



Proceedings of the Spring Servitization Conference

The Role of Servitization in Grand Challenges

**Spring Servitization Conference 2023
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This ground-breaking research programme is set to shape industrial best practices and influence decisions around industrial policy associated with productivity and de-carbonisation. It will establish evidence to illustrate how servitization impacts both economic productivity and environmental performance (i.e., net-zero and the green economy) and use these insights to influence industrial policy and practice in the UK. This will clarify and explain whether, when, and how the adoption of servitization should be encouraged to maximise the economic and societal impact. Researchers, from The Advanced Services Group in collaboration with The Energy and Bioproducts Research Institute and The College of Engineering and Physical Sciences at Aston University together with researchers at Warwick Business School; will develop a strong theoretical foundation based on prior research on business model innovation and value networks.



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The multidisciplinary research platforms combine strong disciplinary knowledge with prevailing global trends. They are utilized to advance multi-, cross- and inter-disciplinary research to help address the complex challenges facing our society. University of Vaasa is committed to the principles of open science.

Introduction

The 2023 Spring Servitization Conference (#SSC2023) is dedicated to understanding how organisations can develop and adapt their business models through servitization and advanced services. The theme focused on the 'Role of Servitization in Grand Challenges' and was held on the 8th and 9th of May 2023 in Helsinki, Finland in collaboration with our colleagues from the University of Vaasa, Finland.

Once again, the conference brought together the world's leading researchers, practitioners and doctoral students to debate and engage with the theory and practice of servitization. On Monday 8th and Tuesday 9th May, we followed the now-established format of a single stream where all contributors have an opportunity to present to the whole conference audience and engage in both structured and semi-structured panel sessions to discuss their work. The programme was designed to encourage extensive debate and bridge research theory and industrial practice. The conference also featured keynotes from senior executives at leading manufacturing businesses.

In addition, we dedicated some sessions to the early-stage research which comprised interactive keynotes by leading academics in the field, debates around emergent research themes, and poster reviews of proposed projects and doctoral theses.

We would like to thank all new and returning contributors, reviewers, delegates, sponsors, and staff for their continued support and commitment to the Spring Servitization Conference.

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DIGITAL SERVICIZATION IN UK MANUFACTURING SMEs

Antonios Karatzas, Dimitrios Dousios, Jawwad Raja

ABSTRACT

Purpose: Research in digital servitization has proliferated, but there is a lack of large-scale quantitative studies, partly due to the dearth of appropriate measures. Moreover, the literature has primarily focussed on large enterprises, neglecting the SME sector of the economy. As a consequence, it is unclear under which conditions SMEs move towards (higher levels of) digital servitization, and what alternative business models they adopt.

Design/Methodology/Approach: This work develops two approaches to capture digital servitization in a quantitative manner: first, it builds on existing typologies to develop an operationalizable digital business model classification; second, it develops a formative measure to capture the degree of digital servitization in SMEs. Based on the literature, a set of salient conditions are motivated as antecedents that could differentiate between different business models choices by SMEs. A large-scale survey study based on three independent samples from UK-based manufacturing SMEs is currently under way.

Findings: Only a pilot study had been completed by the time of this writing. The feedback on the relevance of factors, clarity of questions, and overall experience with the survey was very satisfactory.

Originality/Value: This work contributes by developing two approaches to capture digital servitization in SMEs, and identifying the factors that are conducive to each development.

KEYWORDS: Digital servitization, Digitalization, Business model typology

1. INTRODUCTION

Digital technologies that enable management of information input and output at a distance are fostering servitization through digitalization (Coreynen et al., 2017). This trend is increasingly referred to as ‘Digital Servitization’ (DS), i.e., *“the transition toward smart product-service-software systems that enable value creation and capture through monitoring, control, optimization and autonomous function”* (Kohtamaki et al. 2019: p.383). Most extant research has focussed on the process of digital servitization, identifying internal (i.e., organizational) and external (i.e., environmental) enablers and barriers (see: Chen et al. 2021, Coreynen et al. 2020, Gebauer et al. 2021). It is commonly assumed that DS combines two processes that are interdependent but distinctly disruptive (i.e., servitization and digitalization). As such, this entails a fundamental shift in the entire business model and a chance that a firm might face both the service and the digital paradox (Gebauer et al. 2020).

However, due to the nascency of the DS phenomenon, there are clear shortcomings that hinder a holistic understanding. For example, there is a lack of quantitative measures of DS (Gebauer et al. 2021), while most insights generated to date are relevant almost exclusively to large organisations (Rabetino et al. 2021) with unclear applicability to Small and Medium-sized Enterprises (SMEs). This is concerning, given that SMEs vastly outnumber large enterprises in almost all economies accounting for approximately 99% of all businesses (OECD 2019). SMEs are characterised by liabilities of smallness (Freeman et al. 1983) assuming an inherent lack of access to productive resources (Eggers 2020) which in turn, suggests limited resource commitment to innovative activities and venture growth (Wiklund and Shepherd 2003, Choi et al. 2022). Due to these constraints, small firms are rarely able to create new capabilities or build separate service organisations, while the servitization and digitalization processes vary widely across such firms (Kowalkowski et al. 2013).

Moreover, the literature is far from conclusive about which service-based business models, and by extension, digitally enabled service-based business models, are most suitable under different conditions (Raddats et al., 2019). Although research on the transition toward digital servitization has

proliferated, identifying a host of enablers and barriers, it is unclear which organisational and contextual factors are conducive to higher levels digital servitization (Favoretto et al. 2022) and differentiate between different digital servitization business models (Coreynen et al. 2020).

In line with past research that showed that the choice of a firm's service strategy depends on the environment it faces (e.g. Visnjic et al. 2019), and against the backdrop of an overwhelming focus on large firms, the aim of this work is to identify the environmental and organisational factors that lead SMEs to: a) different digital servitization business models, and b) higher levels of digital servitization.

