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From products to smart solutions: A value-creation approach

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Abstract

Smart solutions comprise a synergy of products, services, software, connectivity, data, and intelligence. This study examines the evolution of a manufacturer into a smart solution provider, highlighting the role of value-creation capabilities, activities, and practices. Through a longitudinal, in-depth single-case study of a leading technology provider, we scrutinize the value-creation capabilities, activities, and practices that enable a manufacturer to convert its product-focused capabilities and activities into those of a smart solution provider. Particularly, we uncovered three key value-creation-related capabilities that are crucial for the successful transition, namely: 1) visualization capability, 2) integration capability, and 3) scaling capability to revamp the business model for the adoption of smart solutions logic. The findings highlight the role of sensing, seizing, and transforming in a product manufacturer's transition. For managers, our study provides a framework that helps identify, manage, and alter a firm's capabilities and activities when steering the firm toward smart solutions.

KEYWORDS

activity system, business model innovation, digital servitization, dynamic capabilities, smart solutions

INTRODUCTION

The literature on product-service systems and servitization has recorded a transition of manufacturers from developing and selling standard products and add-on services to the development of smart solutions, including advanced services (Baines et al., 2020; Cusumano, Kahl, & Suarez, 2015; Rabetino, Kohtamäki, Kowalkowski, et al., 2021). This transition from product logic to service logic has been coined as servitization (Vandermerwe & Erixon, 2023). Digital servitization, considered a substream of servitization research, emphasizes how incumbent manufacturers utilize smart technologies such as Artificial Intelligence (AI), Cloud computing, Internet of Things (IoT), and smart connectivity to develop novel business opportunities to create, deliver, and capture value from the integrated provision of goods, services, and software (Kowalkowski, Bigdeli, & Baines, 2022; Naeem, Kohtamäki, & Parida, 2024). In the literature, digital servitization has been defined as "the transition toward smart product-service-software systems that enable value creation and capture through monitoring, control, optimization, and autonomous function" (Kohtamäki et al., 2019, p. 383). Smart solutions comprise a synergy of products, services, software, connectivity, data, and intelligence. In short, smart solutions result from successfully integrating advanced digital tools and technology. This transition inherently embeds a shift in value logic, requiring manufacturers to rethink how value is identified, shared, and appropriated when moving up in the service ladders. Furthermore, this transition requires a shift from traditional product-service activities, processes, and capabilities to smart-solution activities, processes, and dynamic capabilities that support robust product-service and software development (Coreynen, Matthyssens, & Van Bockhaven, 2017; Leemann & Kanbach, 2021; Schiavone et al., 2022). Moreover, it inherently embeds a significant shift in business logic from a product-service logic focused on tangible goods and add-on services to a value logic focused on customer value in integrated, technology-driven solutions.

Extant studies (Rabetino, Kohtamäki, Brax, & Sihvonen, 2021; Raddats et al., 2019) have discussed the challenges of digitalization and software development for industrial product manufacturers. Industrial firms are traditionally associated with manufacturing cultures with some hardware and service engineering capabilities. However, they fall short regarding customer engagement, rapid software development, agile development models, and hackathons (Kowalkowski & Ulaga, 2017). This transition calls for capabilities to adopt agile software development and data-driven practices and innovation approaches that are reminiscent of pure software and service firms rather than proprietary companies (Huikkola et al., 2022). Scholars acknowledge that the shift in smart solution business model requires fundamental changes not only in firms' business models (Kohtamäki et al., 2019; Sjödin, Parida, Kohtamäki, & Wincent, 2020) but also in their organizational capabilities (Coreynen et al., 2020; Ulaga & Reinartz, 2011) and mindsets/cultures (Töytäri, 2018). Transformation towards smart solutions requires the development of new capabilities, which are associated with high software development costs and perceived risks. This leads manufacturing firms to operate in a hybrid form, offering traditional product services and smart solutions. This multi-business model approach creates organizational tensions and structural rigidities (Visnjic, Jovanovic, & Raisch, 2022). Even though service-based business models have been complex to adopt (Ulaga & Reinartz, 2011), some product manufacturers, such as KONE and Rolls-Royce, have been able to reap the financial and strategic benefits from selling (smart) services as they have developed capabilities to create, deliver, and capture from software and services (Linde, Frishammar, & Parida, 2022; Raddats, Naik, & Ziaee Bigdeli, 2022; Struwe & Slepniov, 2023). Therefore, firms can address these challenges through different mechanisms, such as coping strategies, renewing organizational structures, developing data-driven decision-making (Friedl, Matthyssens, & Van Bockhaven, 2025), and processes that facilitate organizational agility.

Within the domain of serviced manufacturing, integrating digital technologies reshapes strategic decisions, transforms managerial decision-making processes, and cultivates intricate partnerships with business counterparts to facilitate value creation (Franzè, Paolucci, & Pessot, 2024; Porter & Heppelmann, 2015; Sklyar et al., 2019). Simultaneously, it fosters the creation of personalized, customer-centric solutions and encourages value co-creation through customer integration (Burström et al., 2021; Kiel, Arnold, & Voigt, 2017; Kohtamäki & Partanen, 2016). From a conceptual perspective, Frank et al. (2019) suggest that smart solutions are rooted in the value creation paradigm and emerge as a response to evolving mechanisms for generating and delivering value. Tóth et al. (2022) argue that smart solutions are one of the most disruptive changes in today's manufacturing landscape, profoundly reshaping organizations' operations and value-creation processes. Moreover (Martin, Schroeder, & Ziaee Bigdeli, 2019), conceptualize value creation as a complex process driven by continuous and interdependent interactions between manufacturers and their stakeholders. Despite growing interest in smart solutions, the core activities, practices, and capabilities that underpin value creation remain underexplored, limiting the theoretical development.

Literature often treats business model innovation and capability development in parallel rather than in an integrated manner. The servitization literature emphasizes dynamic capabilities, i.e., a firm's ability to sense, seize, and transform (Teece, 2007), to study the transition of business models (Leoni & Chirumalla, 2021; Rodríguez, Lepratte, & Rabetino, 2021; Sjödin, Parida, & Kohtamäki, 2023). Therefore, using the dynamic capability framework, this study focuses on how firms develop and enhance value creation-related capabilities while transitioning from manufacturing business models to smart solutions. To provide a more nuanced understanding, we further divide this main question into two subquestions: 1) How do manufacturers transform their business models in the shift from product manufacturing to smart solutions? and 2) What value creation-related capabilities do manufacturers require to develop for the smart solution transition? To study these issues, we used the value creation approach and identified its capabilities, activities, and practices that enable the business model transition. Furthermore, to answer the question, we conducted a longitudinal single-case study of a leading, globally operating technology provider. The present study contributes to the existing literature on the nexus of digital servitization and dynamic capabilities by identifying the three value-creation capabilities required for business model transformation. The capabilities are 1) visualization, 2) integration, and 3) scaling. The study extends the discussion about developing dynamic capabilities in digital servitization. For managers, our study provides a framework that helps identify, manage, and alter a firm's capabilities and activities when steering a firm toward smart solutions.

THEORETICAL BACKGROUND

Digital servitization and business model innovation

Digital servitization is a strategic transition that emphasizes the role of digital tools in transforming a firm's product-oriented business model and logic to a service-focused one (Paschou et al., 2020). Visnjic et al. (2022) demonstrated that this type of strategic change creates tensions for firms due to its dualistic nature. To manage the servitization process successfully and cope with almost inevitable paradoxical tensions (Kohtamäki et al., 2020) stemming from conflicting business logic

between products and services, previous literature has highlighted the required changes in business model components (Adrodegari & Saccani, 2017; Frank et al., 2019), cognitions and mindset (Töytäri et al., 2018), management practices (Kohtamäki et al., 2020), decision-making structures (Li et al., 2025), behavioral routines (Huikkola et al., 2022), and capabilities (Jia et al., 2024; Khan et al., 2022).

