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Becoming a smart solution provider: Reconfiguring a product manufacturer's strategic capabilities and processes to facilitate business model innovation

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ABSTRACT

The present study analyzes how a product manufacturer alters its strategic capabilities to become a smart solution provider by employing its dynamic capabilities. We scrutinize how a manufacturer facilitates strategic change by realigning its strategic capabilities and processes from a focus on technical product-development capabilities to product-service-software development capabilities, reconfiguring organizational routines focused on efficiency to routines focused on customer productivity, and shifting from a product logic to a service logic. By studying six leading manufacturing firms based on 86 manager interviews, the present study finds that strategic capabilities are renewed through dynamic capabilities, which involve a reconfiguration of strategic capabilities and processes. Furthermore, manufacturers need to consider the dynamic interplay between resource realignment modes (building digital capabilities, leveraging existing capabilities, accessing external capabilities, and releasing decaying capabilities), hence stressing their reinforcing mechanism to converge products, services, and software. For managers, our study highlights several strategic renewal practices designed to assist and benchmark how strategic capabilities are altered.

"Every industrial company must become a software company" (GE's former CEO Jeff Immelt; Immelt, 2017; Porter and Heppelmann, 2015: 108)

1. Introduction

To escape the commoditization trap, established manufacturing companies such as AGCO, GE, and Rolls-Royce have started to provide smart solutions to their clients (Hsuan et al., 2021; Immelt, 2017; Porter and Heppelmann, 2014; Tian et al., 2021). This strategic transition from selling products to selling smart solutions has been termed digital servitization, which is defined as *"[t]he transition towards smart solutions (product-service-software systems) that enable value creation and capture through monitoring, control, optimization, and autonomous function. Digital servitization emphasizes value creation through the interplay between products, services, and software"* (Kohtamäki et al., 2021). Smart solutions are thus considered bundles of products, services, and software and are built on advancements in cyber-physical systems and Internet of Things (IoT) technologies, which highlight connectivity between the client's systems (Jovanovic et al., 2021; Langley et al., 2021). The term "smart" refers to intelligence embodied in a solution, including the software, ports, protocols, and antenna that enable equipment to collect and transmit data between different systems (Porter and Heppelmann, 2015). A "solution" refers to the integration of equipment, services, and software (Nordin and Kowalkowski, 2010) that creates more value for the client than an alternative where parts are sourced separately (Ulaga and Reinartz, 2011). Smart solutions provide both economic and strategic benefits for manufacturers (Gebauer et al. 2020) through improved up- and cross-selling opportunities, cost savings, and customer experiences (Kowalkowski and Ulaga, 2017). Studies demonstrate some encouraging results regarding positive profit gains achieved through the interplay of service and digital business development (Kohtamäki et al., 2020b; Rapaccini et al., 2020; Vendrell-Herrero et al., 2017).

The previous literature on digital servitization provides detailed

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evidence of the transition from product manufacturing to the provision of smart solutions (Baines et al., 2020; Cusumano et al., 2015; Rabetino et al., 2021) and how manufacturers' business models change (Forkmann et al., 2017; Kohtamäki et al., 2019; Gebauer et al. 2020; Sjödin et al., 2020). However, it fails to present detailed microlevel evidence on how resources, capabilities (Coreynen et al., 2020; Ulaga and Reinartz, 2011), and associated processes and routines (Immelt, 2017, 2021) change when manufacturers move towards product-service-software solutions (Hsuan et al., 2021) even though it acknowledges that these elements are key sources of inertia in such a strategic transition (Lenka et al., 2018). This transition is challenging, and the majority of product manufacturers fail to pursue it (Nebuloni et al., 2019; Ulaga and Reinartz, 2011) not only because of capability gaps (Storbacka, 2011) but also because different profit-and-loss responsible units face contradictory goals and paradoxes when managing this new business model adoption (Bond et al., 2020; Brax, 2005; Kohtamäki et al., 2020a; Visnjic et al., 2021). This transition calls for the development of new and existing capabilities (Töytäri et al., 2018), which causes rigidity as obtaining new capabilities is considered costly and risky, and managers may be uncertain about their initial strengths (Danneels, 2011). Furthermore, the literature has shown that old behavioral routines, for instance, in pricing and selling (Raja et al., 2020; Reinartz and Ulaga, 2008), hinder a successful transition towards smart solutions. Last, a product mindset may be dominant among manufacturers and hence prevent successful adoption of new capabilities and processes needed in digital servitization (Kapoor et al., 2021; Kowalkowski and Ulaga, 2017; Töytäri et al., 2018). Manufacturers need to be able to simultaneously sell products and smart solutions (Sjödin et al., 2020). This business model duality causes rigidities and tensions inside an organization (Visnjic et al., 2021) but can be overcome through different coping practices (Kohtamäki et al., 2020a), capability development practices (Töytäri et al., 2018), and the establishment of new organizational structures, processes, and routines (Huikkola et al., 2021).

Even though servitization research demonstrates evidence of dynamic capabilities, that is, a firm's ability to sense and seize new business opportunities (Teece, 2007) and modify its assets (Sirmon et al., 2007) when shifting from a product logic to service logic (Coreynen et al., 2020; Kindström et al., 2013; Raddats et al., 2015), previous studies nevertheless neglect the interplay between strategic and dynamic capabilities as they focus on either (static) strategic resources and processes (Huikkola and Kohtamäki, 2017) or dynamic capabilities (emphasizing the learning to learn aspect) (Coreynen et al., 2020). The link between strategic and dynamic capabilities is thus unexplored in the servitization research, and there is a need to understand how dynamic capabilities facilitate a product manufacturer's strategic capability alteration, following Kohtamäki et al. (2019: 385), who have called for *"studies on strategic capabilities in digital servitization … [and] on the role of dynamic capabilities in resource reconfiguration for digital servitization."*

Specifically, the present study aims to address the following research question: *"What dynamic capabilities does a product manufacturer employ to alter its strategic capabilities?* To address this question, we conduct a multiple Case study (Eisenhardt, 2021) of six leading product manufacturers and analyze how they have transitioned towards the provision of smart solutions by employing their dynamic capabilities. This study contributes to the intersection of the digital servitization literature and capability theory. First, the present study sheds light on how capability reconfigurations help manufacturers to change the focus of their strategic capabilities from products to smart solutions. Second, the study extends the discussion of capability modifications to smart solutions by emphasizing the interplay of realignment modes (building, leveraging, accessing, and releasing assets; see Danneels, 2011; Eisenhardt and Martin, 2000) and their reinforcing mechanisms for capability development to converge products, services, and software successfully. For managers, the present study provides guidelines and benchmarks for managing the processes of capability alterations when transitioning towards the provision of smart solutions.

2. Theoretical background

2.1. Strategic transition from products to smart solutions

Traditional manufacturers embrace the opportunity to create value by digitizing downstream activities (Allmendinger and Lombreglia, 2005; Brax and Jonsson, 2009). Studies have used various terms to denote the concept of a transition towards value creation and capture through digitally enabled smart solutions such as *digital servitization* (Kohtamäki et al., 2021b; Paschou et al., 2020; Sklyar et al., 2019; Tronvoll et al., 2020), *digital transformation* (Hanelt et al., 2020; Li, 2020; Nasiri et al., 2020; Zangiacomi et al., 2020), or *digital revolution* (Rindfleisch et al, 2017). Smart solutions consist of *physical elements* such as hardware and mechanical parts (e.g., equipment made of steel), *intelligent elements* such as software, sensors, and internal intelligence (e.g., software embedded in the equipment), *connectivity elements* such as ports, protocols, and enabling networks connected to the cloud (Porter and Heppelmann, 2015), *data elements* such as production data, malfunction data, and predictions based on data analysis (e.g., the utilization of artificial intelligence (AI) in equipment maintenance) (Langley et al., 2021), and *intangible service elements* such as personnel competencies to repair and fix equipment and processes (Ulaga and Reinartz, 2011). When combined, these elements allow data for exchange between the product owner and product users, leading firms to reconsider different strategic options: Should they pursue an open or closed system (Porter and Heppelmann, 2015), do they want to develop the required resources internally or externally (Salonen and Jaakkola, 2015), what data should be collected and how should it be monetized (Tronvoll et al., 2020), how will the role of distribution channels change (Huikkola et al., 2020), what business models should be adopted (Sjödin et al., 2020; Tongur and Engwall, 2014), and what will the company's new strategic scope be (Kohtamäki et al., 2019)?