Answering to recent reviews of the digital servitization stream of research (e.g., Paschou et al. 2020, Rabetino et al. 2021), this work contributes to the literature by: a) focussing exclusively on SMEs; b) identifying when and where different digital servitization business models are preferred; c) conducting a large-N quantitative study. The theoretical background that follows introduces the organisational and contextual antecedents considered here. The methodology section details the process of the construction and validation of two different measures of digital servitization, and is followed by some preliminary results.

2. THEORETICAL BACKGROUND

2.1 Digital servitization business models

It is widely accepted that there is a strong interplay between servitization and digitalization (e.g., Chen et al. 2021), the two processes converging into digital servitization (Gebauer et al. 2020) which represents the *"transformation in processes, capabilities, and offerings within industrial firms and their associated ecosystems, to progressively create, deliver, and capture increased service value, arising from a broad range of enabling digital technologies"* (Sjodin et al. 2020, pp.479). Despite a few notable attempts (e.g., Kohtamäki et al. 2019), there is a lack of digital servitization business model typologies and measures, and an over-reliance on small scale qualitative case studies (Rabetino et al. 2021) that focus on the digital transformation process and the role of digital technologies in developing service offerings (e.g. Schroeder et al. 2020). As such, the prevalence of related business models is insufficiently understood, as well as the conditions under which such business models are adopted by firms. Therefore, after reviewing the extant literature, we focus on set of salient contextual and organisational antecedents which we motivate theoretically in what follows.

2.2 Contextual antecedents

Competitive intensity. The prevalence and growth of industrial services have been widely recognized as a corollary of intense competition within markets (Gebauer 2007), playing a pivotal role in determining the effectiveness of service innovation endeavours (Morgan et al. 2019). Businesses that operate in highly competitive landscapes have been found to be more inclined towards after-sales and outsourcing services, whereas those functioning in less competitive environments are more predisposed to customer-support and development services (Gebauer 2008). As the level of competition determines the choice of added services, it is reasonable to expect that it will also lead firms to adopt different *digital* servitization business models. Firms finding themselves in overly competitive environments might resort to more sophisticated digital services to differentiate themselves and lock customers in.

Technological turbulence. Technological turbulence occurs due to the proliferation of competing technologies vying for dominance within the industry (Cusumano et al. 2015). To address this challenge, product firms have employed service-oriented business models (Frank et al. 2022, Visnjic et al. 2019), which can mitigate customer uncertainties related to technology adoption, and reduce capability-based switching costs (Frank et al. 2022). The literature suggests that rapid technological changes, such as digitalization, require an internal alignment of the business model to enable the provision of customised solutions (Coreynen et al. 2020). Moreover, companies can respond by increasing service customisation through the use of digital technologies in response to experienced turbulence, with evidence indicating that those prioritising knowledge integration can better manage technological shifts and achieve higher levels of (digital) servitization (Frank et al. 2022).

Product/process complexity. A product or process is complex if it is comprised of many parts (or elements) that interact with each other in many ways (Vickery et al. 2016). Complex products create service opportunities that are more profitable, since customers seek long contracts with the providers of such products (Raddats et al. 2016). They are also better candidates to be ‘networked’, since they require more information to adequately describe and understand them, and their failure could severely impact the organisation (Allmendinger and Lombreglia 2005). Digital technologies can be used to capture and employ this information, transforming complex products into “smart, connected” ones (Porter and Heppelman, 2014).

Demand unpredictability. The unpredictability of demand for ‘traditional’ services presents a challenge for most firms, as customers tend to seek service only when equipment failure occurs. This increases the unpredictability of sales, makes it difficult to plan service visits or predict equipment failures, and impairs forecasting of spare parts and capacity planning. However, the emergence of digital servitization comes with significant advancements in technology that promise to mitigate these challenges. Advanced digital technologies such as the Internet of Things (IoT), sensors, digital twins, big data, and artificial intelligence (AI) offer unprecedented opportunities to improve the predictability of demand for products and services. These technologies are capable of facilitating improved forecasting of service activities, which can help predict equipment failures before they occur (Visnjic-Kastalli and Van Looy 2013; Chen et al. 2021). As such servitized SMEs facing an unpredictable demand might consider introducing digital technologies and adopting a digital servitization business model, as a means to achieve a more efficient delivery of value to customers, by, for example, remotely diagnosing equipment failures and delivering predictive maintenance (Tronvoll et al. 2020).

Complexity of customer needs. The complexity of customer needs can be attributed to the integration of numerous individual requirements, as firms seek to navigate the intricate interplay between products and services (Gebauer et al. 2011). However, the heterogeneity of customer perspectives concerning product and service attributes engenders divergent strategic choices by providers that aim to fulfil these underlying needs (Neu and Brown 2005). Such strategic options may involve outsourcing of product maintenance as a unification strategy, optimization of product efficiency and effectiveness within the customer process, or other measures to ensure proper product functioning (Gebauer et al., 2011). Moreover, the complexity of customer needs encapsulates both the variability of customer requirements over time and customers’ persistent search for new offerings. These offerings are more likely to have a strong digital component, which manufacturers will try to provide by adopting different digital servitization business models.

2.3 Organisational Factors

Degree of digitalisation. Digital transformation disrupts two of the fundamental assumptions that underpin entrepreneurial processes in terms of the boundary conditions and predefinition of entrepreneurial agency (Nambisan 2017). In SMEs, these assertions challenge the established operational model which is characterised by low levels of digital advancement (Denicolai et al. 2021). In evaluating readiness for digitalisation, research suggests that a firm’s digital maturity level may impact the success of digital transformation initiatives (Westerman et al. 2014). This is reasonable, since technology adoption has a systemic impact across the organization’s processes, sales and supply channels (Urbach and Ahlemann 2016, Schwer et al. 2018) with the implications of technology reflecting a critical emphasis on new forms of customer interaction and proactive development of digital skills (Schwer et al. 2018, Ostmeier and Strobel 2022). Framed in the above premises, in the intricate case of digital servitization the organization’s degree of digitalization represents a key organizational antecedent that demonstrates the organization’s state to strategically leverage new technologies (Mikalef et al., 2019). As digital servitization represents a long-term firm-level activity, digitally mature firms have the processes in place to lead this transformation (Kane 2017, Kane et al. 2015; Forliano et al. 2023).