Service-based business models differ significantly from product-oriented revenue models. As the product-focused business model emphasizes a value-in-exchange transactional approach, the service-based business model stresses a value-in-use relational approach to value creation (Töytäri et al., 2018). While product-based business models have been proven effective, they have led to severe problems, including increased commoditization and price erosion (Reinartz & Ulaga, 2008), a lack of differentiation (Ulaga & Reinartz, 2011), and shallow customer engagement.

Reflecting on the digital servitization definition, it encapsulates two key ideas: first, digital servitization is a process of transition or transformation enabled by digitalization, and second, it may alter the whole business model, reshaping the business model components (Teece, 2010). While transforming the business model, manufacturers seek a competitive advantage (Baines et al., 2017), optimize profitability (Gebauer & Fleisch, 2007), seek higher revenue growth (Gebauer, Gustafsson, & Witell, 2011), and enhance operational performance (Vendrell-Herrero et al., 2017).

Smart solutions

Embedding software into solutions has been acknowledged in the seminal servitization literature (Vandermerwe & Rada, 1988). The proliferation of digital technologies, including artificial intelligence, cloud computing, and the Internet of Things (IoT) (Boehmer et al., 2020; Favoretto et al., 2022; Naeem et al., 2024), has been emphasized to provide abundant value-creation opportunities. Thus, smart solutions are robust and resilient integrated products, services, and software enabled by advancements in cyber-physical systems and IoT technologies, ensuring seamless connectivity across client systems (Jovanovic et al., 2022) and automation. They connect (both horizontally and vertically) machines, systems, products, and services, merging the physical and digital worlds within a company and across an ecosystem (Porter & Heppelmann, 2015). Furthermore, smart solutions tend to foster a trustworthy and collaborative environment that supports innovation and data sharing at various levels (Franzè, Paolucci, & Pessot, 2024). The smartness feature of solutions refers to intelligence (Porter & Heppelmann, 2015) and enables firms to utilize digital resources and capabilities effectively in collaboration with stakeholders, thereby creating new value for customers. The adoption of digital tools and technology shifts the mechanism of value creation from closed to open systems (Chen et al., 2021; Nambisan, Wright, & Feldman, 2019; Saadatmand, Lindgren, & Schultze, 2019), affecting both intra-firm and inter-firm levels (Cenamor, Sjödin, & Parida, 2017; Rabetino, Kohtamäki, & Gebauer, 2017). At the intra-firm level, it enables centralized decision-making, optimization of product, service, and software processes, as well as front-end and back-end integration and coordination. At the inter-firm level, smart solutions enable resilience, coordination, integration, and flexibility (Choi, Wallace, & Wang, 2018; Rai et al., 2006; Srinivasan & Swink, 2018; Venkateswaran, 2020), which in turn expand to the entire ecosystem (Sklyar et al., 2019). They also facilitate the development of personalized, customer-centric solutions and promote value co-creation through customer integration and engagement (Burström et al., 2021; Kohtamäki & Partanen, 2016).

Incorporating intelligence, connectivity, and data features distinguishes smart solution business models from traditional product manufacturing. The manufacturer embarks on a journey to opt for smart solutions to address the paradoxical tensions between product, service, and software innovations (Kohtamäki et al., 2020). However, the digital aspect of smart solutions alone may not directly generate business benefits; manufacturers can achieve financial and strategic advantages by developing innovative and distinctive solutions that enhance customer value (Töytäri et al., 2018) or reduce customer operational expenses (Ulaga & Reinartz, 2011). Also, the culture at manufacturing firms is often too cautious and avoids taking risks (Brekke et al., 2024). Therefore, the transition from product manufacturer to smart solution provider calls for a shift in logic and mindset (Åkesson & Löfberg, 2021; Raddats et al., 2019). The literature describes this shift in logic and mindset as a transition from goods-dominant to service-dominant logic, from a product-centric to a customer- and service-centric approach, and from a cost-based to a value-based perspective (Kowalkowski, 2010; Lindhult et al., 2018; Vargo, Maglio, & Akaka, 2008).

In the management literature, the shift in mindset can be driven by either a top-down approach, where top management develops a new value logic and updates capabilities, or a bottom-up approach, where capability development occurs first, followed by the development of new logic (Töytäri et al., 2018). These two approaches for changing an organization's mindset pose a challenge for managers, much like the classic chicken-and-egg dilemma. To address this dilemma, firms either initiate new solution development, which leads to the development of capabilities, or change and enhance their capabilities and activities, thereby initiating new solution development. In short, developing new capabilities and enhancing existing ones are central to manufacturers' value logic and mindset change, whether approached

through new solutions or by first realigning existing capabilities. Thus, in transitioning from the product-manufacturing business model to the smart solution business model, understanding and developing the necessary value-creation capabilities, activities, and practices are key to enabling and sustaining this shift.

Advancing value-creation capabilities to facilitate manufacturer's strategic renewal

Value creation is a key motivating factor driving manufacturers' transformation toward smart solutions. Together, digitalization and servitization have a significant impact on firms' operations and value-creation processes in the manufacturing sector (Tóth et al., 2022). Therefore, one of the most enduring and significant outcomes of digital servitization is the enhancement of value co-creation between firms and their customers (Annarelli et al., 2021; Lenka, Parida, & Wincent, 2017; Sjödin, Parida, Jovanovic, & Visnjic, 2020; Struwe & Slepniov, 2023). In this process, firms engage in complex and dynamic interactions to maximize value-creation opportunities. Resource integration, particularly the integration of data, plays a fundamental role in supporting value creation and enabling a successful transformation toward smart solutions.

The concept of value is understood as experiential (Vargo, Maglio, & Akaka, 2008), suggesting that firms cannot create value solely through the exchange of products or services. Instead, the beneficiary determines the value by utilizing the product, service, or solution. This perspective positions smart solution providers as facilitators or enablers of value creation rather than sole creators (Vargo & Lusch, 2016). Smart solution is an integrated business model; it not only requires the integration of resources and processes but also necessitates deeper customer business understanding, comprehensive market understanding (Bustinza et al., 2019; Kowalkowski & Ulaga, 2017), strategic alliances (Rapaccini et al., 2023), and close collaboration with stakeholders and partners to visualize value-creation opportunities. As in smart solutions, multiple actors are involved in the value-creation process, which could lead to challenges related to ambiguous roles (Sjödin, Parida, & Wincent, 2016), resource misintegrations (Echeverri & Skålén, 2011; Laud et al., 2019; Mustak & Plé, 2020), or decentralized development structures (Kindström & Kowalkowski, 2009). In other words, the shift to smart solutions highlights the complex challenges manufacturers face in understanding how value is created. These challenges also depict value creation as a complex, dynamic, and evolving process, highlighting the crucial role of appropriate value creation-related capabilities, processes, and activities. To the best of the authors' knowledge, no study has yet explored how manufacturers seek value creation while transitioning to smart solutions.

In the literature on manufacturers' transition to new business models, particularly service or solution-based models, researchers have examined this shift through either a strategic capabilities or dynamic capabilities perspective (Leoni & Chirumalla, 2021; Rodríguez, Lepratte, & Rabetino, 2021; Sjödin, Parida, & Kohtamäki, 2023). These perspectives explain the distinctive ways in which firms develop and deploy resources differently while sustaining competitive advantage. Strategic capabilities refer to a firm's unique resources (Long & Vickers-Koch, 1995) and their effective utilization to create value (Ulaga & Reinartz, 2011) through strategic processes (organizational structure, processes, and routines) (Day, 1994). The dynamic capability view emphasizes the evolution of capabilities as a central element in sustaining the firm's competitive advantage (Teece, Pisano, & Shuen, 1997). Dynamic capabilities refer to a firm's ability to transform its resources in response to changes in its external environment.

