycle contributes to increased value creation and moves toward the development of new capabilities. Over several cycles, this approach leads to a larger portfolio of tried-and-tested digital service innovations and a stronger capability base for the provider, which in turn reduces the likelihood that the digitalization paradox emerges.

6.3. Future research

Digital servitization and knowledge-intensive digital services (Holmström & Partanen, 2014; Porter & Heppelmann, 2014) are prime examples of complex, customized digital offerings that may present special challenges in terms of value co-creation. We urge researchers to invest greater efforts in studying such exchanges for the most advanced level of digital servitization (Kamalaldin, Linde, Sjödin, & Parida, 2020).

This study highlights the notion that managing the digitalization paradox is critical because different perceptions of value and unclear value-capture approaches are likely to lead to failure. For example, issues such as how firms align value-creation and value-capture approaches in digital value co-creation are highly relevant in this context (Sjödin et al., 2020). Moreover, many roles identified in this research merit further examination (e.g., how joint digitalization steering teams govern digital service partnerships over time). Finally, in the era of digitalization, value co-creation is not simply dyadic; instead, broader sets of ecosystem actors shape value creation (Parida et al., 2019; Sklyar et al., 2019). Thus, exploring the alignment of actors to realize distinct value propositions and investigating in the orchestration strategies needed to direct ecosystem actors could provide interesting multi-actor perspectives in future research. It would also be of interest to consider how parties' roles vary from equal partners to dominators and followers in different ecosystem contexts.

References

- Aarikka-Stenroos, L., & Jaakkola, E. (2012). Value co-creation in knowledge intensive business services: A dyadic perspective on the joint problem solving process. *Industrial Marketing Management*, 41(1), 15–26.
- Adrodegari, F., & Saccani, N. (2017). Business models for the service transformation of industrial firms. *The Service Industries Journal*, 37(1), 57–83.
- Ardolino, M., Rapaccini, M., Saccani, N., Gaiardelli, P., Crespi, G., & Ruggeri, C. (2018). The role of digital technologies for the service transformation of industrial companies. *International Journal of Production Research*, 56(6), 2116–2132.
- Barrett, M., Davidson, E., Prabhu, J., & Vargo, S. L. (2015). Service innovation in the digital age: Key contributions and future directions. *MIS Quarterly*, 39(1), 135–154.
- Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., . . . & Kern, J. (2001). The agile manifesto. <https://agilemanifesto.org/>.
- Bianchi, M., Marzi, G., & Guerini, M. (2018). Agile, Stage-Gate and their combination: Exploring how they relate to performance in software development. *Journal of Business Research*. <https://doi.org/10.1016/j.jbusres.2018.05.003> Available online