Ambidexterity. SMEs are faced with, and have to systematically manage, externalities that trigger the adoption of servitization (Frank et al. 2022) and paradoxes that are embedded in digital transformation (Smith and Beretta, 2021). To this end, digital servitization suggests the transition

towards smart product-service offerings (Paiola et al., 2022), and is driven by an underlying dynamic that orchestrates the firms scarce resource base between optimisation and innovation initiatives. This suggests that ambidexterity is a fundamental antecedent of digital servitization (Favoretto et al. 2022). The nested nature of ambidexterity in SMEs (Andriopoulos and Lewis, 2010) suggests that to reap the benefits of digital servitization, firms should jointly allocate resources across current exploitation and novel exploration activities. Strategic utilisation of ambidexterity helps SMEs to reap benefits by supporting incremental changes and adaptation of existing firm offerings, whereas investment in new solutions is equally important to meet new customer demands and expand into new markets. In manufacturing SMEs, ambidexterity reflects the sequential switching between exploitation and exploration (Wenke et al. 2021), which in turn is related to shifts in the organisation's business model (Paschou et al. 2020). In attempting to move towards a digital servitization business model and reap the benefits of technology adoption, firms redefine their business model configurations (Kohtamäki et al. 2019). This is driven by ambidexterity, as digital technologies provide manufacturing firms with the opportunity to overcome trade-offs between standardization over customization (Paiola and Gebauer, 2020), and implies a critical balance among control and co-creation activities (Tronvoll et al., 2020). As such ambidextrous SMEs might be able to increase the sophistication of their existing business models by capitalising on service "add-ons", co-creation activities and digital technologies.

3. METHODOLOGY

3.1 Development and Validation of Business Model Descriptors and Degree of DS Measure

The main influences behind the creation of the DS business model classification were Suppatvech et al. (2019) and Kohtamäki et al. (2019). The authors of the first study conducted an extensive systematic literature review, and inductively derived four 'archetypes' of *IoT-enabled* business models, which they describe in detail, specifying the distinguishing features of each model. Those business model archetypes were named: "add-on", "sharing", "usage-based", and "solution-oriented". Although 'digital technologies' is a broader term than Internet of Things (IoT), it is straightforward to extend and generalise the four types of Suppatvech et al. (2019) into 'digitally-enabled' business model types. This was the first step toward our typology. On the other hand, Kohtamäki et al. (2019) derived their classification after reviewing four (grand) theories of the firm and other attempts to categorise (digital) servitization business models. Although the descriptions they provide are generic, and do not differentiate the models on the basis of the digital technologies employed in each, they include a "platform provider" archetype, which is exceedingly pertinent in the business world and a popular digital servitization path for entrepreneurial SMEs (Cenamor et al. 2019). As such, we included "platform provider" as a fifth category.

The next step was to develop descriptors for each category, in lay language, which knowledgeable respondents from SMEs could use to self-classify their firm. Drafts of the model descriptors were reviewed for clarity, relevance, and comprehensiveness by six academic experts. Their areas of expertise included servitization, digitalisation, and business models. Four SME practitioners with long experience in manufacturing and technology firms also provided their views over short interviews. Their feedback helped us simplify the descriptors and make the respective business models clearly distinct, as well as make them clearly relevant to SMEs. Crucially, the "sharing" category was absorbed in the description of the "usage-based" model descriptor, because it was agreed that the value creation and capture mechanisms of the underlying model was also based on 'usage'. As such we ended up with four *digitally-enabled* business model types (and the respective descriptors). We also included a "product-only" (no services) category, as well as a "basic services" category where it was specified that digital technologies played no role in the provision of services.

The *degree* of digital servitization measure was constructed following closely the approach originating in Homburg et al. (2002), that conceptualised the degree of servitization as a formative index comprising the number of, broadness of, and emphasis on, a portfolio of services (see also Brax et al. 2021, Calabrese et al. 2019). Our initial list of 'digital services' was reviewed by three academics and two practitioners with deep knowledge and experience in servitization and solution provision. According to the received feedback, and in an attempt to strike a balance between

comprehensiveness and brevity, we considered seven digital services: a) remote monitoring of product condition; b) remote diagnostics; c) remote control of product operation and usage optimisation; d) remote maintenance, upgrade and/or repair; e) remote provision of access to information (e.g., automated analysis of operational information, predictive analytics), feedback and/or reports; f) predictive maintenance; and g) cloud services (e.g., software-as-a-service, infrastructure-as-a-service, platform-as-a-service). Respondents were asked: a) whether their company offered the service (Yes/No); b) how many customers they offered the service to (7-point Likert scale with anchors “not at all” and “to all customers”); and, c) how actively they emphasized the service (7-point Likert scale with anchors “not at all” and “very actively”).

The final business model descriptors and the phrasing of the ‘degree’ measure are available from the authors upon request.

3.2 Measures of Contextual and Organisational Antecedents

We operationalised *competitive intensity* and *technological turbulence* by adopting the original scales of Jaworski and Kohli (1993). The scale reflecting *product complexity* comes from Vickery et al. (2016), while *complexity of customer needs* comes from Gebauer et al. (2011). To capture *demand unpredictability*, we adopted the 3-item scale of Droge et al. (2003), but to make it more relevant to our context, we added a 7-point Likert scale item capturing the extent of predictability of product and/or service failures.