Previous studies illustrate that manufacturers strengthen their sales capabilities by shifting the focus from product-based to value-based selling (Boehmer et al., 2020; Reim, Sjödin, & Parida, 2019; Töytäri & Rajala, 2015). They form partnerships with knowledge-intensive firms to manage risks and gain new insights (Bustinza, Opazo-Basaez, & Tarba, 2022), enhance relational and networking capabilities to learn from customers (Hafeez, Shahzad, & De Silva, 2025; Kamp, Ochoa, & Diaz, 2017; Pagoropoulos, Maier, & McAloone, 2017; Tronvoll et al., 2020) renew innovation-related processes, routines, and capabilities to integrate a service perspective from the design phase (Gustafsson et al., 2020; Ulaga & Reinartz, 2011), and develop data capabilities with supporting processes for data warehousing, optimization, and monetization (Frank et al., 2019; Jia et al., 2024; Ritala et al., 2024). Overall, the change in strategic capabilities necessitates a corresponding adjustment in business processes, including organizational structures, processes, and routines. This change in business process necessitates the development of dynamic capabilities and related activities, enabling firms to sense, seize, and transform capabilities.

The dynamic and evolving interactions in the smart solution business model reflect the relevance of dynamic capability (Teece, 2007, 2018), which is a firm's ability to sense, seize, and transform tangible and intangible assets to maintain a competitive edge. Sensing is a cognitive capability that stresses scanning the market dynamics and identifying unaddressed needs and emerging business opportunities (Teece, 2018). Seizing is a decision-making capability that focuses on deploying organizational resources to capture emerging opportunities and shape the business case (Ott & Eisenhardt, 2020; Teece, 2018). Transformation is a capability that emphasizes modifying existing capabilities and developing new ones to stay competitive in rapidly changing environments (Teece, 2018). Management literature has acknowledged that

developing dynamic capabilities can lead to a sustainable competitive advantage (Fainshmidt et al., 2019) if managers can align capabilities to sense and seize new business opportunities and modify resources to match those emerging opportunities (Danneels, 2011). According to Zahra, Sapienza, & Davidsson (2006), dynamic capabilities serve as a pathway to a cohesive set of knowledge and skills crucial for navigating emerging opportunities, allowing firms to sense and seize them ahead of others in the market. However, the limited literature provides insights into changes in value-creation capabilities and related activities and practices as manufacturers transition to a smart solution business model. Therefore, this study focuses on studying how firms transition from manufacturing business models to smart solutions using the value creation approach.

METHODOLOGY

Research design and case selection

Smart solution business model transformation represents a complex and longitudinal process for a manufacturer. For this reason, we employed a longitudinal, in-depth, qualitative single-case study method to identify the underlying dynamic capabilities and activity changes that facilitate the transformation into a smart solution provider. A qualitative research strategy is particularly useful when making sense of complex and novel phenomena (Piekkari, Plakoyiannaki, & Welch, 2010), such as a manufacturer's business renewal. A single-case study approach was chosen to capture the in-depth and detailed processes involved in modifying the capabilities required in smart solutions (Eisenhardt, 2021). This method permits the qualitative analysis of the evolution of the smart solution business model over an extended time horizon (Weigel & Hadwich, 2018). Furthermore, it is particularly suitable for developing inductive theories and making sense of intrinsic and novel phenomena (Edmondson & Mcmanus, 2007; Piekkari, Plakoyiannaki, & Welch, 2010). For instance, it can shed light on how a manufacturer develops both inter- and intra-firm capabilities and activities to transition to a smart solution business model. To accomplish this, we chose to study the transition of an advanced product manufacturer to a smart solution business model because (a) the firm is at the forefront of its industry, offering a wide range of smart solutions, from engine-as-a-service solutions to hybrid and automated operations and maintenance solutions (the firm has taken the initiative to provide more advanced services to its clients), (b) the firm has been a pioneer in adopting the servitization business model and has recently transformed itself into a solution provider, aiming to gain sustainable competitive advantage by enhancing value creation, delivery, and capture (services account for more than 50% of the firm's revenues), and (c) we have established consistent and continuous research collaborations with the firm, granting us access to research data spanning several years, enabling us to acquire an in-depth understanding of the case. The selected case company defines itself as a world leader in smart technologies, lifecycle solutions, and decarbonization for the marine and energy industry. Thus, the case company is deliberately selected due to its immense potential to provide deep insights into developing new capabilities and activities for transitioning to a smart solution business model (Siggelkow, 2007), thereby aiding managers responsible for the transformation process (Patton, 2002).

Data collection

We initiated our study by thoroughly examining the extensive existing data regarding the firm to assess the evolution of servitization over a prolonged period. This dataset provides valuable insights into the firm's strategic initiatives within the markets, elucidating how it has distinguished itself and remained steadfast in addressing changes in corresponding sectors. Table 1 below shows the primary data collected for the study.

To gather data, we employed semi-structured interviews conducted in two rounds. In the initial round, from 2015 to 2022, we interviewed twelve senior management personnel representing various business units to gain insights into the firm's business strategy, landscape, and sources of competitive advantage in the market, as well as identify critical rigidity, strengths, challenges, and market opportunities. The second round of seven interviews, conducted between 2023 and 2024, aimed to understand the firm's transition to the newly adopted business model, the motivations behind this shift, and the observed effects of the transition. We conducted a study to gain insights into the firm, each lasting between 35 and 90 minutes, with an average duration of approximately 64 minutes. All interviews were recorded and meticulously transcribed, resulting in 300 pages of transcripts. We also collected extensive secondary data from multiple sources, including the firm's annual reports, histories, and executive presentations (e.g., capital market days, YouTube videos/interviews). Furthermore, we accessed some firms' internal strategy documents due to our close collaboration on various research projects. Therefore, a triangulation approach was employed, integrating multiple active and passive data sources to validate data accuracy (Yin, 1994), enhance the study's reliability (Beverland & Lindgreen, 2010), and capture diverse dimensions of the phenomenon being investigated (Dubois & Gadde, 2002).

Data analysis

To identify the capabilities necessary for manufacturers to transition from product manufacturing to smart

TABLE 1 Primary interview data sources.

First interview round		Second interview round	
Job title	**Relevant industry experience (years)**	**Job title**	**Relevant industry experience (years)**
Sourcing director	17	Senior Project Manager *2	20
Director, Services	19	General Manager, Innovation *2	12
General Manager, Advanced Services	19	General Manager, Open Innovation	28
Sales Director	28	Program Director	26
Director, Solutions	18	General Manager, Technology	24
		General Manager, Ecosystem Innovation	17
Director, Sales and Development	18	Innovation Manager	14
Development Manager	19		
Marketing Director	37		
Digitization Director	13		
Director, Solutions business	30		
Director, Services	22		
Vice President, Solutions	24		
Average	22 years	Average	20 years
Median	19 years	Median	20 years

solutions, we used content and thematic pattern matching method (Yin, 1994) combined with a three-stage coding process (Corley & Gioia, 2004). Initially, we examined the case firm's overall servitization journey, focusing on organizational capabilities, activities, and practices related to managing solution business during the first round of interviews. This initial interview round provides us with an understanding of general challenges and opportunities associated with servitization, in the context of the incumbent manufacturer. Then, we conducted a second round of interviews, which underpins the smart solutions management and arguments behind the smart solution offering model. Finally, we coded the interviews into a three-stage coding process (see Figure 1). In the first order, respondents' original statements were recorded to provide a detailed understanding of the examined phenomenon. Subsequently, the data were thematically analyzed in the second order, based on the findings of the first-order analysis. Second-order themes were then linked to mechanisms of value creation required for the transition to a smart solution business model. In the final step, the second-order themes are synthesized into an aggregated dimension that captures the transformation of value creation capabilities into a smart solutions business model.

FINDINGS

This chapter presents empirical evidence on how manufacturers transition from selling products to offering smart solutions by developing three key capabilities related to value creation: visualization capability, integration capability, and scaling capability. Figure 2 outlines the transformation journey of the case firm, detailing the activities, processes, and practices involved in developing new capabilities. Furthermore, these capabilities support the transformation of the business model and organizational structure to align with the logic of smart solutions.