- 10 May 2018.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Campanelli, A. S., & Parreiras, F. S. (2015). Agile methods tailoring—A systematic literature review. *Journal of Systems and Software*, 110, 85–100.
- Cram, W. A., & Newell, S. (2016). Mindful revolution or mindless trend? Examining agile development as a management fashion. *European Journal of Information Systems*, 25(2), 154–169.
- Cenamor, J., Sjödin, D., & Parida, V. (2017). Adopting a platform approach in servitization: Leveraging the value of digitalization. *International Journal of Production Economics*, 192, 54–65.
- Clark, S. M., Gioia, D. A., Ketchen, D. J., Jr., & Thomas, J. B. (2010). Transitional identity as a facilitator of organizational identity change during a merger. *Administrative Science Quarterly*, 55(3), 397–438.
- Cooper, R. G., & Sommer, A. F. (2018). Agile–Stage-Gate for Manufacturers: Changing the Way New Products Are Developed Integrating Agile project management methods into a Stage-Gate system offers both opportunities and challenges. *Research-Technology Management*, 61(2), 17–26.
- Coreynen, W., Matthyssens, P., & Van Bockhaven, W. (2017). Boosting servitization through digitization: Pathways and dynamic resource configurations for manufacturers. *Industrial Marketing Management*, 60, 42–53.
- Echeverri, P., & Skalen, P. (2011). Co-creation and co-destruction: A practice-theory based study of interactive value formation. *Marketing Theory*, 11(3), 351–373. <https://doi.org/10.1177/1470593111408181>.
- Edmondson, A. C., & McManus, S. E. (2007). Methodological fit in management field research. *Academy of Management Review*, 32(4), 1246–1264.
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532–550.
- Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *The Academy of Management Journal*, 50(1), 25–32.
- Gebauer, H., Fleisch, E., & Friedli, T. (2005). Overcoming the service paradox in manufacturing companies. *European Management Journal*, 23(1), 14–26.
- Ghezzi, A., & Cavallo, A. (2018). Agile Business Model Innovation in Digital Entrepreneurship: Lean Startup Approaches. *Journal of Business Research*. <https://doi.org/10.1016/j.jbusres.2018.06.013>.
- Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods*, 16(1), 15–31.
- Glaser, B., & Strauss, A. (1967). The discovery of grounded theory. *London: Weidenfeld and Nicholson*, 24(25), 288–304.
- Grönroos, C. (2011). Value co-creation in service logic: A critical analysis. *Marketing Theory*, 11(3), 279–301. <https://doi.org/10.1177/1470593111408177>.
- Grönroos, C., & Voima, P. (2013). Critical service logic: Making sense of value creation and co-creation. *Journal of the Academy of Marketing Science*, 41(2), 133–150.
- Hasselblatt, M., Huikkola, T., Kohtamäki, M., & Nickell, D. (2018). Modeling manufacturer's capabilities for the Internet of Things. *Journal of Business & Industrial Marketing*, 33(6), 822–836.
- Holmström, J., & Partanen, J. (2014). Digital manufacturing-driven transformations of service supply chains for complex products. *Supply Chain Management: An International Journal*, 19(4), 421–430.
- Iansiti, M., & Lakhani, K. R. (2014). Digital ubiquity: How connections, sensors, and data are revolutionizing business. *Harvard Business Review*, 92(11), 90–99.
- Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly*, 24(4), 602–611.
- Kastalli, I. V., & Van Looy, B. (2013). Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance. *Journal of Operations Management*, 31(4), 169–180.
- Kock, A., & Gemünden, H. G. (2016). Antecedents to decision-making quality and agility in innovation portfolio management. *Journal of Product Innovation Management*, 33(6), 670–686.
- Jovanovic, Marin, Raja, Jawwad Z., Visnjic, Ivanka, & Wiengarten, Frank (2019). Paths to service capability development for servitization: Examining an internal service ecosystem. *Journal of Business Research*, 104, 472–485. <https://doi.org/10.1016/j.jbusres.2019.05.015>.
- Kamalaldin, A., Linde, L., Sjödin, D., & Parida, V. (2020). Transforming provider-customer relationships in digital servitization: A relational view on digitalization. *Industrial Marketing Management* 0019-8501 <https://doi.org/10.1016/j.indmarman.2020.02.004>.
- Kohtamäki, M., Parida, V., Oghazi, P., Gebauer, H., & Baines, T. S. (2019). Digital servitization business models in ecosystems: A theory of the firm. *Journal of Business Research*, 104, 380–392.
- Kohtamäki, M., & Rajala, R. (2016). Theory and practice of value co-creation in B2B systems. *Industrial Marketing Management*, 56(7), 4–13.
- Kumar, N., Stern, L. W., & Anderson, J. C. (1993). Conducting interorganizational research using key informants. *Academy of Management Journal*, 36(6), 1633–1651.
- Lenka, S., Parida, V., & Wincnet, J. (2017). Digitalization capabilities as enablers of value co-creation in servitizing firms. *Psychology & Marketing*, 34(1), 92–100.
- Lenka, S., Parida, V., Sjödin, D. R., & Wincnet, J. (2018). Exploring the micro foundations of servitization: How individual actions overcome organizational resistance. *Journal of Business Research*, 88, 328–336.
- Martin-Peña, M. L., Díaz-Garrido, E., & Sánchez-López, J. M. (2018). The digitalization and servitization of manufacturing: A review on digital business models. *Strategic Change*, 27(2), 91–99.
- Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital innovation management: Reinventing innovation management research in a digital world. *MIS Quarterly*, 41(1), 223–238.