Ambidexterity is measured through an 8-item scale developed and validated by Jansen et al. (2009), combining (in an additive manner) organizational exploration and exploitation. To capture *service prominence*, we adapted and combined two scales from Gebauer et al. (2010): ‘service orientation of corporate values’ and ‘organizational distinctiveness between product and service businesses’. The resultant construct captures the importance and emphasis the SME places on the service business. Finally, to measure *digitalisation maturity* we used the four-item digital maturity scale developed by PwC (Greif et al. 2016) that considers the degree of digitalization of process and infrastructure, people and culture, sales, and customer involvement. It is treated as formative; all other measures are treated as reflective, as originally conceptualised.

Control variables include firm *age* and *size*, *industry type* and *types of customers* (consumers, businesses or governments). All these can reasonably be assumed to correlate both with the sophistication of the digital servitization business model (or the degree of digital servitization) and with various antecedents.

3.3 Sample and Data Collection

The entire instrument was first reviewed by two academic and two industry contacts with survey experience. At the time of this writing, only preliminary data collection had been conducted, that involved 38 respondents commissioned through Qualtrics. Respondents were asked to submit comments about the relevance of factors, the clarity of the questions and their overall experience with the survey (e.g., time taken). The feedback was overall excellent. A careful skimming through the data led to the exclusion of eight responses that were completed in an abnormally short period of time, suggesting insufficient engagement and/or random answers. On the basis of this, discussions with Qualtrics led to slight modifications to their screening and recruitment strategy. The final sample will comprise three separate sub-samples: one commissioned through Qualtrics (N=400; work in progress), one voluntarily solicited through the authors’ gatekeeping contacts in NAAME (New Anglia Advanced Manufacturing & Engineering) forum (<https://naame.co.uk/>), and one through the InterAct network (<https://interact-hub.org/>), which is the direct funder of this project.

3.4 Data Analysis

The standard exploratory and confirmatory factor analysis apparatus is used to ensure scale validity and reliability. Subsequently, multinomial logistic regression modelling will be applied to identify the factors that differentiate between the different business models, and a linear regression analysis to understand which factors lead to higher levels of digital servitization.

4. RESULTS, DISCUSSION AND CONCLUSIONS

The results will be presented and discussed in the main conference.

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PRODUCT-SERVICE SYSTEMS FOR THE CIRCULAR ECONOMY: THE “4R” CHALLENGES

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ABSTRACT

Purpose: It has been advocated that servitization could effectively support the implementation of the Circular Economy paradigm. This study aims to investigate how servitized business models could support the adoption of different circular economy strategies by manufacturing companies.

Design/Methodology/Approach: A review of the literature systematizes the most relevant typologies of Product Service Systems business models, and the main features of the “4R” strategies of Circular Economy, and their potential connection. Moreover, three exemplary cases have been analyzed to cover the “4Rs”, and to identify common and specific characteristics and challenges of adopting these strategies in practice.

Findings: the three cases unveil specific synergies among the “Reduce” strategy of circular economy and different types of PSS, showing that the relationship with product-oriented services is more nuanced than expected. When addressing the “Reuse” or “Recycle” strategies, the role of different supply chain actors different from the OEM appear as crucial showing the importance of supply chain coordination in servitization.

Originality/Value: This study is among the first attempts to analyse together the Servitization and “4R” circular economy perspectives, exploring their potential connections. The preliminary findings provide a promising ground to develop further research and consolidate the conceptual insights here suggested as well as to provide food for thought for decision makers in company wishing to move to more sustainable business models.

KEYWORDS: servitization, circular economy, business models, reduce, reuse, remanufacturing, recycle

1. INTRODUCTION

Europe is pushing the Circular Economy (CE) as a new economic solution to keep products, components, and materials at their highest value (Ellen McArthur Foundation, 2013). The CE paradigm has reached increasing attention within academia and practitioners, as a mean to promote sustainability (Ghisellini et al., 2016), i.e., development that meets the need of the present without compromising the ability of future generations to meet their own needs, but also as a way to generate economic benefits (Geissdoerfer et al., 2017; Jabbour et al., 2017). CE decouples economic growth from resource extraction since it aims to implement closed-loop production systems where products, components and materials are used several times (Bressanelli et al. 2019).

At the same time, manufacturers confronted with exacerbated competition, manufacturers of capital goods are reorienting their value proposition from selling products to providing solutions and advanced services, following a servitization strategy (Paiola et al., 2013; Jacob and Ulaga, 2008; Baines et al. 2009). It has been advocated that servitization could effectively support the implementation of the CE paradigm. However, the linkages between the two concepts have not been deeply investigated in the literature, in particular in relation to the different “R” strategies through which the circular economy paradigm can be deployed. Therefore, this study aims at exploring through empirical cases how the features of servitized business models could support the adoption of different CE “4Rs” strategies by manufacturing companies.

The next section provides a background for the study, section 3 describes the research methods and framework. Three empirical cases are presented in section 4, and compared and discussed according to the conceptual framework in section 5.