Visualization capability

Our empirical analysis reveals that as the company transitions from product manufacturing to smart solutions, it develops a value visualization capability, enabling it to identify new opportunities for value creation. This capability encompasses three primary activities and practices: understanding customer value, identifying market opportunities, and discovering new value propositions, which are outlined below.

Understanding customer value

The finding shows that during the transition toward smart solutions, the case firm first concentrated on developing a deeper understanding of customer value to drive opportunities for value creation. This effort began with gaining a comprehensive understanding of customers business and operational processes, recognizing that customers often seek support rather than manage every task independently. As one top manager explained:

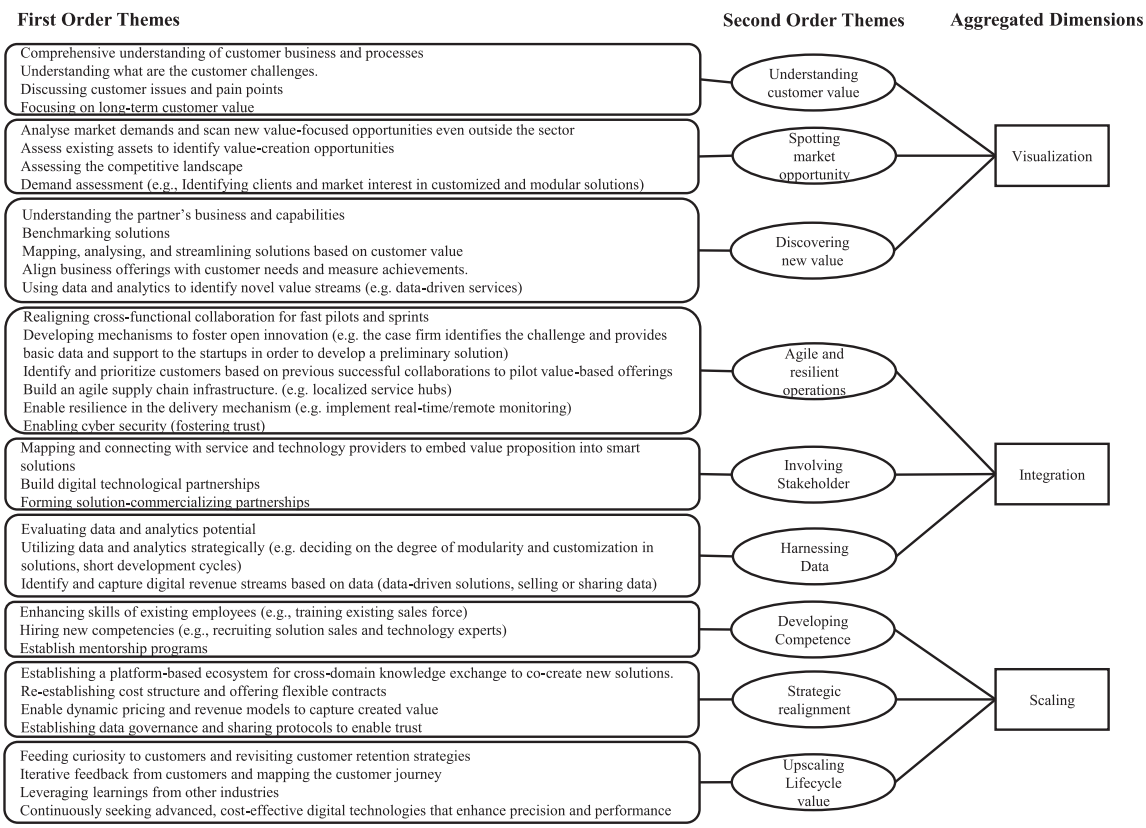

FIGURE 1 Data structure of the study.

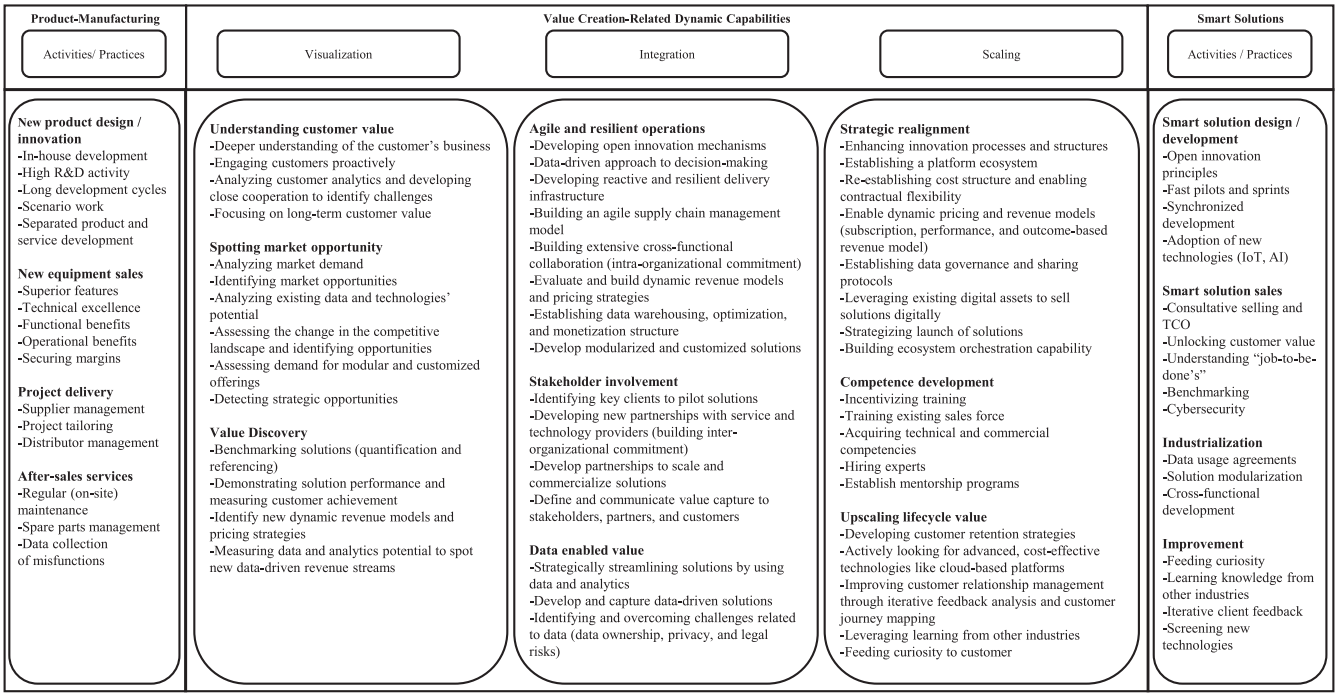

FIGURE 2 Smart solution transition.

> *"Our ability to understand their (customers) business case as it changes is fundamental to our understanding of what our customers value"*
>
> (Vice President of Energy Services)

Second, the case firm identified where customers seek support to uncover new areas for creating value beyond traditional product offerings. The firm's involvement with customers enabled it to gain a deep understanding of the challenges faced by its customers. Moreover, they shifted from an inward engineering approach to a more collaborative approach, emphasizing and engaging customers at an early stage. The early-stage involvement aids the firms in analyzing customer pain points and uncovering unseen inefficiencies, thereby identifying further value-creation opportunities, as explained by the interviewees:

> *"We have to have the client involved in the very early stage. Previously, engineers were ideating in their caves. They had good ideas, but I believe that we could get much better ideas if we engaged customers early enough"*
>
> (General Manager, Innovation)

Thirdly, the empirical data show that the firm leverages digital tools and data to anticipate customer needs and discover new ways to create value. Leveraging the digital tools and data enhanced the visibility of the case firm into customer business and operations while increasing the possibilities of value creation through data-driven insights, as the excerpt explains:

> *"We will digitalize our customer engagement"*
>
> (CFO)

> *"I also see possibilities in a more direct communication with customers regarding performance data to increase our competencies and improve our products (offerings). We need to have a new way of thinking and be open-minded about the possibilities of digitalization (smart solutions)"*
>
> (Product Lifecycle Engineer).