From a business perspective, smart solutions are *embedded systems*. Thus, the digital component does not necessarily provide strict business benefits *per se,* but manufacturers can reap financial and strategic benefits by providing advanced and unique smart solutions that create value for customers (Töytäri et al., 2018) or decrease the focal company's costs (Ulaga and Reinartz, 2011). According to the literature (see Raddats et al., 2019), transitioning from products to smart solutions calls for the manufacturer to adopt a new type of mindset and logic. In the literature, this mindset change has been defined as a movement from a product logic (or a goods-dominant logic) to a service logic (or a service-dominant logic) (see Grönroos, 2008; Vargo and Lusch, 2004), from a cost logic to a value logic (Töytäri et al., 2018), or from a product orientation to a service and customer orientation (Gebauer and Kowalkowski, 2012; Raddats et al., 2015). Töytäri et al. (2018) state that there are two opposing paths that drive mindset shifts, namely, 1) top-down and 2) bottom-up approaches. A top-down approach promotes managerial foresight by developing and effectuating a new value logic and then renewing capabilities. In this approach, top executives drive overall mindset change, stressing the importance of managerial cognitions (Danneels, 2011; Helfat and Peteraf, 2015) and discourses (Korkeamäki et al., 2021) for facilitating change. The latter approach promotes new capability/routine creation first and thereafter drives the overall logic change from the bottom up. Similarly, Huikkola et al. (2020) suggest that this mindset shift creates a problem reminiscent of a "chicken-and-egg" dilemma. Firms need to resolve this dilemma by either promoting a new service mindset that initiates capability development or altering its capabilities, processes and routines, which further supports a new service mindset. Overall, a mindset shift is associated with a firm's ability to realign its capabilities, processes and routines.

2.2. Realignment of capabilities to provide smart solutions

Capability theory is one of the most popular theory streams used to study the transition from products to services/solutions (Raddats et al.,

2019). Strategic capabilities refer to the possession of a firm's most distinctive resources (Long and Vickers-Koch, 1995) and their effective use and deployment through strategic business processes (Day, 1994). Strategic processes refer to the firm's deployment of strategic resources in a value-creating manner (Ulaga and Reinartz, 2011) through organizational structures, processes, and routines (Huikkola et al., 2021; Visnjic et al., 2021). These processes thus include how managers make decisions, how resources are allocated, and how different activities are managed and coordinated within the focal company (Huikkola and Kohtamäki, 2017). Building on resource-based theory (Barney, 1991), Ulaga and Reinartz (2011) find that successful manufacturers convert their distinctive resources (e.g., installed base of products, production assets, product sales force, field services) into the strategic capabilities required in solution provision by building capabilities related to data processing and interpretation, risk assessment and mitigation, service innovation, and hybrid offering sales and delivery. Similarly, Raddats et al. (2015) find that manufacturing firms achieve a greater service orientation through resource reconfigurations.

Previous studies on a manufacturer's transition to services have focused on either strategic (Paiola et al., 2013; Spring and Araujo, 2013; Storbacka, 2011) or dynamic capabilities (Coreynen et al., 2017; Kindström et al., 2013; Töytäri et al., 2018) to explain how firms differ in terms of resource deployment. Studies have found that manufacturers develop their sales competencies from selling products to selling value (Reinartz and Ulaga, 2008; Schaarschmidt et al., 2021); initiate new partnerships with knowledge-intensive business solution (KIBS) firms to mitigate risks and gather new knowledge (Bustinza et al., 2021; Eloranta and Turunen, 2016); develop relational capabilities to learn from their customers (Kamalaldin et al., 2020; Schaarschmidt et al., 2018; Tuli et al., 2007); renew their innovation processes and capabilities to consider a service perspective already in the design phase (Gustafsson et al., 2020; Santamaría et al., 2012; Ulaga and Reinartz, 2011), and develop IT capabilities to collect, analyze, and interpret "big data" (Immelt, 2017). In sum, to change their strategic capabilities, firms need to change their associated strategic processes and routines through developing dynamic capabilities (i.e., how firms learn and alter capabilities).

The dynamic capability perspective thus addresses how firms recreate themselves by sensing (Eggers and Kaplan, 2013) and seizing (Ott and Eisenhardt, 2020) new business opportunities, and reconfiguring their capabilities to meet the expectations of rapidly changing environments (Ferreira et al., 2014; Teece, 2007). Firms thus attempt to maintain their competitiveness by employing routines to develop their extant resources and obtaining new ways to create and build novel resources (Feldman and Pentland, 2003) and bundling both acquisition and innovation-based routines (Prange et al., 2018). Organizational routines refer to repetitive behavioral or activity-related patterns designed to effectuate specific organizational tasks such as hiring new staff or evaluating and executing mergers and acquisitions (M&As) (Feldman and Pentland, 2003; Nelson and Winter 1982). Routines thus consist of specific, repeated action steps and work practices used to progress through a dedicated strategic process such as alliance management or internationalization (Bingham and Eisenhardt, 2011). The organizational routine perspective of dynamic capabilities suggests that organizations learn from process experiences, similar situations, and past mistakes (Bingham and Eisenhardt, 2011). Routines are thus rooted in heuristics (Schilke et al., 2018; Teece, 2012) but are much more detailed, frequent and operational than managerial heuristics that revolve around broader decision-making constructs. The almost never-ending debate on routines focuses on routine continuity: When should a firm establish a new routine and when should a new routine can be defined as a routine?

Eisenhardt and Martin (2000; Danneels, 2011) suggest that firm-level renewal occurs through different resource realignment modes, namely, 1) creating new capabilities, 2) leveraging the current resource base in the form of new offerings, 3) accessing external resources, and 4) releasing existing resources. In enacting these four modes for exercising dynamic capability, new capabilities are created by accessing the modes of obtaining, acquiring, building, integrating, and developing new resources through new hires, business development programs, personnel training, or restructuring operations (Huikkola et al., 2016). Leveraging the existing resource base refers to the expansion of resources in the form of diverse sets of products and services (Fang et al., 2008). Access to external resources refers to making acquisitions or building partnerships and employing alliances and collaborations with external firms such as dealers, technology providers, start-ups, or research institutions (Bustinza et al., 2021; Clarysse et al., 2014; Finne et al., 2015; Paiola et al., 2013), defined as selection capability in the prior dynamic capability literature (Capron and Mitchell, 2009). The release of existing resources refers to the use of routines and practices that eliminate resources such as outsourcing, offshoring, divesting and closing businesses, laying off staff, or organizational unlearning (Moliterno and Wiersema, 2007; Tsang and Zahra, 2008).

Winter (2003) has described a firm's capabilities as a collection of routines that enable the firm to thrive and prosper in a complex world. Studies (e.g., Helfat and Peteraf, 2003) have shown that routines lead to improved efficiency, reliability, and speed when certain tasks are performed. Eisenhardt and Martin (2000: 1107) define dynamic capabilities as *"organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die."* We build on this definition and consider strategic processes and routines as vital elements of exercising dynamic capability at the task level, as they help firms "get things done" and develop new strategic capabilities. We acknowledge that strategic processes and routines are not ad-hoc processes (Heimeriks et al., 2012) but need to be reconfigured occasionally as they are inherently evolutionary.