2. THEORETICAL BACKGROUND

2.1 Circular Economy and the “4R” strategies

To achieve a sustainable business model, the circular economy employs different so called “R strategies”. There are several frameworks and available, ranging from 3Rs to 10Rs (Ranta et al., 2021; Rosa et al., 2020). We use the “4R” scheme, often adopted to classify strategies to achieve CE. The 4Rs (Reduce, Reuse, Remanufacturing, and Recycle) represent a comprehensive approach to resource management in which waste is minimised and resources are utilised as efficiently as possible (Bressanelli et al., 2019). It defines the following strategies:

- **‘Reduce’** implies using fewer natural resources, raw materials, energy and waste in a way to increase resource (material or energy) efficiency (Morseletto, 2020). This definition is extended to reducing the number of products in circulation as a result of product life extension, e.g. through system upgrades that improve performances and increase durability (Khan et al., 2018 and 2020), and/or sharing to use idle capacity (Allwood, 2014; Blomsma et al., 2019). An example of “Reduce” strategy is the implementation of lean manufacturing principles, which seeks to minimize waste in all areas of production (Raut et al., 2021).
- **‘Reuse’** implies re-application of the equipment (i.e. a second or further use for the same or different application). This often includes refurbishment/reconditioning to return them to a suitable condition for use (Blomsma et al., 2019; den Hollander et al., 2017; Morseletto, 2020). In this case, the reference unit is the equipment as a whole (i.e. the system). For example, companies may implement product take-back schemes, where used products are collected from customers and refurbished (Salvador et al., 2021). Another example of reuse is the sharing economy, where products and services are shared among multiple users, reducing the need for individual ownership and reducing waste (Acerbi et al., 2021).
- **‘Remanufacturing’** is an industrial process by which previously sold, worn, or otherwise non-functional parts or subassemblies (i.e. subsystem level) can be refurbished/reconditioned to return them to a suitable condition for use (Blomsma et al., 2019; den Hollander et al., 2017; Morseletto, 2020). In this case, the reference unit is the subsystem (i.e., parts or subassemblies).
- **‘Recycle’** implies recirculate materials and is the processing of materials extracted from discarded products to obtain recycled materials of the same or lower quality (Morseletto, 2020). It thus extends the material’s lifespan (Allwood et al., 2014). The reference unit is the material. Recycling decreases the environmental impact of manufacturing by reducing the need for virgin materials and the amount of waste sent to landfill (Rahman et al., 2021).

A hierarchy among the “Rs” should be followed (Kalverkamp et al., 2017): reuse is preferable to recycling since much of the product's intrinsic value remains intact (Park et al., 2014). Moreover, products should be redesigned to enhance multiple lifecycles (Go et al., 2015), to improve reuse, refurbishment, remanufacturing, and recycling.

2.2 Servitized business models

Servitization focuses on the role of services in sustaining the competitiveness of manufacturers. Servitization is “the process of creating value by adding services to products” (Baines et al., 2009). A Product-Service System (PSS) is defined as “*a system of products, services, supporting networks and infrastructure that is designed to: be competitive, satisfy customer needs and have a lower environmental impact than traditional business models*” (Mont, 2002). Servitized business model can be deployed in several ways, as there is no “*one-size fit all approach*” due to a range of contextual aspects. The taxonomy by Tukker (2004) defines three categories and 8 archetypes of PSS. The first category is **product-oriented services**, focused on the sales of products with some additional services. The second group is the **use-oriented services**, where the provider keeps the product ownership, and the customer pays for access to it; several customers may also use the product. The third category is **result-oriented services**, based on the agreement on a result, and no pre-determined product is involved.

The three major drivers for firms to servitize are the financial, strategic and marketing opportunities (Baines et al., 2009). However, as described by Mont (2002), the PSS research stream emphasises reducing the lifecycle impact of products and services and increasing their sustainability. Manufacturers or retailers own products in use- and result-oriented business model categories while customers adopt new ‘consume and return’ patterns through access to the product or its function (Sundin and Bras, 2005). Firms profit from the services offered, and the material products and consumables involved in providing the service become cost factors (Tukker, 2015).

Sousa-Zomer et al. (2018) investigated through a case study the challenges of implementing a circular business model from a renting perspective, emphasizing the need to combine tangible and intangible aspects of the value creation processes, such as changing the organizational mindset, creating collaborative circular networks with stakeholders and new partners, or offering a structured after-sales service. Through the exploration of a Chinese state-owned company for air separation units, Yang et al. (2018) found that PSS business models can generate value through the circularity of supply chains. The analysis compared product-, use- and result-oriented PSSs and found that the regular provision of technical services of maintenance, repair and remanufacture can push towards a more circular supply chain. The study also shows that the closer the value creation is to result-oriented PSS, the tighter and more efficient the cycle is, since products need less intervention to come back to cycle again, and the potential environmental and economic savings are higher.

2.3 A perfect match? Open issues and research gap

Although a promising avenue for aligning business and environmental sustainability objectives, the linkage between servitization and the circular economy “4Rs” is still under-investigated, leaving several points to theory and practice.

On the one hand, servitization does not always bring environmental benefits as many product-oriented service business models are deeply rooted in a linear economy, where at best, reduction of the impacts during the middle-of-life of the product can be pursued. On the other hand, advanced servitized business models may be unattractive to customers and entail only marginal benefits. In 2015, Tukker provided a quite accurate picture of products for which a PSS business model will work and provide significant environmental advantages: they “*are typically expensive, technically advanced, requiring maintenance and repair, easy to transport, infrequently used by customers, and not heavily influenced by branding, fashion, etc.*” (Tukker, 2015 p. 86). Moreover, recent literature pointed out the risk of rebound effects associated to the “4R” strategies and the circular economy more broadly (Castro et al., 2022; Jin et al., 2023).

We argue that servitization can be a powerful business model to implement the “4R” strategies, but several aspects should be taken into account in order for this coupling to be effective. Among these are the product characteristics, the type of service offered and the supply chain structure, especially regarding the OEM’s role and visibility over the product end-of-life, and the orchestration mechanisms.