Overall, understanding customer value is crucial for manufacturers transitioning to smart solutions. It enables manufacturers to identify and prioritize opportunities for meaningful value creation. Without a comprehensive and in-depth understanding, firms risk misaligning their offerings and missing the potential of digital transformation.

Spotting market opportunity

The empirical analysis shows that the case firm strengthens its value visualization capability by developing practices for spotting market opportunities during its transition toward smart solutions. This process starts with actively analyzing the demand for smart solutions and scanning for emerging value-focused opportunities. The case firm adopts the practice of searching beyond the traditional industrial boundaries and exploring other sectors as well for value creation opportunities. For instance, they participate in industry conferences and seminars to exchange insights and identify changing market dynamics. This approach facilitates the case firm in recognizing evolving customer needs and industry development ahead of its competitors, as explained by an interviewee:

> "*We discuss in many conferences and seminars where we present our insights. At the same time, this creates an opportunity to discuss with others and why they consider certain things relevant"*
>
> (General Manager, Technology)

Second, the findings show that the case firm actively assesses the potential of existing assets, particularly data and analytics, to uncover new business opportunities. They leverage digital assets to transform concrete value propositions into value creation for customers, as one interviewee explained:

> *"When you have data available, you can improve power plant efficiency by analyzing it effectively. The key is to make sure you measure and focus on the right things. Only then – with the help of data – you can pinpoint what in fact needs improving and how you can optimize operations and maintenance costs"*
>
> (Business Development Manager)

Third, the findings depict that the case firm systematically assesses the competitive landscape to understand how competitors position their offerings, which aids in repositioning the offerings more effectively. Recognizing the evolving competitive landscape enables the case firm to adapt its offerings and capture emerging market segments. For instance, the case firm understood the client's interest and market demand for flexible and modular solutions, particularly those aligned with regulatory compliance, and accordingly developed new avenues for value creation, as explained by an interviewee:

"In the USA, we are seeing a rapidly increasing demand for flexible generation"
(Press release)

"There is already significant market demand for our products as owners look to prepare their ships ahead of the regulatory implementation"
(Director, Ballast Water Management Systems).

With all these combined activities and practices, the case firm moved beyond the reactive approach and established a proactive approach with an opportunity-driven mindset. Overall, the ability to systematically spot market opportunities is a key enabler of value creation during the manufacturer's transition to smart solutions.

Discovering new value

The finding depicts discovering value as an activity, which enhances the case firm's value visualization capability by analyzing customer value and market demand together to scrutinize value creation opportunities. The firm began by emphasizing the importance of recognizing partners' strengths and capabilities, as this creates opportunities for value creation and innovation that might otherwise be overlooked, as the excerpt illustrates:

"The challenge is that if you go beyond some product, then you need some other organization to be involved"
(General Manager, Solution Development)

"A thorough due diligence process is a must when looking to partner up. We look through what the team can do, but also into financial and legal aspects to see if anything is standing in the way of reaching the agreed-upon targets. Reputational and sustainability-related matters are also increasingly important"
(Managing Counsel).

Second, the case firm develops the practice of benchmarking to quantify and reference previous project outcomes with an aim to validate new value creation and innovation opportunities, as the excerpt depicts:

"Making sure the innovation playbook creates real and tangible value for projects is a key concern for the team, so they are developing it while driving the projects forward, identifying challenges and validating approaches. The team is also benchmarking the innovation playbook against past projects to figure out if it could have played a meaningful role there"
(Public document)

In the meantime, the case firm focuses on systematically mapping value-creation opportunities related to smart solutions. It conducts a thorough analysis through the lens of customer value, market demand, and the capabilities of both itself and its partners. This practice extends from adjusting offerings to implementing systems to measure the achievement of value-creation goals and streamlining solutions accordingly.

Third, the empirical evidence depicts the case firm leveraging data and analytics to identify novel value streams by optimizing customer operational and performance data, which enables the uncovering of hidden opportunities related to optimization and cost saving. These data-based insights enable the case firm to design new digital and performance-based solutions, increasing the firm's role in customer operations, as the excerpt explains:

"To challenge the status quo to lead the change towards a digitally connected, intelligent ecosystem, we must invest heavily in developing ideas to accelerate digitalisation and intelligent automation of the entire value chain. We need to leverage data and collaborate with technology partners and startups to come up with trailblazing solutions."
(Vice President, Branding)

"For example, owners, operators and managers may want to assess fuel performance over time and identify where there are latent opportunities for improvement. On the other hand, data could be deployed to see which vessels are suited to clean technologies depending on their historic performance over a year"
(Public document)

Lastly, the finding depicts that the case firm recognizes the importance of capturing the value-creation, which is dynamic in nature. Thus, the case firm began exploring novel value-based revenue and pricing models, as the CEO explains:

"We are transitioning into value-based pricing"
(CEO)

This practice reflects a strategic shift in which pricing is closely linked to the outcomes delivered by smart solutions. The case firm moves toward flexible, value-focused revenue models, enabling it to better capture and reflect the differentiated value created through its smart solutions. Overall, the case firm systematically adopted the above-mentioned practices to discover and capture new value opportunities.

Integration capability

Our finding shows that when the case firm transitions from product manufacturing to smart solutions, it develops a value integration capability to seize emerging value creation opportunities. This capability is built on three core activities and practices: agile and resilient operations, involving stakeholders, and data-enabled value, which are explained below.

Agile and resilient operations

The finding depicts agile and resilient operations as the first and core activity, which enhances the case firm's value integration capability by managing its resources and aligning operations to seize the emerging value creation opportunities in the transition towards smart solutions. First, the case firm realizes that the traditional product-centric structures are unable to meet evolving market needs, which require fast pilots and sprints, as one interviewee explained:

> *"Our [previous development] models have been developed to serve our R&D and technology development level issues … They have been quite rigid"*
>
> (Innovation Manager)

To respond effectively to the pace and complexity of the new market landscape, the case firm overcame the traditional silos and established multidisciplinary teams, as the excerpt explained:

> *"We are dealing with such complex problems that we need multidisciplinary teams to solve them. The sooner we start solving together, the better … Aim for win-win-win situations"*
>
> (Internal document)

> *"It [decision-making process] must have cross-functional coordination"*
>
> (Public document)

These teams are responsible for fast pilots and sprints to test smart solutions offerings. This development allowed the case firm to respond dynamically to new opportunities. Meanwhile, the case firm also developed mechanisms to foster open innovation principles. Moving away from the traditional practice of developing everything in-house to co-development of preliminary solutions, as the excerpt explained:

> *"Open Innovation is about taking an "ecosystem thinking" approach to innovation, by collaborating with partners, for example customers, suppliers, regulators, start-ups, universities to name a few"*
>
> (Public document)

Building on this further, the case firm focused on piloting the value-based smart solution offerings with identified and prioritized customers based on previous successful collaborations. This practice embedded the culture of experimentation and quick feedback loops, as explained by the managers:

> *"A culture of experimentation and the 'fail-fast' attitude … is about truly understanding just what the customer needs and providing exactly that in a faster manner – through prototyping, testing and iterating together, with constant customer involvement – and about taking user experience into account"*
>
> (General Manager, Business Innovation)

> *"By using APIs we have a much more agile development process. We have more speed, more flexibility and more backend services. You might need a slower process for something which needs to be more robust, like an ERP system, but you have the ability to be fast with something experimental. APIs allow us to try and fail faster"*
>
> (Director, IT)

The case firm also enhances its operational agility and resilience in delivery mechanisms by building a localized and flexible supply chain infrastructure and utilizing digital tools for real-time and remote monitoring.