3. Methodology

We employed a multiple Case study (Eisenhardt, 2021) of six leading international product manufacturers to study how they had altered their organizational capabilities and processes towards becoming smart solution providers. The studied technology companies manufactured, sold, and serviced different industrial equipment in different industrial sectors. Services accounted for 19–47% of their total revenues, thus contributing at a level identified by previous studies as increasing shareholder value (Fang et al., 2008). The studied companies were purposefully selected (Eisenhardt, 2021) because a) all have been widely considered technological forerunners in their industries and b) have invested heavily in smart solution development for more than a decade, and c) we had good access to these companies because of our geographic proximity and collaboration through research projects related to digital servitization. The sample consisted of publicly listed companies only, allowing the researchers to obtain extensive secondary data to complement the primary interview data. Furthermore, most of the studied firms have participated in research projects related to the development of service businesses and smart solutions, helping the researchers observe them closely through deeper collaboration taking the form of consultative development work, workshops and seminars over a longer period of time. Research projects enabled researchers to observe studied firms' concrete actions to develop smart solutions at the operational level, allowing researchers to notice issues neglected or overlooked in executives' speeches. Additionally, research projects helped researchers obtain access to relevant interviewees. Longitudinal research is beneficial when studying dynamic capabilities because the evolution of capabilities typically takes many years (Danneels, 2011). The studied companies were considered technology leaders in their industries, and they shared a differentiation strategy. However, the initial need to develop smart solutions had arisen mainly from service business requirements, as the firms had struggled to optimize spare part intervals and effectively manage field personnel routes. Even though some

customer requirements for such services have been presented (e.g., ways to track the fleets owned), the trigger for the development of smart solutions seems to have been endogenous rather than exogenous, thus initially highlighting internal efficiency advantages over customer benefits.

3.1. Data sources

The research team conducted 86 senior manager interviews, with 13 of the respondents (15.12%) being C-level executives. All of the interviews were recorded and transcribed, resulting in 1470 pages of transcripts. Respondents were chosen for interviews based on their roles and responsibility for the development of smart solutions, technology, or the solution business in general. The interviewees held various senior manager positions, such as CEO, CDO, Digitization Director, and Service Director. Generally, interviewees were experienced managers in their industries, holding approximately 19 years of industry experience (no experience information was provided by 8 interviewees). The interviews took place between 2010 and 2018. The interviews explored the development of smart solution business in general, focusing on the following three areas: 1) background information on the firm; 2) description of (smart) solution contexts; and 3) direct questions related to capabilities, processes, routines, and their evolution. Particularly in the beginning of the research project (years 2010–2012), terms such as IoT and Industry 4.0 had not yet been established or widely recognized among companies, and the terms in use varied from remote management to service-related technologies. Since 2012, the terminology in use has converged, with the IoT/Industrial Internet being widely acknowledged among manufacturing companies today. We interviewed multiple managers (ranging from 7 to 19) at the focal companies to avoid single-respondent bias. Some managers were interviewed several times at different time periods to obtain an in-depth understanding of the studied subject. Additionally, we interviewed the focal companies' strategic customers and suppliers to better understand the external perspective on the provision and adaptation of smart solutions and to triangulate the data. briefly describes the sample and the data.

We conducted semi-structured interviews. This first template was first tested with the pilot cases to cover potential issues that had not been identified in the literature review. The first interview template used from 2010 to 2015 generally focused on capabilities in solution business, and the second modified interview template used between 2016 and 2018 focused particularly on the evolution of capabilities in the smart solution business development context. Furthermore, the research team conducted interviews with two industry experts to discuss smart solutions in general. Finally, we sent our analysis to an experienced industry expert in the IoT (22 years of relevant experience) for additional comments via e-mail for increased validity.

3.2. Data analysis

Our data analysis followed an abductive reasoning process (Dubois and Gadde, 2002). Our initial understanding of smart solutions was based on early interviews with field engineers who were considered pioneers in remote diagnostics (to clarify, executives in general did not have many commercial applications related to remote applications at the beginning of the research project, and development was based on engineering). After these first interviews (2010–2012), the academic literature on solution business expanded (see Rabetino et al., 2018), our understanding of the subject increased, and we were able to identify emerging themes (e.g., what firms had started to do to develop smart solutions and how firms obtain digital capabilities) from the data.

First, we undertook a within-Case analysis of each of the six manufacturers by synthesizing the data into individual case stories to understand how they altered their assets to provide smart solutions. These stories describe the firm's traditional strengths, rationale for smart solutions, capability realignment modes of building, leveraging, accessing, and releasing capabilities (Danneels, 2011; Eisenhardt and Martin, 2000), and future capabilities and modus operandi. A within-case analysis uncovered how the manufacturers had realigned their assets and practices when moving towards the provision of smart solutions. After obtaining a good understanding of each case, we undertook a cross-case analysis to identify patterns across the cases (Eisenhardt, 2021) and utilized tables and charts to code, list, and structure themes in the data. We coded each interview based on the respondent's interpretation of the manufacturer's initial strengths and capabilities, realignment modes, and capabilities, processes and routines associated with smart solution providers.

3.3. Research context and Case descriptions

During the investigated time period (2010–2018), the studied firms grew remarkably, as on average, their revenues grew by 73.9% (median 80.5%; no inflation adjusted). In particular, the studied firms reported that service business revenues grew by 80.1% (median 72.1%). They were also able to generate wealth as their net profits increased by 35.6% on average (median 69.5%) and market values increased by 43.6% on average (median 46%; altogether 12,538 M€). On average, studied firms' personnel increased by 80.1% (median 72.1%). Hence, both product and service businesses contributed to overall growth relatively equally. In cases Beta, Delta and Zeta, service business growth rates exceeded their revenue growth rates. By definition, smart solutions contribute to both CAPEX and OPEX businesses because smart elements are utilized throughout the product life cycle, affecting both new equipment and service sales.

Case. Alpha has been considered a forerunner in developing smart solutions, as its CEO already in 2009 started to push foresight regarding the industrial internet forward. During the reviewed time period, the firm started to measure how much equipment is connected to the Internet. By 2019, the company had more than 20,000 units of connected equipment and had established a data lab to advance data research capabilities that help it develop new smart solutions, business models and greater customer value from the increased amount of data. Case Beta has also been considered a technology leader in its customer sectors and provides smart life-cycle solutions to its industrial clients that help them optimize the usage and productivity of their equipment based on real-time data. During the investigated time period, Beta acquired software firms and hired numerous software professionals to develop smart solutions. Recently, Beta has initiated the development of autonomous solutions in collaboration with other organizations for its industrial clients, becoming a coordinator within an ecosystem. Case Gamma has developed from a company with a strong foothold in the automation sector to a company improving its client's performance (increasing production capacity, maximizing uptime, and optimizing resource efficiency) based on data collected through the industrial internet. Case Delta has set an objective of linking more than million products to its cloud-based services. Data collected from this equipment through the IoT enable Delta to minimize the downtime of its equipment and service its customers more quickly and proactively. Delta has joined forces with a tech giant to develop and deliver better services to their customer bases based on big data and AI. Case Epsilon had incorporated network connections into their products in as early as the 1990s. Today, data must be transmitted from remote locations using satellites. The collected data enable Epsilon to develop better equipment but also to service this equipment faster and more proactively. Epsilon has described that a focus on customers is written in its DNA and that its objective is to see the customer as its partner. Epsilon has emphasized that its focus is on making the best products for its clients. Case Zeta provides complex solutions, including O&M solutions to industrial clients that operate in a rather conventional industry. Zeta applies most applications of transferred data for its service business development, namely in the forms of operation efficiency improvements and the

automatization of processes and decision-making.

4. Findings

This chapter examines the transition from a traditional industrial product manufacturing towards the provision of smart solutions, and the dynamic capabilities developed. The investigation intends to understand a) the product manufacturers' product-related strategic resources, capabilities and processes, b) the dynamic capabilities required for altering the strategic capabilities, and c) the resources, capabilities and processes required for the manufacturer to operate as a smart solution provider. Fig. 1 outlines a product manufacturer's strategic capability change process on its journey towards becoming a smart solution provider. The figure illustrates that a traditional product manufacturer's strategic capabilities and processes are associated with product-related issues such as an emphasis on efficiency logic, which is achieved through tight control. A smart solution provider's strategic capabilities and processes, on the other hand, revolve around a customer productivity logic, which is achieved through a wide range of collaborations. To alter its strategic capabilities, firm needs dynamic capabilities, that is, the ability to reconfigure its strategic capabilities and processes.