- Opresnik, D., & Taisch, M. (2015). The value of big data in servitization. *International Journal of Production Economics*, 165, 174–184.
- Paluch, Stefanie, Antons, David, Brettel, Malte, Hopp, Christian, Salge, Torsten-Oliver, Piller, Frank, & Wentzel, Daniel (2019). Stage-gate and agile development in the digital age: Promises, perils, and boundary conditions. *Journal of Business Research*. <https://doi.org/10.1016/j.jbusres.2019.01.063>.
- Payne, A. F., Storbacka, K., & Frow, P. (2008). Managing the co-creation of value. *Journal of the Academy of Marketing Science*, 36(1), 83–96.
- Parida, V., Rönningberg Sjödin, D., Lenka, S., & Wincnet, J. (2015). Developing Global Service Innovation Capabilities: How Global Manufacturers Address the Challenges of Market Heterogeneity. *Research-Technology Management*, 58(5), 35–44.
- Parida, V., Sjödin, D., & Reim, W. (2019). Leveraging digitalization for advanced service business models: Reflections from a systematic literature review and special issue contributions. *Sustainability*, 11, 391. <https://doi.org/10.3390/su11020391>.
- Porter, M. E., & Heppelmann, J. E. (2014). How smart connected products are transforming competition. *Harvard Business Review*, November, 65–88.
- Qumer, M. E., & Henderson-Sellers, B. (2006, December). *Crystallization of agility: back to basics*. Data Technologies, Proceedings.
- Raddats, Chris, Kowalkowski, Christian, Benedettini, Ornella, Burton, Jamie, & Gebauer, Heiko (2019). Servitization: a contemporary thematic review of four major research streams. *Industrial Marketing Management*, 83.
- Reim, W., Sjödin, D., & Parida, V. (2018). Mitigating adverse customer behaviour for product-service system provision: An agency theory perspective. *Industrial Marketing Management*, 74, 150–161.
- Rindfleisch, A., O'Hern, M., & Sachdev, V. (2017). The digital revolution, 3D printing, and innovation as data. *Journal of Product Innovation Management*, 34(5), 681–690.
- Schroeder, A., Ziaee Bigdeli, A., Galera Zarcos, C., & Baines, T. (2019). Capturing the benefits of industry 4.0: A business network perspective. *Production Planning & Control*, 1–17.
- Sjödin, D. (2019). Knowledge processing and ecosystem co-creation for process innovation: Managing joint knowledge processing in process innovation projects. *International Entrepreneurship and Management Journal*, 15(1), 135–162.
- Sjödin, D., Frishammar, J., & Thorgren, S. (2019). How Individuals Engage in the Absorption of New External Knowledge: A Process Model of Absorptive Capacity. *Journal of Product Innovation Management*, 36(3), 356–380. <https://doi.org/10.1111/jpim.12482>.
- Sjödin, D., Parida, V., & Kohtamäki, M. (2019). Relational governance strategies for advanced service provision: Multiple paths to superior financial performance in servitization. *Journal of Business Research*, 101, 906–915.
- Sjödin, D. R., Parida, V., Leksell, M., & Petrovic, A. (2018). Smart Factory Implementation and Process Innovation: A Preliminary Maturity Model for Leveraging Digitalization in Manufacturing. *Research-Technology Management*, 61(5), 22–31.
- Sjödin, D., Parida, V., & Lindström, J. (2017). Barriers and conditions of open operation: A customer perspective on value co-creation for integrated product-service solutions. *International Journal of Technology Marketing*, 12(1), 90–111.
- Sjödin, D., Parida, V., & Wincnet, J. (2016). Value co-creation process of integrated product-services: Effect of role ambiguities and relational coping strategies. *Industrial Marketing Management*, 56, 108–119.
- Sjödin, D., Parida, V., Jovanovic, M., & Visnjic, I. (2020). Value creation and value capture alignment in business model innovation: A process view on outcome-based business models. *Forthcoming in Journal of Product Innovation Management*. <https://doi.org/10.1111/jpim.12516>.
- Sklyar, A., Kowalkowski, C., Tronvoll, B., & Sörhammar, D. (2019). Organizing for digital servitization: A service ecosystem perspective. *Journal of Business Research*, 104, 450–460.
- Story, V. M., Raddats, C., Burton, J., Zolkiewski, J., & Baines, T. (2017). Capabilities for advanced services: A multi-actor perspective. *Industrial Marketing Management*, 60, 54–68.
- Suarez, F. F., Cusumano, M. A., & Kahl, S. J. (2013). Services and the business models of product firms: An empirical analysis of the software industry. *Management Science*, 59(2), 420–435.
- Suddaby, R. (2006). What grounded theory is not. *Academy of Management Journal*, 49, 633–642.
- Tuli, K. R., Kohli, A. K., & Bharadwaj, S. G. (2007). Rethinking customer solutions: From product bundles to relational processes. *Journal of Marketing*, 71(3), 1–17.
- Van Maanen, J. (1979). Reclaiming qualitative methods for organizational research: A preface. *Administrative Science Quarterly*, 24(4), 520–526.
- Vargo, S. L., & Lusch, R. F. (2008). From goods to service(s): Divergences and convergences of logics. *Industrial Marketing Management*, 37(3), 254–259. <https://doi.org/10.1016/j.indmarman.2007.07.004>.
- Vendrell-Herrero, F., Bustinza, O. F., Parry, G., & Georgantzis, N. (2017). Servitization, digitization and supply chain interdependency. *Industrial Marketing Management*, 60, 69–81.
- Yin, R. K. (2009). *Case study research: Design and methods*. Sage.

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