> *"{we} will allocate a dedicated, permanent, team to support the … vessels included in the agreement. The team will co-ordinate activities on a worldwide basis, focusing on value creation, energy efficiency and a sustainable supply chain"*
>
> (Press release)

The operational agility reduced lead times and enhanced the cast firm's responsiveness, while delivery resilience ensured that solutions remained dependable even under volatile conditions, as explained by the following excerpts:

> *"We have, during a very short time span, redesigned our operations to provide increased customer value in the changing markets. Long-term success requires resilience and a new mindset from our workforce across the globe"*
>
> (President & CEO, Press release)

> *"Now, manufacturers are scrambling to build more resilient and agile supply chains by moving manufacturing hubs closer to demand centres, revisiting local associated infrastructure, and incorporating new technologies"*
>
> (Public document)

As the use of data and analytics is critical for smart solution transition, the case firm also enabled cybersecurity, which is crucial to building trust among partners, stakeholders, and customers. The case firm embeds robust cybersecurity practices from a very early stage into the design and development process of value creation, as explained in the following excerpt:

> *"Where you should start is in when you are designing the product. You move from understanding the potential threats to setting the capabilities and requirements, making the code resilient, testing it and releasing it securely. We bring everybody to the table - test engineers, developers and product managers - to build products more securely. This is one of the key elements of cyber security resilience and we want it to be a backbone for everything we do with the product"*
>
> (Head of Cyber Security)

Furthermore, the case firm also developed cybersecurity requirements and guidelines for the suppliers, thereby strengthening the security and resilience of its smart solution offerings. Overall, the case firm built agile and resilient operations, which enabled it to realize value-creation opportunities uncovered with the visualization capability.

Involving stakeholders and customers

The finding involves stakeholders as the practice through which the case firm strategically engaged with a wide range of stakeholders, transforming its role from a traditional technology manufacturer to an ecosystem orchestrator.

The company increasingly positioned itself as a hub that integrates partners, customers, and even competitors into joint development initiatives. In this sense, the identified capability of integration becomes central: rather than integrating only internal technologies or processes, the firm extends integration outward to align diverse stakeholders, technologies, and business models into a shared ecosystem vision, as the company emphasizes:

> *"By orchestrating these developments through the use of high levels of connectivity and digitalization, (we) intend to lead the industry's transformation towards a Smart Marine Ecosystem."*
>
> (Press release)

> *"(We) are ideally positioned, together with our customers and partners, for positive disruptive development and to lead the transformation into a new era of shipping. Building on our strong existing portfolio of products, systems, and solutions, the broadest in the marine sector, and on our vast installed base and industry know-how, we shall continue to develop the smart technologies, business models, and competences needed to create a Smart Marine Ecosystem,"*
>
> (President, Marine Solutions)

> *"Along with the other members of the ecosystem, we have proved the technology is ready. Now it is time to start thinking about industry pilots rather than small-scale pilots,"*
>
> (Senior Manager)

This shift enabled the firm to develop innovation-driven partnerships that integrated greater value into its offerings. In this practice, the case firm first identifies the potential partnership service and technology providers. The partners are selected through benchmarking and based on their commitment level towards innovation and value creation, as one excerpt explains:

> *"The cooperation partners we have now selected, are partners who are committed especially to designing a new operating model and creating a so-called playbook"*
>
> (Director, R&D)

These collaborations concentrate on enhancing customer value throughout the solution lifecycle. Also, this ecosystem approach enabled the case firm to shift its focus from traditional services to more customized, data-driven solutions, offering more value to its customers, as the excerpts explain:

> *"The acquired company helps our clients to move from time-based to truly predictive maintenance with solutions that ensure reliability and minimize total cost of ownership. Our advanced modeling takes into account client's vessel's unique parameters and overall performance. Data is filtered and analyzed to find the right balance between reliability and maintenance costs"*
>
> (Public document)

> *"Our goal is to move our offering from one size fits all to serving the customers according to their specific needs"*
>
> (Public document)

Furthermore, the case firm also developed practices to monitor groundbreaking technologies and providers, thereby acquiring a technological advantage and developing and delivering state-of-the-art solutions. For instance, the case firm integrated AI into its service delivery for resource allocation.

> *"As shipping becomes more used to data-based decision-making, this way of working will become increasingly commonplace. What's most important is that data can be shaped and deployed to always support commercial goals … . it's critical that data can be used in service of that aim"*
>
> (Public document)

> *"As shipping becomes more used to data-based decision-making, this way of working will become increasingly commonplace. What's most important is that data can be shaped and deployed to always support commercial goals … . it's critical that data can be used in service of that aim"*
>
> (Public document)

Simultaneously, the case firm also focused on entering solution commercialization partnerships to market the created value more effectively. Through these partnerships and stakeholder involvement, the case firm established a collaborative environment that is essential for developing smart solutions. Overall, this practice expanded the firm's innovation and commercialization capabilities.

Harnessing data

The empirical analysis shows the case firm recognized the role of data while strategically transitioning to a smart solution. They develop the practices of leveraging data and digital technologies to seize new value-creation opportunities. Utilizing data enables the firm to transition from a reactive to a proactive approach. In these practices, first, the firm evaluates the value of operational and customer data. The firm has recognized the critical importance of data, as well as the integration of embedded sensors and connectivity systems, in its products and services. This helps firms acquire operational data directly from the fields and identify areas of value creation, as one excerpt explains:

> *"By measuring and collecting data from any operation onboard the ship we learn to understand better and to improve"*
>
> (Public document)

> *"Data-based decision-making now gives the sector and its players the ability to chart compliant, efficient, and responsible futures for their fleet based on the full picture, spanning vessel, sea, and supply chain"*
>
> (Public document)

Building on the practice of evaluating data potential, the firm began utilizing data strategically to create value through smart solution design. For instance, combining data from the field and customer guides the organization's decisions regarding the degree of modularity and customization, as well as short or long development cycles. Further, the data-driven approach enabled the firm to tailor smart solutions more precisely to customer needs, as the excerpts explain:

> *"Realizing the true value of the data that your organization collects opens the door to decision-making that combines traditional principles grounded in behavioral science, human expertise and intuition, with real-time, data-driven insight"*
>
> (Public document)

> *"Through intelligent, software-based solutions, we can untangle this complex web and generate tangible and actionable insights—and ultimately create the foundation for a wider cultural shift towards data-driven decision making within shipping"*
>
> (Public document)

Lastly, the case firm's data-centric approach opened new digital revenue streams by offering data-driven solutions, selling performance data, or exchanging insights within the digital ecosystem, as the excerpt explains:

> *"We see a growing demand to connect to more and more subsystems, for energy efficiency evaluation, for example. Data exchange with shore-based fleet operation centres is also in strong demand"*
>
> (Product manager)

Overall, by building a practice of harnessing data, the case firm has created and captured emerging value, transforming the data into a strategic asset.

Scaling capability

The transformation of an established business model presents significant challenges, particularly for market-leading firms. For the case firm, transitioning to smart solutions proved especially demanding due to its

established structures, longstanding practices, and product-manufacturing cultures. To address this transition, the case firm acknowledged the development of its scaling capability, which enabled the firm to transform its structures and processes to deliver smart solutions. This capability focuses on three key activities and practices: competence development, strategic realignment, and upscaling lifecycle value, which are explained below.