4.1. Product manufacturer's strategic capabilities and processes

Our findings illustrate that the dominant product logic held among the studied manufacturers neglects the role of the customer and emphasizes a strong product and technological heritage. Regarding the capabilities associated with the traditional product manufacturer, all the studied manufacturers stated that their strategic capabilities were related to the development and provision of superior and novel technologies and cutting-edge products. Similarly, their processes and routines stemmed from these product-based capabilities and were focused on improving (internal) efficiency.

This product-based mindset stresses engineering know-how and culture to develop cutting-edge technologies and products. The following quote, despite using a joking tone, illustrates the mindset adopted by a product-oriented manufacturer when it used to sell projects without considering the customer:

> *"We used to say* [laughing] *that we sold the project, and that's it. We delivered the project and forgot the customer." (VP, Sales, Zeta)*

The studied firms emphasized that their product-related strategic capabilities were related to product design, product sales, manufacturing operations, and automation. Hence, capabilities were engineering-based and revolved around the "intranet-of-things" type of thinking, i.e., how equipment could be used effectively in closed systems. These capabilities emerged from processes and routines that emphasized well-planned and structured engineering-based mindset and capabilities. The following quote reflects the technical, product-related in-house strategic resources that the studied companies possess:

> *"We have considerable technical, equipment-related know-how within the company."* *(Area Manager, Delta)*

Depending on the viewpoints expressed, these product-related strategic capabilities can be depicted as a strength or source of rigidity (or both) for the company. Specifically, product-based sales processes and routines were price-oriented and highlighted technical features over the customer's quantified value, as the following quote illustrates:

> *"The product sales force still struggles to sell value because it considers this* [solution] *expensive. The sales force doesn't realize the value for the customer and sticks with the price tag, not what value it has generated." (Service Director, Gamma)*

One manager stated that engineers were good at developing new (breakthrough) product ideas but often failed to achieve customer engagement and value when designing such ideas:

> *"It's not enough for an idea to be technically superior. Engineers sometimes have this kind of "nerd fault" where they overemphasize technical features over monetary value." (Senior Project Manager, Beta)*

Overall, the interviews indicated that product-focused capabilities,

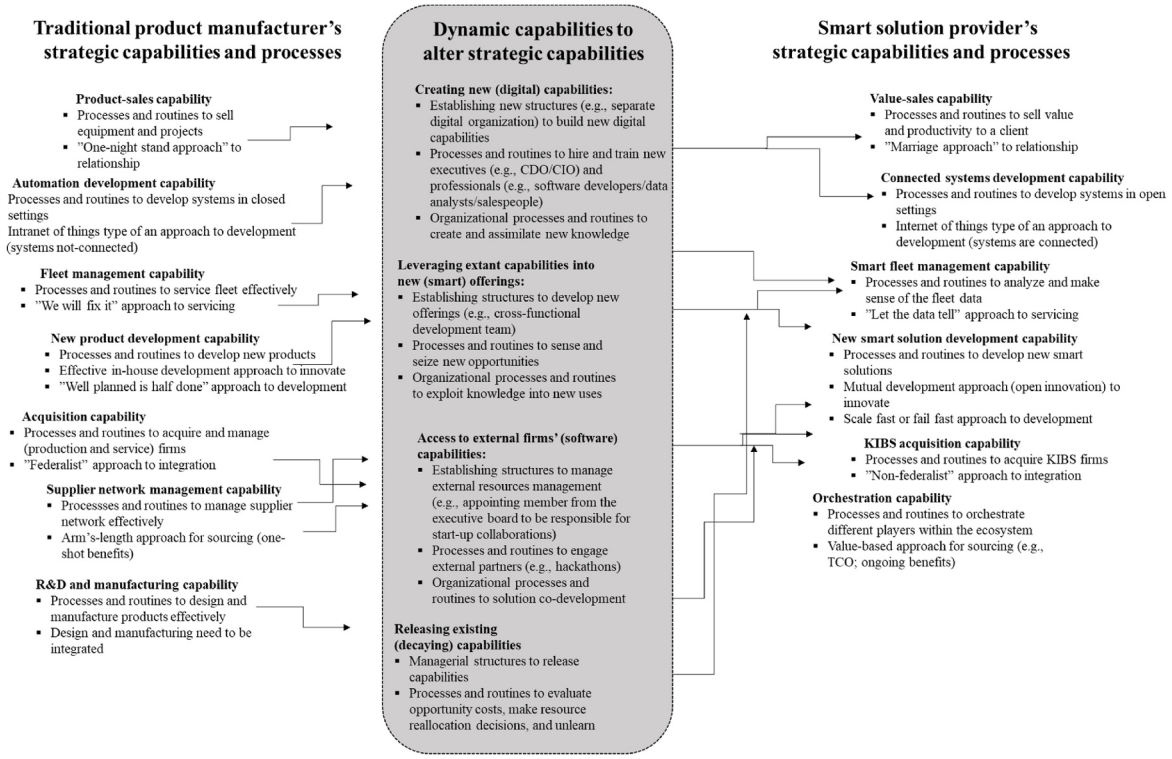

Fig. 1. Product manufacturer's dynamic capabilities to alter its strategic capabilities when becoming a smart solution provider.

processes, and routines constituted the firms' initial strengths, as they are antecedents for creating cutting-edge products, but they had limited the firms' development to some extent. In particular, typical "sins" identified were related to a misunderstanding of inherent customer needs and values. To recreate themselves, firms need to alter their strategic capabilities and processes to become different types of companies.

4.2. Changing manufacturer routines to realign capabilities when becoming a smart solution provider

In the following chapters, new routines to realign capabilities are identified in the modes of creating and building new digital capabilities, leveraging existing capabilities into new (digital) offerings, accessing external capabilities, and releasing existing capabilities.

4.2.1. Building new (digital) capabilities

The studied solution providers' incentives to build and create new digital capabilities in house were related to increased control and integration benefits. Key barriers were related to identity issues (defining "who are we as a firm?"), a lack of digital competencies (capability mismatch), a lack of slack resources, problems related to evaluating opportunity costs, concerns about the pace of development, and decisions about firm boundaries (determining whether to remain in-house, outsource or employ alliances). Hence, executives were struggling whether it would be better to digitize through internal or external assets (Salonen and Jaakkola, 2015; Paiola et al., 2013; Prange et al., 2018). To solve this dilemma, the studied firms first acknowledged that they did not need to possess all of the digital/software capabilities themselves. More importantly, the firms observed that rather than running the digitization initiatives themselves, they needed to be able to effectively manage and coordinate digitalization processes by recruiting competent managers and personnel, as stated by one manager:

> *"We don't need to do all the coding and analytics on our own. We have to have enough competencies that we can manage that process* [coding and analytics]*." (Manager, Strategic Alliances, Beta)*

The studied firms naturally hired new personnel to gain the competencies required for the provision of smart solutions. Although large-scale hires were performed mainly in traditional service businesses (e.g., technicians and field personnel), the companies increasingly started to hire pure software developers, data scientists/analysts, system specialists, and service designers to obtain software know-how in house. One CEO emphasized that the number of software engineers exceeded the number of traditional engineers in the company, thus representing a remarkable logic change within the firm:

> *"We have now more software engineers than mechanical engineers in the company." (CEO/Epsilon)*

Another significant competence-related issue concerns the development of sales operations, as firms struggled to find employees who could simultaneously handle technical features and respond to customer needs. The studied firms therefore started to emphasize the importance of value-selling competencies (Keränen et al., 2021; Ulaga and Reinartz, 2011; Schaarschmidt et al., 2021). This movement towards consultative selling was seen as particularly challenging because the product salesforce often lacked the competencies, processes, and routines to identify customers' value drivers and to discuss financial issues with the customers' top executives. On the other hand, salespeople recruited from outside the industry struggled to gain sufficient credibility with traditional customers. Some of the studied companies focused on training their existing salesforce (or a subset of it), and others relied on new recruits. These two approaches, namely, hiring salespersons externally or training salespeople internally, are exemplified by the following quotes:

> *"In our global team, we have hired people outside the company. However, our business is not so easy. You have to be able to discuss with our customers about this industry and metal processing at a quite detailed level. That's why we have tried to find Account Managers and Directors inside the company and train them to work in that role* [solution sales]*. We have seen that this is a better route. The other option would have been to hire Account Managers elsewhere and teach them how the industry works." (VP, Sales/Zeta)*

> *"So, that's one challenge, really, this evolution from technical sales to commercial. You probably should recruit some new people with these new skills." (Director, Maintenance, Beta)*

To exploit these human resources effectively, some of the studied manufacturers established separate digital organizations to run all digitization initiatives more independently and to legitimize themselves internally. The most typical way to increase the strategic importance of digitalization was to nominate a Chief Digital Officer (CDO) or Chief Information Officer (CIO) as part of the top executive team. In 2010, Beta and Epsilon had persons responsible for IT development in their executive board (Alpha had CIO as part of their extended management group then). By 2018, all of the studied companies except for Zeta had a CIO/CDO as part of their executive boards. Moreover, Beta established a separate digital development unit in 2017 to execute its digital strategy. This restructuring was done to boost digital development in house and communicate the strategic importance and urgency of digitalization to key stakeholders.

> *"We have established a separate digital organization that supports businesses in digitizing them. They bring best practices and competencies regarding cybersecurity, service design, software development, et cetera. But eventually, it should be integrated. As our CDO has said, we need transformation towards a new culture and mindset. This digital organization is just a temporary stage, and its lifecycle will come to an end at some point. But to facilitate this cultural renewal faster, we have chosen this way." (Digitization Director, Beta)*

To prioritize the development of smart solutions, the studied companies established ICT-related strategic development programs, i.e., must-win battles (MWBs). In 2010, none of the studied firms had digitization-related MWBs as part of their formal strategy. In 2014, Alpha and Zeta had determined digitization as one of their strategic development programs. By 2018, all but Epsilon had named digitization/IoT its key MWB (at Epsilon, IoT had been heavily emphasized in its strategy since 2016). Hence, technological disruption and digitization were seen as key megatrends affecting these firms' competitive landscapes. Firms thus established formal development programs to obtain management's attention and metrics for these programs to meet.

> *"We have these MWBs that emerge from our strategy. This enables us to follow things at an individual level … One of our MWBs is related to this industrial internet. We want to be the leading firm in this area." (Director, IoT/Gamma)*

Cross-functional development teams are essential to increasing the mutual understanding of smart solutions. This is one way to facilitate intraorganizational learning. However, such a committee does not typically have decision-making authority (Porter and Heppelmann, 2015) and may lack the power to facilitate change. On the other hand, the strengths of cross-functional development teams are delivered through their open discussions, informal structure, and knowledge-sharing practices. At their best, cross-functional teams open organizational silos and increase collaboration between business units. At worst, they are reminiscent of committees, and no real development occurs through them. One director noted that the development of smart solutions requires cross-functional collaboration across the development phases:

> *"We need various competencies* [in smart solutions]. *One needs to know ICT, another needs to know mechanical engineering, one needs to have technology-enabling competencies and automation know-how. We need to possess all of these technical competencies. Then we have business model developers, people who think about the added value, and they also feed this need to the subcontractors. This is related to project management competences, as we need to manage and control these highly talented people. When we get closer to the solution launch phase, we need marketing people. And when we deliver this solution, we need ICT people, people who are highly competent with databases. Then we have information system coordinators who manage these remote connections." (Director of Product and Services Development/Alpha)*

In sum, based on empirical work, the studied manufacturers created and built new capabilities through strategic (e.g., establishment of industrial internet MWBs/appointing CDOs) and structural (e.g., establishing separate organizations for IT development) rearrangements. These higher-level routines enabled manufacturers to justify internal software development, acquire new (software) talent, and train personnel to obtain new knowledge.

4.2.2. Leveraging existing capabilities

Leveraging extant capabilities is a mode to exercise a dynamic capability by applying these capabilities to new uses such as new product and service offerings (Prahalad and Hamel, 1990; Subramanian et al., 2011). The capabilities that product manufacturers can leverage are typically their brand, distribution channels, customer understanding, production assets, and collected product and customer data (Danneels, 2011). Key incentives for leveraging solution providers' existing capabilities among respondents were related to an increased share of customer wallets, customer profitability and faster learning/development cycles (increased clock speed). Key barriers to leveraging their extant capabilities were related to the questions of "strategic fit" or "strategic stretch." Hence, the dilemma of scale (accompanying fit) or scope (accompanying stretch) should be addressed. Therefore, it may be challenging to understand a firm's core business and customers' true needs, as well as to understand how its core capabilities could be stretched for use in various other business opportunities. Firms were thus struggling to balance their exploitative and explorative activities.

The installed base of products provided a solid base for understanding how products are used and maintained. Manually collected historical (service) data provided good knowledge of product functionality, but these data were not very extensive and were mainly reactive, as traditional manufacturers did not know exactly how customers used the products. However, the history of these already supplied products provided not only past information about their functionality but also opportunities to modernize by adding new features and technologies. These "retrofits" are important for many manufacturers, as only connecting new equipment would require a long time until manufacturers could obtain a sufficiently large fleet to monitor data. In our sample, retrofits were seen as a strong opportunity to generate sufficient product-related data.

> *"Retrofits are a relatively easy and economical way to add current features and technologies to existing equipment. Common retrofits include component replacements, variable speed control, radio remote control and LED lighting. Compared to modernizations, retrofits typically require much less preplanning and downtime." (Alpha/Public document)*

The studied solution providers aimed to increase their share of the customer's wallet by starting to provide total/turnkey solutions to their clients. For instance, Gamma reported that spare parts accounted for 70% of its service sales, and Epsilon's CEO stated that *"majority of the service sales comes from spare parts."* To increase the relative shares of other services such as O&M solutions, Case Zeta took strategic initiative to increase the number of other services, as they observed that differentiation through spare parts is becoming more challenging and that there is untapped potential in the provision of turnkey solutions. This initiative is controversial for both the manufacturer and customer because each must decide which activities to perform in-house and which activities to outsource. For manufacturers, this initiative provides financial opportunities, but they need to assume responsibility for activities that they currently do not provide. For clients, this initiative may decrease their transaction costs because they can source everything from one company, but it also makes them more dependent on a single supplier. In total solutions, data become vital, as the data reveal potential production bottlenecks. Thus, data ownership becomes a key issue because the clients understand the value of the data, and the manufacturer must obtain the relevant data to run the process effectively. At Alpha, this was solved by agreeing that customers always own the data and have the right to erase the data. The manufacturer has the right to use the data, but this ends when the contract ends as illustrated below:

> *"The customer always owns the data, and we have access to it, we must be able to use the data." (CDO/Alpha)*

Software development practices had helped manufacturers conduct rapid experiments through fast piloting. In the traditional hardware business, pilots were costly and time consuming until the product reached large-scale production, but it was challenging to shift the mindset towards new agile thinking. Based on the data, technology companies were able to quickly see the value of the pilot Case and adjust based on feedback and user experience. Fast piloting represents a new routine based on agile development and immediate feedback loops. New enabling technologies, such as digital twin platforms, have allowed solution providers to speed up their R&D processes and increase clock speed in development as the following quote illustrates:

> *"With an integrated digital twin platform, we see major potential in speeding up the product development process, reducing prototypes, increasing traceability and thus improving quality and reducing development cost." (CDO/Alpha)*

In sum, the studied firms primarily targeted their existing customers when starting to sell smart solutions. Although the studied firms acknowledged that smart features could potentially expand their current customer base (e.g., a manufacturer can expand its customer base through provision of performance-oriented services), they focused on serving their established customers by providing software-based innovations to them first. In addition, changes in offerings were evolutionary. These smart elements were first embedded in the most expensive and advanced equipment for profitability reasons but also because they had the most developed relationships with these customers. It should be noted that the studied manufacturers were not able to leverage their distributor channels through their digitizing initiatives because the power and roles of distributors were likely to erode due to increased smartness across products and a power transition for equipment providers.