3. RESEARCH METHODOLOGY AND FRAMEWORK

Three industrial cases have been selected from different market segments with products with lifespans from a few years to over twenty years to investigate the abovementioned aspects from an empirical perspective. Additionally, the firms are of very varied sizes (large multinationals to SMEs); the objective was to provide a range of contextual differences and then to understand the cases based on the 4Rs. The authors have had a long relationship with the firms selected and have combined primary and secondary data to create the cases and provide contextual aspects of the cases in addition to the analysis of the business models and the application of the 4Rs. The following aspects have been covered through the case studies:

- Size
- Nation
- Unit of analysis

- Type of product (simple vs. complex)
- Activity / Manufacturing activity carried out by the case company
- "4Rs" covered by the case (REDUCE, RESUE, REMANUFACTURE, RECYCLE)
- PSS BUSINESS MODEL
- Services / Advanced services that are connected to the offering of the BM
- TARGET CUSTOMERS
- DIRECT AND REVERSE SUPPLY CHAIN STRUCTURE and PARTNERSHIPS
- PRODUCT REDESIGN CARRIED OUT TO ENABLE THE "R" Business model
- PRODUCT "SMARTNESS" and KEY DATA COLLECTED
- ENVIRONMENTAL BENEFITS ACHIEVED

4. FINDINGS

In this section, we will describe the three cases by first providing the contextual aspects of the case and associate them to the adoption of one or more among the "4R" strategies.

4.1 Case A: Hilti fleet management

Hilti provides equipment that is used primarily in the construction industry. The tools range from hand drills to complex construction equipment. Rather than selling the tools with a traditional transactional approach, Hilti provides a service where the tools are selected for a particular construction site and 'rented' to the customer firm. Hilti charges a monthly subscription that covers the tools, services and repair costs. The tools are routinely upgraded with newer generations of tools. The approach is designed to support the back office activities considered 'normal' within a construction environment. This is a use-oriented PSS offer with some aspects that are outcome-based.

To support the service, Hilti has a network of repair and logistics centres necessary to ensure that the tools can be sent to the construction site and returned for inspection and repair at one of the service centres. The service centre maintains spare components necessary for standard repairs. They service centres have standard repair scope for tools and the disposal processes for tools (or tool subsystems).

Table 2: Assessment of Hilti's case according to the "4Rs" framework

Dimension	Case description
Lifespan	Three to five years
Reduce	The firm reduces the overall tool demand by reducing the number of tools by optimising the tools' need for a particular construction site. Repairs on tools result in a reduction of total material consumption by extending the lifespan of tools. Tools can be added on demand, reducing underutilised tool assets for construction companies.
Reuse	Fleet management is based on a rental model, the customer's only have the tools when they need them, tools are used by multiple customers over the tool's lifespan.
Remanufacturing	Tools are repaired and refurbished at a service centre. This extends the lifespan of tools by replacing or rework defective subsystems. The batteries in the tools are an example of a high value component that can be repaired.
Recycle	Replacement of subsystems creates waste that needs to be recycled. Some (not all) of the materials can be recycled and reused.

4.2 Case B: GE Power

GE Power manufactures and provides advanced services on gas turbines used in power generation. GE provides a range of turbines with different power and efficiency ratings. The turbines are sold to a power generator (direct customer), the customer then has different maintenance options, from basic

services (i.e., transactional spares, repairs and field service) to advanced services (i.e., contractual service agreements) where the maintenance is rented on a '*per hour*' basis. The agreements are a mix of outcome (i.e., capacity and availability) and use (i.e., per factor fired hour) based revenue streams and can be considered 'advanced services'. GE also integrates 'mandatory technical information letters (TILs)' into the advanced service, where the upgrades are included with the CAS fees. There are other in-service upgrades possible and these are sold transactionally to the customer even when there is such an agreement in place.

To support the delivery of the maintenance service, GE has a worldwide network of manufacturing, repair and field service centres. GE also partners with logistics firms to ship the parts to and from the repair centres. A detailed operating and maintenance manual (e.g. GER-3620P, 2021) provides details of the expected maintenance regimes for their turbines and is the bases of their total cost of ownership model.

Table 3: Assessment of GE's case according to the "4Rs" framework

Dimension	Case description
Lifespan	15-25 years
Reduce	Spares are shared between part of the installed base, meaning that a site with three turbines need fewer spares than a site with only one unit. New subsystems (i.e., turbine blades) may reduce the frequency for inspections. Subsystems are repaired and refurbished, with a 'per hour' based contract it is in GE's interests to extend the life of components (i.e. gas turbine blades/bucket). Service upgrades can improve environmental performance (i.e., efficiency or emissions improvements).
Reuse	Turbines are usually too large to move from one location to another, although with smaller turbines there is a 'relocating and installation' service offered often by third parties.
Remanufacturing	New turbine components may be introduced during the operational life of the turbine, these may improve the interval between inspections
Recycle	The high grade metals used in turbine components means that scrap materials have for many years been recycled. There are professional firms that recycle a power plant and segregate the materials into different material streams.

4.3 Case C: household appliance refurbishment

Company C is an SME whose core business is spare parts distribution for large household appliances. Thanks to its technical experience on components and spare parts of several brands, in 2016, the company started a project aiming to re-generate end-of-life appliances, especially washing machines. This initiative aims to reintroduce them into a new usage cycle instead of being disposed of.

In a refurbishment facility, seven technicians experienced in repair activities carry out renovation and re-selling activities. In one year on average, the company renovates more than 1000 WMs, with total savings on of about 23 tons of concrete, 23 tons of steel, 8 tons of wire, 11 tons of bulk plastics and 3 tons of aluminium. The renovated appliance sales are carried out in two physical shops owned by the company in collaboration with a charity organization and through e-commerce. The company also partners with small logistic providers in charge of collecting the end-of-life appliances from the point of sales or directly when delivering the new appliance to the end user's house: they identify products that can be potentially refurbished and ship them to company C.