Competence development

The finding depicts competence development as the first step toward maximizing the value of smart solutions. This activity focuses on developing and enhancing the skills, knowledge, and abilities required to support the transition from traditional product offerings to data-driven, value-focused solutions. Through this activity, the case firm seized value-creation opportunities by actively realigning its internal competencies. Initially, the firm focused on upskilling its existing employees, particularly those who are involved in the innovation and sales of smart solutions, as the excerpt explains:

> *"Innovating in sustainable technology and services to help {our} customers continuously improve their environmental and economic performance requires engaged and highly competent workforce"*
>
> (Annual report)

Empirical evidence shows the firm provides internal training, workshops, and several learning opportunities for their workforce, as the excerpt explains:

> *"{we} offers a wide variety of internal training and learning opportunities for its employees"*
>
> (Annual report)

Further, the finding shows that the company recognized that it had enough digital competencies to manage smart solutions. However, developing value-based sales competencies emerged as another central competence area. The transformation from selling goods to selling smart solutions was identified as a critical focus and development area in the service ladder, progressing from transactional services to outcome- and optimization-based solutions. This new, value-based sales approach (other labels such as consultative or white-collar selling were also used among practitioners) required new people and skills, as the excerpt explain:

> *" … this evolution from technical sales to commercial [is a challenge]. You should probably recruit new people with new skillsets"*
>
> (Director, Maintenance)

Beyond the internal competence development, the case firm extended its competence-building efforts to its wider innovation ecosystem as well. The firm established mentorship programs for startups, as explained by a senior executive:

> *"Once we identify promising start-ups with really innovative ideas, we will partner with them under this corporate venturing model, provide mentorship, finance and in the future, even partnership opportunities"*
>
> (Vice President, Digital Innovation)

Overall, through this activity, the case firm develops the practice of continuously enhancing its workforce skills through employee training, hiring new talent, and mentoring its ecosystem, enabling it to upscale value-creation opportunities in smart solutions.

Strategic realignment

The empirical findings suggest that the case firm undergoes significant strategic transformations to seize value-creation opportunities enabled by the transition to smart solutions. It has renewed its organizational structures, transformed the processes, and established new units and platforms to strengthen its value-creation capabilities. First, the case firm restructured its innovation processes and internal units to support the end-to-end delivery of smart solutions, as the excerpt explains:

> *"Company foresees that the new unit will be able to capture new market opportunities and improve operational efficiency for its customers, thereby increasing both the sales and profitability of the business"*
>
> (Public document)

Then, the case firm established a platform-based ecosystem that enabled cross-domain knowledge exchange and co-creation with external partners. This platform ecosystem aids the firm in connecting technology, data, and operational expertise in a unified framework and accelerating innovation, as the excerpt explains.

> *"We operate in a world of ecosystems where we have to be able to partner and share elements of digital progress: when we share data, we co-create the future and this collaboration truly realizes the potential of digital transformation"*
>
> (Public document)

Meanwhile, the firm also restructured its cost structures and enabled flexibility to tailor contracts according to customer needs. This shift enabled dynamic pricing

and the implementation of novel revenue models, such as outcome-based and performance-based agreements, which aim to deliver measurable value to customers. The emergence of dynamic pricing and revenue model has allowed the firm to capture created value by charging the customer for increased efficiency, uptime, and decarbonization, as the excerpt explains:

> *"Performance-based service agreements include quantifiable targets … based on the customer's business needs. Measurable indicators can include, for example, power availability, reliability, fuel consumption, and emissions"*
>
> (Public document)

Furthermore, the case firm also established data governance and sharing protocols to develop the trust of its customers and stakeholders, enabling them to acquire, use, and share data with partners and customers.

> *"{we} continuously improves employee data protection awareness with mandatory data protection (GDPR) training, targeted training sessions, communication activities, as well as comprehensive guidance materials. {we} continues to invest in the development of data protection platforms to support data protection management and implementation"*
>
> (Public document)

> *"We're starting to see contractual requirements where … if we're aware of a vulnerability … we should inform the ship owner and have certain policies and procedures in place"*
>
> (Director of Cyber Security)

Overall, by reorganizing structures, establishing platform ecosystems, and adopting dynamic pricing and data governance practices, the case firm demonstrates its strategic realignment efforts, which enable it to capture value creation opportunities arising from the shift to smart solutions.

Upscaling lifecycle value

The empirical analysis shows that the case firm transformed its operations to identify emerging value-creation opportunities throughout the solution lifecycle. During product manufacturing, the firm equips products and services with sensors that lack a consistent interface and increase difficulties for customers in learning the system. On the other end, the smart solution overcomes the inconsistent interface challenges by offering a unified and user-friendly experience, as the excerpt explains:

> *"In the past, each sensor solution had its own interface but, having taken on board feedback from its customers, all its sensors now look more or less the same from the user perspective"*
>
> (Marketing Director)

This reflects the firm's focus on functional performance and motivation to provide a great user experience. Iterative feedback loops with customers and users help the case firm showcase solutions and keep customers engaged, as the following excerpt explains:

> *"The customer feedback that we get, you know, our track record of executing on time and delivering in a stable way, it is something that's… some of our critical customers are looking for"*
>
> (CEO, Webcast).

Further, the iterative engagement allows the firm to map the customer journey more precisely, aligning its offerings to dynamic customer needs and operations. The firm went beyond the traditional practices and developed a practice to scan other industries and leverage their learning continuously. This practice enabled the firm to stay ahead of its competitors and offer advanced digital solutions to its customers, such as advanced monitoring for vessels and optimizing engine performance, as the excerpt explains:

> *"From fuel consumption and efficiency, ship companies are able to accurately monitor and optimize the performance of their engines… or work out how changing route based on weather conditions will affect consumption"*
>
> (Public document).

> *"By leveraging our combined smart learning technologies and mariner performance optimisation services, shipping can achieve the desired outcome of operating with more efficient, safer, and environmentally aware crews"*
>
> (President).

All these practices underpin the firm's commitment to seeking advanced and cost-effective digital technologies that can enhance precision and sustainability. The firm is also engaged in adopting technologies that can automate the reporting process to comply with regulatory and operational demands, as the excerpt explains:

> *"Automating the reporting process will become even more valuable in the future… Future requirements will be even more onerous"*
>
> (Public document)

Overall, the findings depict that the case firm has transformed its operations to capture value creation opportunities throughout the solution lifecycle by leveraging customer feedback, adopting cross-industry insights, and integrating advanced digital technologies to enhance user experience, efficiency, and compliance.

DISCUSSION

Theoretical contributions

The present study aims to understand the role of dynamic capabilities in enabling the transition from product manufacturing–centric activities and practices to smart solutions–related activities and practices. This study contributes to the intersection of digital servitization and dynamic capabilities literature (see Coreynen et al., 2020; Huikkola et al., 2022; Kindström, Kowalkowski, & Sandberg, 2013) by examining how firms develop and enhance value creation–related capabilities during their transition from traditional manufacturing business models to smart solutions. Our contributions to the literature on dynamic capabilities and digital servitization are twofold, as the present study 1) advances understanding of the dynamic capabilities of smart solution providers by adopting a value creation approach and 2) maps the activities and practices that enable manufacturers to transition towards a smart solutions business model.

When an industrial manufacturer seeking resilient solutions embarks on an exploratory path, it either innovates the business model entirely through piloting (Thomson et al., 2023) or alters some of the mechanisms, such as value creation (e.g., autonomous systems, customer-centric offerings). The intelligence, connectivity, and data features of smart solutions require new procedures, processes, activities, and routines, affecting business operations, structure and processes to enhance productivity and performance (Hofmeister et al., 2023; Holst et al., 2020; Raddats, Naik, & Ziaee Bigdeli, 2022). Further, addressing the technological and relational challenges (Echeverri & Skålén, 2011; Kindström & Kowalkowski, 2009; Mustak & Plé, 2020) is also necessary, even if partially, to complete the transition. To overcome challenges and leverage advanced contemporary technologies, manufacturers leverage dynamic capabilities and undergo business model innovation. While previous research has discussed the dynamic capabilities required for firms to navigate from traditional manufacturing to digital servitization (Kohtamäki et al., 2019; Paschou et al., 2020; Sklyar et al., 2019), there is limited attention to the specific value creation-related capabilities that enable firms to successfully transition from offering products to delivering smart solutions. The unique challenges of developing smart solutions, such as product-driven culture, mindset, capabilities, and routines (Bustinza, Vendrell-Herrero, & Baines, 2017; Kowalkowski & Ulaga, 2017), dispersed growth models (Kindström & Kowalkowski, 2009), and integrating technological advancements and organizational resources, suggest that firms need to obtain distinct capabilities tailored for a successful transition.