4.2.3. Accessing external capabilities

One way to renew a company is through accessing external capabilities. The key drivers behind this alteration mode are rapid access to external capabilities and the generation of novel development ideas. Meanwhile, the key barriers are integration challenges (particularly in acquisitions), cultural misfit, lack of a common language, lack of management cognition about complementary capabilities, and existing sourcing routines, namely, use of arm's length governance mechanism. This mode of exercising a dynamic capability constitutes another alternative to creating and building capabilities in house. External resources can be accessed through acquisitions and alliances (Danneels, 2011). However, the decision between pursuing an acquisition or forming an alliance is difficult to make (Dyer et al., 2004): The studied solution providers employed both methods. Most often, the providers used M&As to gain access to core technologies or business/technology

areas they believed would be central in the future. M&As were particularly utilized as a strategic practice among companies that were considered "system sellers" in our sample. System sellers refer to those vertically integrated solution providers that produce product and service components in house. By contrast, "system integrators," i.e., manufacturers that focus on coordinating the integration of components produced by external companies, seemed to rely on alliances to gain access to software and analytics know-how (Davies et al., 2007). Our interviews indicated that the acquired companies were not immediately integrated into the focal companies but were most often allowed to continue their operations as individual companies (e.g., Beta uses one of its software acquisitions as part of their brand names related to real-time fleet monitoring). Unlike in pure service acquisitions, federalist attitudes were not observed in software acquisitions because these knowledge intensive business service acquisitions (KIBS) were competence-driven, the focal companies did not have the competencies to run such businesses themselves, and these acquisitions were relatively small.

> "*I think that our focus has been changed about what types of acquisitions are made. The recent few acquisitions are related to digitization and new services. This is also something that can be easily seen in revenues and within the organization." (Digitization Director, Beta)*

> *"We just acquired a software firm. It's a leading software firm for developing monitoring software for industrial companies. We are now incorporating it into our solution model. This means that we don't sell pure software anymore, but we bundle products, services, and software into a solution. The customer can get quantified benefits through our solution." (Service Director, Gamma)*

As global access to resources is considered to be common in the current economy, access to resources should no longer be considered a sustainable source of competitive advantage (Prahalad and Krishnan, 2008); instead, a firm's ability to deploy and manage external partners is critical (Capron and Mitchell, 2009). In our sample, the studied firms started to collaborate with pure software companies, start-ups, universities, and peripheral companies to develop digitally enabled (total) solutions. For instance, Delta hired a manager in 2016 to develop and coordinate their partnerships with large technology companies and start-ups. To gain access to software competencies and, for instance, to more specific competencies such as AI and machine learning, the studied solution providers started to work with pure software companies. These benefits of collaboration are described as follows:

> *"If you look at the work we are doing with Delta, on predictive maintenance, for instance, these are projects with less risk. If we can predict maintenance problems, to tell when something is going to fail rather than service something once a year or wait and then react when it breaks down, the savings in terms of cost and time can often pay for the investment in IoT and AI technologies on its own." (Delta's software partner)*

Firms became increasingly interested in collaboration with start-ups when they wanted novel ideas and new applications. One routine designed to boost collaboration with IT companies and start-ups involved hackathons. Since 2015, all of the studied companies except for Gamma had organized hackathons on a regular basis to develop creative ideas and address real business problems and customer needs. Beta nominated one executive from its executive board responsible for start-up collaborations, indicating a remarkable shift in its way to manage partnerships (as a contrast, decade ago, the Chief Purchasing Officer was part of the firm's executive board).

> *"We got bunch of good new ideas. In addition, we created new networks. Through hackathons, you get a much better understanding of firms' capabilities instead of hearing traditional sales speeches in the conference room. They can concretely prove what they know." (Manager, Data Analytics & AI/Epsilon)*

Collaboration with research institutes such as universities was considered to be important when developing smart solutions. IoT labs are useful when developing applications, analyzing product data, and testing new viable business models in safe test environments. In a broader context, this collaboration facilitated general IoT education and benefited the entire ecosystem, as demonstrated below:

> *"This is an excellent way for us to deepen our cooperation with the university. The Industrial Internet is one of our key strategies and represents great potential and an enabler of the future business conducted by us and our customers … Opening product data interfaces to researchers and other developers enables innovations that, in the long run, will benefit everybody in the ecosystem." (Strategy Executive/Alpha)*

When business models shift towards outcome-based contracts and total solutions where the role of software is central, solution providers need to productize these business concepts and prenegotiate financial issues, as the ownership of equipment and financial risks are no longer transferred to customers. This change means that the manufacturer needs to collaborate with peripheral organizations such as banks, financial institutions, investors, insurance companies, or pension insurance companies to provide such agreements.

> *"We have had some projects where we sell outcomes. Currently, these contracts are negotiated separately. To productize this concept and make it truly scalable, we need parties that are not involved today such as financial institutions, investors, insurance companies, maybe financial service companies, and some others we may need." (Digitization Director, Beta)*

In sum, access to external resources seems to be a central component in renewing companies. To benefit from these external capabilities, firms must have some valuable complementary internal capabilities to exploit (Bustinza et al., 2019; Kohtamäki et al., 2013). The installed base of products, existing fleets, access to established relationships with customers, a deep customer understanding, physical facilities, and a wide range of customer solution offerings are complementary assets that enable solution providers to engage in successful acquisitions and alliances with start-up, software, and peripheral companies.

4.2.4. Releasing existing capabilities

The last mode to renew a firm involves releasing assets and capabilities (Moliterno and Wiersema, 2007). This mode consists of not only business divestments, closures, layoffs, and outsourcing (Huikkola et al., 2016) but also organizational unlearning and behavioral/routine changes (Tsang and Zahra, 2008). The key incentives behind releasing assets are related to freeing up assets to develop and build new capabilities and to reducing operational and transaction costs. The key barriers are related to fears of losing control, business cannibalization, identity change, and the difficulty of evaluating opportunity costs.

The studied solution providers needed to make resource trade-offs when developing new capability portfolios. This mode consisted of business divestments, layoffs, outsourcing/offshoring manufacturing activities, and activities aimed at decreasing transaction costs, such as compression of the supplier network. Most typically, solution providers shed their manufacturing assets or outsource their standard products offshore to obtain the resources needed for developing solution business and advanced technologies, as stated by one manager:

> *"There has been both evolution and revolution: business has been adapted, developed and made more focused. What doesn't fit has been released." (EVP, Beta)*

As with every listed company, profit pressures forced the studied firms to lay off people, especially in their production plants. Simultaneously, more personnel were hired for the emerging businesses:

"We are laying off some people from our R&D facility and global support functions to give more space to new digital innovations, as some products have decayed." (Communications Manager, Public document, Delta)

One initiative the companies adopted was compression of the supplier network. The initial goal of this move was to realize cost savings, but they also aimed to decrease their transaction costs and make network management more rational. The downside of this activity is that the firms became more dependent on more powerful strategic suppliers. On the other hand, smart solutions were seen as key enablers in this movement because they facilitated deeper collaboration with customers and allowed the firms to transition to becoming a customer's strategic partner. Hence, this transition takes place throughout the ecosystem.

"We are transforming ourselves from a regional buy-make-sell model to a global buy-move-make-move-sell anywhere mode … We currently work with 13,000 active direct material, project, service and indirect suppliers all over the world that act as extensions of our own company. We have been developing our supplier base by decreasing the number of suppliers and continue to engage them in responsibility work. At the moment, 250 suppliers provide us with the central supplier base, and these are the ones we especially concentrate on." (Annual report, Alpha)

Generally, top executives highlighted the need to unlearn old routines and learn new routines, thus stressing the fact that strategic change also calls for individual-level changes:

"Even though it's difficult, we need to unlearn our old ways of doing things." (CEO, Delta)

In sum, releasing capabilities is a vehicle used to steer the firm in another direction. This mode is a difficult way to exercise dynamic capability not only because of sensitive personnel issues but also because freeing capabilities to build new capabilities is always uncertain. It should be noted that once the decision to release has been made, it is not easy to redevelop that capability area. The studied firms were not forced to release their capabilities, but releasing decisions were systematically and proactively made to achieve a vision of becoming a smart solution provider.