Table 4: Assessment of company C's case according to the "4Rs" framework

Dimension	Case description
Lifespan	5-15 years
Reduce	A warranty is provided on the refurbished appliances, however the "reduce" impact is only indirect (due to a decreased need for new appliances on the market that to the re-sales of refurbished ones). Refurbished appliances may, on the opposite, have higher energy consumption rates than newer models, though the company focuses on refurbishing medium-to-high quality machines
Reuse	The company focus on a reuse strategy, since it "brings to a new life" old household appliances (especially washing machines) that have been substituted by customers
Remanufacturing	Parts that are substituted may undergo a remanufacturing activity (e.g. printed boards)
Recycle	Appliances and parts that a cannot be renovated are disassembled and recycled, following the WEEE directive (i.e. brought to specialized centres)

5. DISCUSSION

5.1 Cross-case analysis

The cross-case analysis is presented in Table 5, where we focus on the 4Rs to understand the similarities and differences among the cases. First, we see that the firm's size and location and the unit of analysis are different. The degree of complexity of the product is also quite different, yet all products can be further broken down into subsystems. Their markets are also quite different; case A is in the construction project market, case B is capital equipment in the B2B market, and case C operates in a B2C environment. We can see similarities in the "4R" strategies and interesting differences, discussed below:

- **Reduce**, cases A and B strongly focus on the 'reduce' strategy, thanks to an advanced service basis where they are rewarded for increasing materials efficiency. On the other hand, for case C, the situation is mixed: reduce is an indirect strategy as old washing machines are given a second life with a new customer (this way reducing the need for production of new appliances) but refurbished appliances may have higher energy consumption rates than newer models. Interestingly, Case B, experiences this to some degree with the second-hand market for turbine spares and for smaller turbine units.
- **Reuse**, all cases provide solid examples of reuse, built into all business models, yet differently due to the contextual differences among the cases. Case A shows the benefits of sharing resources among different customers using the fleet management and rental model; case B hints at this by sharing high-value spares (i.e. subsystem) between the different power plants. Case C, finally, is centred on a reuse strategy: it focuses on reusing the whole system thanks to the renovation activity and shows that a non-OEM company can carry out a refurbishment activity exploiting the synergy with its expertise in the product and the availability of spare parts.
- **Remanufacturing**, cases A and B use local repair centres to inspect and repair tools or subsystems. In Case B, one of the key exhibits expense the total maintenance approach that the firm has with the expected number of repair cycles for subsystems. In both cases, companies manage the lifecycle of products and their subsystems and outsource the logistics to a partner. In case C, parts of appliances unsuitable for reuse are either sent for recycling or remanufactured (internally or externally).
- **Recycle**, an external specialist partner, is used for the final recycling aspects in all cases. This is perhaps not unexpected, as the firms are used to buying in subsystems and not dealing with the material reclamation activities themselves. This may also have to do with the generated volumes of recycling materials. Case B is peculiar here, as when a power plant is fully decommissioned, it is owned by the power company, which would employ a specialist contractor to clear the site. In

case C, since household appliances are subject to the extended producer responsibility and end-of-life directive, collective logistics and recycling systems carry out the recycling activity.

Table 5: Cross-case comparison

DIMENSION OF ANALYSIS	Case A	Case B	Case C
Size	Large multinational company	Large multinational company	SME
HQ	Lichtenstein	USA	Italy
Unit of analysis (short case description)	Tool hire for construction	Turbines used for power generation	Refurbishment of end-of-life Washing machines
Type of product (simple vs. complex)	Simple, assembled	Complex	Simple, assembled
Manufacturing activity	The company is well known for the manufacture of high quality hand tools used in the construction industry	The firm carries out the design, manufacture, commissioning, and provides O&M services for power plants	The company does not manufacture the product. It is originally a distributor of spare parts
"4Rs" covered by the case:			
REDUCE	Yes	Yes, spares demand is reduced by improve life span and sharing between units	(indirectly)
REUSE / REFURBISH	Yes	No, the machines are too large in general. For smaller machines third parties are active	Yes
REMANUFACTURE	Yes	Subsystems are removed and reused and refurbished	For some parts and through third parties
RECYCLE	Done externally	Done externally	Done externally
PSS BUSINESS MODEL	Sells 'fleet management', use-oriented PSS offer (some aspects may be outcome-based)	Sells the turbines, provides services on the turbines on a transactional or contractual basis (CAS has many outcome and input aspects)	Traditional sales model but on a refurbished product, with warranty service
TARGET CUSTOMERS	Construction firms	Power companies	- Second houses - people looking for good quality products with lower prices
DIRECT SUPPLY CHAIN STRUCTURE and PARTNERSHIPS	Direct to customers	Direct to customers	No direct SC
REVERSE SUPPLY CHAIN STRUCTURE and PARTNERSHIPS	Yes for the logistics management activities.	Yes for the logistics management activities.	Washing machines are "captured" by logistic partners at the end of life if they appear of "good-enough quality"
PRODUCT REDESIGN CARRIED OUT TO ENABLE THE "R" Business model	Failures are noted and integrated back into the design process were appropriate.	Yes, service develops focused on improved service productivity.	no redesign but refurbishment using spare parts
PRODUCT "SMARTNESS"	Equipment is tagged to allow usage to be monitored by the contractor site and the supplier	Yes, machines are connect to a digital system to track performance against commitment and to support billing	none
KEY DATA COLLECTED	Tool asset number, and lifecycle, used to support billing and life management	Yes, data is collected to support the different teams to deliver the services and to track the lifecycle of the parts that are refurbished.	No specific data collection on products neither before nor after refurbishment. Inspections and tests are used instead

5.2 Managerial implications

The cases show how companies offering advanced services may contribute to implementing circular economy strategies, particularly the so-called "4Rs". In particular, the three cases allow understanding that servitization can contribute to a "reduce" strategy in many ways: maintenance services extend the product lifecycle; optimisation of spare parts reduces spare parts stock, wastage and redundancy, rental and reuse offerings decrease the need for newly manufactured products, as well as consultancy services that optimise the "fleet" of products to be used by a customer. The picture of the relationships among servitized business models and "Reduce" seem instead to be more complex than expected.