Using the lens of value creation, our study makes an original contribution by unpacking the three critical value creation-related capabilities required for the successful transition to smart solutions, as differentiated by Teece (2007): sensing, seizing, and transformation, as our findings confirm the importance of dynamic capabilities in enabling transformation, we extend prior work (Teece, 2007) by demonstrating that firms require a set of value creation-related capabilities specifically for smart solution logic. These three novel and specific capabilities of the manufacturer are 1) visualization (i.e., sensing capability), 2) integration (i.e., seizing capability), and 3) scaling (i.e., transforming capability), which are required to revamp the business model towards the smart solutions logic. First, at the initial sensing stage, the visualization capability of manufacturers enables them to conceptualize, articulate, and uncover new pathways for value creation. This capability involves three main areas. The first area is developing a deeper "understanding of customer value" by engaging with customers proactively, analyzing customer data, and focusing on long-term value creation. The second area involves "spotting market opportunities" by assessing demand, analyzing existing data and technologies, and understanding shifts in the competitive landscape to design modular, customized, and strategic offerings. The third area involves "value discovery" through benchmarking solutions, demonstrating solution performance and outcomes, and identifying new data-driven revenue streams, as well as innovative pricing strategies. While prior research has emphasized identifying opportunities and understanding customer needs as part of the sensing capability (Kindström, Kowalkowski, & Sandberg, 2013; Kowalkowski, Gebauer, & Oliva, 2017; Kowalkowski & Ulaga, 2017) of providing solutions (Paiola et al., 2013; Saul & Gebauer, 2018), we contribute to the literature by introducing the visualization capability of manufacturers. This emphasizes that manufacturers should develop technological and data competencies to gain a deep understanding of their customers' businesses, market behavior, and value discovery.

Second, at the seizing stage (Teece, 2007), the integration capability of manufacturers enables them to combine critical resources, processes, and stakeholders to realize and capture emerging value-creation opportunities identified through visualization capabilities. This capability involves three areas. The first area involves the development of "agile and resilient operations" by creating open innovation mechanisms, applying data-driven decision-making, fostering responsive and resilient delivery systems, enabling modularity and customization, strengthening cross-functional collaboration, developing dynamic pricing strategies and revenue models, and

establishing effective data processing mechanisms. The second dimension is "involving stakeholders and customers" by selecting key clients for solution piloting, creating partnerships with service and technology providers to acquire new capabilities, developing collaborations to scale and commercialize solutions, and communicating value capture to stakeholders, partners, and customers. The third area is "data-enabled value," which involves utilizing analytics to streamline solutions, leveraging data to co-create and deliver value, monetizing data to generate new revenue streams, and addressing challenges related to data ownership, privacy, and legal risks. While prior research has highlighted stakeholder engagement, customer involvement, and agile operations (Saul & Gebauer, 2018; Warner & Wäger, 2019) as part of seizing capabilities (Teece, 2007), our study contributes by emphasizing integration capability. This capability underscores the need for manufacturers to develop data warehousing, optimization, and monetization competencies, support data-driven decision-making, and address data-related tensions to enable effective data sharing with partners and stakeholders, thereby facilitating value capture for all the actors.

Finally, during the transformation stage, manufacturers employ their scaling capability to transform internal structures, strategies, processes, and business models. This enables them to capture emerging opportunities for value creation and develop a smart solution business model. The scaling capability of a manufacturer focuses on three main areas. The first area is "strategic realignment". This involves enhancing innovation processes and structures to support open innovation, establishing platform ecosystems to strengthen inter-organizational commitment, adopting dynamic pricing and revenue models to improve value capture for both customers and stakeholders, implementing data governance and sharing mechanisms to build trust with customers and partners, and developing ecosystem orchestration capabilities to create value networks and build resilience. The second area is "competence development". This includes incentivizing training programs, strengthening the digital skills of sales teams, acquiring technical expertise for solution development, and building commercialization competencies to support the sales of solutions. It also involves partnering with consultants, hiring specialists, and establishing mentorship programs to cultivate in-house expertise. The third area is "upscaling lifecycle value". It focuses on strengthening customer retention and relationship management by using feedback analysis, customer journey mapping, and behavioral insights to anticipate opportunities and customer challenges, which serve as a guide for visualization and integration capabilities to create novel value. It also emphasizes leveraging cross-industry learning and actively exploring advanced, cost-effective technologies to enhance solutions across the customer lifecycle. This finding extends the literature that has discussed the transformation capabilities (Huikkola et al., 2022) by highlighting how manufacturers can orchestrate ecosystems, build data-driven expertise, and extend value creation across the customer lifecycle to support the scaled and sustainable transformation of solution business models. Furthermore, our empirical findings also demonstrate that these capabilities are interdependent and mutually reinforce one another. The value of capabilities lies in their systematic and iterative interplay. The interplay of these three capabilities, along with their specific activities and practices, forms the foundation for a firm to successfully transition its business model while creating value through innovative solutions. Thus, the study extends the discussion about the role of dynamic capabilities in digital servitization, broadening the view typically presented in servitization studies.

This study also unfolds the activities and practices of a product manufacturer and a smart solution provider, providing a perspective contrasting these two. This is important because it illustrates the challenge manufacturers face in transitioning their business model from hardware and products, so-called product logic, which focuses on a value-in-exchange approach, to products, services, and software, and the so-called service logic, which focuses on a value-in-use approach (Töytäri et al., 2018; Vargo, Maglio, & Akaka, 2008). By scrutinizing these activities and practices, this study advances our understanding of micro-level activities required in digital servitization (Löfberg, Åkesson, & Skålén, 2025; Sjödin, Parida, Kohtamäki, & Wincent, 2020) by emphasizing the need to alter the firm's activity system.

Managerial implications

For managers, the study has two primary items to consider: 1) the current vs the future activity system, and 2) the required value creation activities, practices, and capabilities for transition from products to smart solutions. The study's empirical case and conclusions suggest that a firm's future activity system often separates remarkably from the current or past activity system. A firm, however, is heavily dependent on the past activity system, so it is difficult to change. Studies use concepts of path dependency (Brekke et al., 2024), rigidity, and learning traps to highlight firms' inertia when trying to change the activity system. This suggests two learning points: a) activities and practices related to product manufacturing and smart solutions separate significantly, and b) any firm must invest heavily in changing the value system due to the inertia faced.

The second primary point was the dynamic capabilities needed to change the activity system. Our study revealed certain value-creation activities, practices, and capabilities that companies should have in place to transition to the activity system despite the inertial elements. Thus, companies should invest in the practices and resources necessary to develop the required dynamic

capabilities, practices, and routines that ultimately enable innovation and transition from product manufacturing to smart solutions.

Limitations and future research

This research has its flaws that mainly stem from its chosen research strategy. As the study is an in-depth, qualitative single-case study, the main limitation is the inability to generalize the findings. The case firm studied was a relatively large manufacturing company; therefore, the research findings may differ for small and medium-sized enterprises. The case company also operates in an established, even conservative industry, driven by cost-saving and efficiency considerations among clients. Hence, the innovations in this sector emphasize cost-reduction outcomes rather than novelty and breakthrough types of innovations. Dynamic capabilities may differ remarkably between moderately changing sectors and high-velocity businesses.

AUTHOR CONTRIBUTIONS

Tayyab Warraich: Conceptualization; supervision; methodology; investigation; data curation; writing—original draft; writing—review and editing; project administration. **Tuomas Huikkola:** Conceptualization; investigation; data curation; writing—original draft; writing—review and editing; supervision. **Marko Kohtamäki:** Writing—original draft; writing—review and editing; supervision. **Sascha Kraus:** Writing—original draft; writing—review and editing; supervision. **Yassine Talaoui:** Writing—original draft; writing—review and editing.

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None.

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The data supporting the findings of this study are not publicly available in order to protect the anonymity of the respondents.

ETHICAL INFORMATION

There are no ethics issues to report.

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