4.3. Interplay of capability realignment

As change is incremental and slow rather than radical and rapid in the studied Case firms' middle-velocity sectors (i.e., markets are moderately dynamic), modes to renew product manufacturers' capabilities happen in parallel and incrementally, which requires considering the dynamic interplay between realignment modes. Creating new software capabilities assists firms in leveraging those capabilities to provide new forms of smart offerings. These new software capabilities also enable manufacturers to make new software acquisitions and formulate new alliances with software firms, as manufacturers have competencies in house to better manage those acquisitions and alliances. Creating new capabilities is possible due to slack resources emerging from profitability, loans, or released assets. Even though firms did not instantly or easily release assets to generate new capabilities, in the long run, we can identify certain patterns whereby the product manufacturers sold their noncore manufacturing and product-related assets (e.g., factories and product design competencies) to acquire and build new software-related assets considered necessary in the future, as the following quote illustrates:

"The move to divest manufacturing assets will free up resources and increase our emphasis on accelerating the development of new products and advanced technologies." (VP, Beta)

Leveraging existing capabilities to new smart offerings creates new opportunities for formulating different alliances. For instance, Delta established a strategic alliance with a tech giant after understanding the value of its data for its installed base of products. Delta itself did not possess capabilities in big data analytics or AI, so it decided to acquire these capabilities externally to exploit dedicated partners' capabilities in this new business/competence area. This new alliance provides opportunities for Delta to develop and sell new offerings to its clients (e.g., AI-powered business services) and to increase its customers' share of wallet (this can be verified from the value of service agreements). The following quote shows how new capabilities can be created through new routines adopted from software development:

"Now we need experiments, rapidly planned and built prototypes, and fast learning. If we are able to achieve cross-functional competencies, new competencies will be created." (CDO, Delta)

Accessing external capabilities through M&As or alliances provides opportunities for continuous morphing. New acquisitions may help firms to expand their current scope of offerings and get control to new capability areas and end-products, whereas establishment of alliances helped firms to get access to specific know-how rapidly. Fig. 2 above describes in more detail the dynamic interplay between the realignment modes of smart solutions, as these modes are in continuous interaction.

4.4. Smart solution provider's strategic capabilities and processes

The managers' responses indicate that in middle-velocity sectors despite being heavily affected by digitalization megatrends, strategic capabilities and processes are not altered rapidly, which poses several challenges for any company. As the change process takes time and resources are not reallocated to new opportunities overnight, this may lead to a lack of feeling of urgency to change ("we are doing fine") among personnel. Discontinuous change in high-velocity markets often pushes firms onward more rapidly because the sense of urgency is more concrete. In a similar vein, external shocks (e.g., COVID-19; financial crisis) are challenging but typically alert organizations early enough to enable them to react to mandatory changes.

According to our interview data, the interviewees still felt that they were on a journey towards smart solution providers. Hence, they had not yet achieved their desired position in the ecosystem but were in the middle of the change process. Some firms' top executives even described their firms as "software companies," which was confusing to some personnel who did not want to be in a software company's position. Instead, all of the studied companies held the view that being an equipment manufacturer that integrates services and software into their offerings is desirable, as it enables better positioning along the ecosystem. However, public statements about manufacturers becoming software companies played a key role when setting expectations both internally and externally. Internally, such discourses may lead to actions that managers are expected to make (e.g., acquire software firms). Externally, such statements help construct a growth narrative about a company's future direction, position, and identity, especially among investors. This type of strategic storytelling intends to communicate the ideal-typical future identity:

"We are becoming a software house." (Head of New Services and Solutions, Delta)

Changing mindsets from product-centric to customer-centric mindsets was also seen vital for change. Instead of looking for smart solutions from the inside out, manufacturers stressed the importance of adopting an outside-in approach as described below:

"While the product unit approach typically ran from products to customers, we turned this upside down. We develop our solutions from the customer's perspective; what are the customer's needs and problems. We're doing this partly based on existing capabilities but this viewpoint shift is changing our mindset." (Service Director, Gamma)

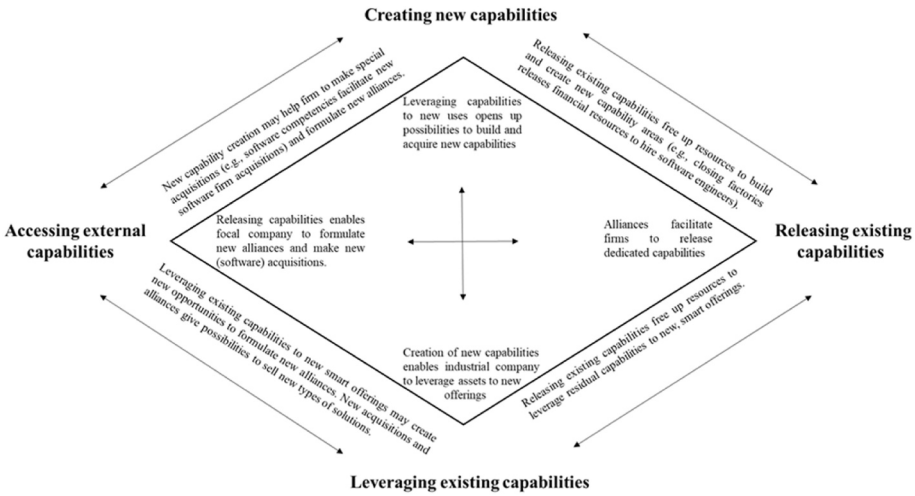

Fig. 2. Interplay of capability realignment modes in smart solutions.

Additionally, development work should become more agile and follow the lean-start-up approach of "scaling fast or failing fast" instead of the typical engineering mindset of "well-planned is half done" when the concurrent problem is that all measures are overly planned. This mindset shift is far from easy, and studied firms established new development models for solution development. For instance, Beta established a corporation-wide strategic initiative in 2017 to renew its new solution development model such that it would become more agile, participatory, and efficient. The aim of this initiative was to change the firm's mindset and dispel old engineering culture and routines when developing new smart solutions. Furthermore, in sourcing activities, firms struggled to purchase systems from new types of firms, such as software firms and start-ups, as their old sourcing routines were reminiscent of an "arm's length mechanism," which is better suited to purchasing standard components. This routine was not considered effective in terms of pursuing (co)innovations. Hence, the studied firms needed to develop "orchestration capability" that is reminiscent of ecosystem coordinators/developers rather than purchasers in a dyadic relationship. Generally, manufacturers started to become more similar to coordinators, coaches and developers, while their traditional identity was reminiscent of those of purchasers, authorities, and teachers, especially in their established strategic capability areas regarding equipment provision. The following quote illustrates how digitalization drives how a firm's role is changing within the ecosystem:

> *"We are developing from producer to partner and from executor to coordinator. Digital solutions are driving this change." (Public document, Beta)*

These mindset and role shifts are profound for product manufacturers and call for special management approaches to develop new capabilities (e.g., value sales capability and software development capability) and integrate them with existing capabilities, as the following selected quotes exemplify:

> *"If we sell these total solutions, they are sold to the top managers through business cases. A product sales force rarely has this type of capability to sell and argument value." (Service Director, Gamma)*

> *"We need to have software and automation competencies. These two competence areas need to be integrated. In addition, we need to combine this digital capability with traditional process and maintenance know-how." (Director of Global Services, Zeta)*

New capabilities are not sufficient *per se* but they need appropriate managerial routines to be executed effectively. Interviewees highlighted the need, for instance, for sales and collaboration routines to be revamped to achieve smart solution provider status, as follows:

> *"These O&M solutions are sold to the customer's top management. Then, the sales arguments change as well* [towards a focus on the total cost of productivity]*." (Director, Global Services, Zeta)*

> *"… but we act as an ecosystem improver through a wide range of collaborations." (CEO, Beta)*

To become a smart solution provider, management cognition in terms of strategic capabilities and processes associated with smart solution providers is important (Danneels, 2011; Helfat and Peteraf, 2015). Such cognition need not be specific and detailed but rather approximate. The need for new strategic capabilities and processes may stem from current opportunities/problems or opportunities/problems expected in the future. In sum, smart solution provider's mindset seems to contain elements of "value logic" (Töytäri et al., 2018), capabilities revolve around product-service-software development capability (Hsuan et al., 2021), and strategic approach shifts from an "internal efficiency" towards an "increased customer productivity".

5. Discussion

5.1. Theoretical contributions

The present study examined how a traditional product manufacturer employs its dynamic capabilities to become a smart solution provider. Our contributions to the intersection of digital servitization literature and capability theory are twofold, as the present study 1) sheds light on how capability reconfigurations help manufacturers to change the focus of their strategic capabilities from products to smart solutions and 2) emphasizes the interplay of capability realignment modes and their reinforcing mechanisms for capability development to converge products, services, and software.

As a first theoretical contribution, the present study extends our knowledge of the dynamic capabilities required to transition from manufacturing products to the provision of smart solutions (Bustinza et al., 2021; Kohtamäki et al., 2019; Paschou et al., 2020; Sklyar et al., 2019; Tian et al., 2021). In particular, the findings of this study highlight the role of managerial cognitions of the required organizational capabilities and processes when operating as a different type of a company (Danneels, 2011) and a general *"managerial cognitive capability"* (Helfat and Peteraf, 2015: 831) as a key factor that facilitates strategic change towards the use of smart solutions. Managers should thus have certain cognitions of their firms' broader mindsets as smart solution providers (e.g., "we will be a software house") (see Töytäri et al., 2018); of their

positions in the ecosystem as smart solution providers (e.g., "we will bypass the intermediaries and move closer to the end-customer") (see Huikkola et al., 2020); of capabilities their firms should possess as smart solution providers (e.g., "we need to have the capability to integrate products, services, and software in a way that creates extraordinary customer value") (see Danneels, 2011); and of related processes and routines (e.g., "we need to develop new solutions more rapidly for the markets") (see Lenka et al., 2018). Managerial cognition of smart solution providers' strategic capabilities and processes can be a source of dynamic capability (Danneels, 2011; Eggers and Kaplan, 2013; Helfat and Peteraf, 2015; Schilke et al., 2018), as empirical studies on the microfoundations of dynamic capabilities have shown (Bingham et al., 2019; Gavetti, 2005; Laamanen and Wallin, 2009). The present study extends our knowledge of dynamic capabilities involved in smart solution development contexts by stressing the role of dynamic capabilities and in particular, realignment modes (building new digital capabilities, leveraging extant capabilities, accessing external capabilities, and releasing existing capabilities) to alter strategic capabilities.

As a second theoretical contribution, this study advances our understanding of dynamic capability development in a smart solution business development context (Coreynen et al., 2017; Kindström et al., 2013; Raddats et al., 2015; Töytäri et al., 2018) by emphasizing the interplay of realignment modes and routines (routines designed to create new digital capabilities, leverage extant capabilities, access external capabilities, and release existing capabilities) when exercising dynamic capability. The interplay of realignment modes provides *reinforcing mechanisms* for capability development, which are important to identify, as they facilitate the already challenging capability development. The challenges presented by capability development stem from the different capabilities needed in product, service, and software businesses (Hsuan et al., 20201) and their different development cycles (Huikkola et al., 2021). Synchronizing these different logics among products, services and software requires time, resilience, and patience, i.e., perseverance from the capability development initiatives, as suggested in prior digital servitization literature (Rapaccini et al., 2020). Our longitudinal evidence suggests that overly rapid capability changes would not produce favorable outcomes, as capabilities associated with different types of businesses (products, services, software) must be aligned, which requires some time and much effort. As a Case in point, Martin (2018) reports examples from GE pursuing strategic change too quickly through mergers, acquisitions, and divestitures. Our evidence suggests that incremental and parallel capability development are preferred when products, services, and software are intertwined; that is, proper capability development requires time as different businesses need to continuously interact to create value for the client. Capabilities evolve through active intra- (Huikkola et al., 2021; Rapaccini et al., 2020; Schaarschmidt et al., 2018) and interfirm collaboration (Sklyar et al., 2019; Töytäri et al., 2018). Hence, dynamic capabilities should facilitate the integration of resources and processes to create unique customer value with smart solutions. As this integration is synchronized with capability evolution across the ecosystem/boundaries (Huikkola et al., 2020; Sklyar et al., 2019) and dyadic relationships (Töytäri et al., 2018), fast changes are improbable, unlike in more dynamic sectors such as consumer goods or platform markets. The results of the study shed light on the nature of dynamic capabilities in other than high-velocity business markets.

5.2. Managerial implications

For managers, our study reveals that they need to establish their smart solution visions (what they attempt to achieve in the long run) and identify the new capabilities and processes required to achieve such goals. In particular, managers must ask themselves what resources they need to create internally and externally to achieve their vision? Second, they need to define the boundaries of resource leverage: what level of "strategic stretch" is purposeful and what is the "strategic fit" of the diversification initiatives? Third, managers need to define partners for collaboration, why they choose these partners and what is the goal of this collaboration and why. Fourth, managers need to consider resource trade-offs and which resources need to be released (or how to obtain financing) to pursue their strategic change. Finally, managers should consider the interplay between realignment modes and whether these modes should be managed simultaneously or sequentially.

The dilemma of smart solutions is that in the short run, investing in them may follow "bad management practices." In other words, investing in existing businesses (hardware and services) would be more profitable in the short run. Thus, the opportunity costs of smart solutions can be higher compared to other alternatives, which makes resource allocation decisions complicated, as managers need to address the following questions: should money be invested in activities that have already proven to be useful and profitable? How much money should be invested in insecure (and risky) projects such as smart solutions? At the board and executive board levels, a willingness to cannibalize existing products and businesses, constructive conflicts, scenario work, and maximum sums to allocate to risky and noncore business development could be further considered part of managerial routines used to manage strategic renewal in a flexible yet controlled manner (Danneels and Sethi, 2010). Simple boundary rules such as the 70/20/10 rule (how many resources are allocated to established, emerging, and periphery businesses), free work-time allocation (e.g., 20% of the work time) or maximum percentage of R&D investments (e.g., 10%) could be stipulated to facilitate controlled and manageable but not overly rigid renewal processes.

5.3. Limitations and future research avenues

This study is based on results derived from leading product manufacturers in their sectors. Although far-reaching generalizations cannot be made, given the qualitative nature of this study, the present work provides valuable insight into how firms reconfigure their strategic capabilities and processes when becoming smart solution providers. The studied companies had a strong foothold in mature markets where customers may possess different capabilities than customers operating mainly in developing markets. It would be valuable to study the perception of smart solutions in the context of immature markets. As digitalization enables the creation of several business models for technology companies, future studies could investigate how capabilities and activity systems differ between the different business models applied.

The studied solution providers were relatively large companies, and they had prior competencies and experience with software and IT development. It would be beneficial to study SMEs and how they alter their capabilities and processes when providing smart solutions because they lack certain resources and may need to rely more on external resources. Furthermore, established companies do not widely reveal numbers received through smart solutions *per se*. Hence, it is difficult to evaluate whether their success is based on the exploitation of old or new technologies. Researchers need business model-specific, business unit-level, or even individual business relationship-level (financial) data to develop an understanding of how profitable smart solutions are. Such in-depth (single) Case studies could provide insight into the development and perceptions of smart solutions across boundaries. Moreover, additional studies are needed on the microfoundations (e.g., managerial heuristics) of dynamic capabilities of smart system sellers and smart system integrators and on how these different smart solution provider types affect the employment of capabilities and processes, especially when a system integrator wants to become a smart system seller and vice versa.

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