The cases provide limited evidence on the other "Rs", where the role of non-OEM actors in the supply chain appears more clearly. Concerning reuse, we observe that it can be facilitated by use-oriented business models (case A), but also by product-service ones (case C). Recycling usually involves third parties specialised in that activity, possessing the capabilities and resources and often also able to exploit economies of scale by concentrating large volumes (on a geographical rather than a brand basis). For Reuse, Remanufacture and Recycle, managing the return flow through a partnership with logistic companies or scavengers is a critical capability to be developed within the supply chain, as Case C exemplifies. In these models, the traditional OEM-user dyad is too simple and reinforces the traditional linear supply chain.

5.3 Academic Implications

These insights, although still preliminary, enrich findings from previous literature that "product services" have little relevance to environmental sustainability (Tukker, 2015). The aspect of the

context within the framework of Tukker (2015) needs further development and understanding as the approaches are linked to individual firms' strategic choices - this was the primary reason for selecting such diverse cases for this paper. Orchestration of the ecosystem is needed to fill the necessary gaps within the supply chain within the CE. Theory needs to be further developed here so that we can learn how to transfer manufacturers from their linear approaches into a more holistic and sustainable approach.

6. CONCLUSION AND RECOMMENDATION

In conclusion, the evidence gathered in this paper contributes to knowledge in the recent research stream connecting CE and servitization, opening up particular opportunities to explore the role of different supply chain structures and actors in supporting servitized business models oriented to circularity.

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TO MAKE, SHAPE, AND EXECUTE A SERVITIZATION STRATEGY: A STRATEGY-AS-PRACTICE APPROACH

Maria Åkesson, Nina Löfberg

ABSTRACT

Purpose: The purpose of the study is to explain how enabled and constrained servitization processes unfold through the interplay between practices, practitioners, and praxes.

Design/Methodology/Approach: The interplay that occurs between practices, practitioners, and praxes when manufacturing firms grow their solutions business was analysed through a longitudinal, four-year study of the servitization processes of two manufacturing firms. The data was analysed using process tracing.

Findings: The study makes three key contributions to this research area: it (1) shows that servitization outcomes may be enabled or constrained based on the interplay between practices, practitioners, and praxes, (2) provides a typology of practitioners involved in servitization, and (3) reveals the importance of changing product-oriented practices into service-oriented ones to enable servitization.

Originality/Value: By adopting a strategy-as-practice perspective, this study extends the literature on servitization and answers the call for a relatively new approach to servitization.

Keywords: competitive strategy; solutions; strategy as practice; strategic change process

1. INTRODUCTION

Researchers and practitioners have increasingly attempted to understand servitization as a strategy used by firms to gain a competitive advantage. In practice, however, many firms lack a strategic perspective of their service business, and managers often underestimate the challenges of implementing a servitization strategy (Kindström & Kowalkowski 2015). For servitization to succeed, shifts in management perspectives and how firms organise their operations are necessary. Therefore, servitization can be considered a strategic change process in which firms not only add to or increase the relative importance of their service offerings but also shift from a goods to service business logic (Kowalkowski et al., 2017; Åkesson & Löfberg 2021). This shift is performed by practitioners.

Servitization as a strategic change process can therefore be challenging to implement, although it has been identified as important (Fang et al. 2008; Gebauer et al. 2005; Visnjic & Van Looy 2013). Martinez et al. (2017) and Baines et al. (2020) expounded specific servitization activities from the perspective of organisational change, whereas Rabetino et al. (2017) used strategic theory to develop a servitization strategy map and discuss practices that enable the implementation of servitization. Further, Kohtamäki et al. (2021) studied intentional narratives for managing digital servitization and thus answered the call for a deeper understanding of servitization microprocesses from a practice perspective. Lenka et al. (2018) identified the various tactics used by individuals to respond to servitization resistance among employees.

We add to previous research by adopting the strategy-as-practice perspective, focusing on managers who drive servitization and the activities they perform. Thus, the focus is on the work of individuals, specifically the *praxes* or activities that practitioners perform (Jarzabkowski & Spee, 2009). Insights into this microprocess level of servitization implementation will contribute to a better understanding of how servitization is influenced by individuals. As practitioners make, shape, and execute a servitization strategy, they are influenced by existing practices that can either enable or constrain them (Feldman & Orlikowski 2011). We argue that practitioners working on servitization in manufacturing firms are often constrained by product-oriented

practices; employees are used to performing their tasks with a focus on products and technology rather than offering solutions. However, the relationship between practices, practitioners, and praxes is dynamic and changes over time (Jarzabkowski et al. 2007). Servitization research lacks an analysis of how practices, practitioners, and praxes interact to achieve strategic change. To address this gap, *the purpose of the present study is to explain how enabled and constrained servitization processes unfold through the interplay between practices, practitioners, and praxes.*

To answer this, the servitization processes of two case firms – PackageCo and HydroCo – were studied over a four-year period. PackageCo did not reach their intended servitization outcomes or make progress towards a service business logic (constrained servitization), whereas HydroCo achieved their intended outcomes and made significant progress towards a service business logic (enabled servitization).

2. THEORETICAL FRAMEWORK

We adopted the strategy-as-practice perspective, which does not consider strategy a core competence that an organisation *has* but, rather, emphasises the practical competence of an organisation's people and how they *do* strategy (Jarzabkowski 2004). Consequently, understanding managerial activity and how managers perform and discuss strategy work is essential for understanding the implementation of a servitization strategy. Accordingly, the strategy-as-practice perspective takes into account the practices, practitioners, and praxes involved in strategy.

2.1. Strategy-as-practice

Practices comprise shared routines of behaviour, such as traditions, norms, procedures of thinking and acting, and organisational culture (Whittington 2006). They persist over time (Jarzabkowski 2004) and are, therefore, difficult to change. Organisations are built on shared practices that employees act upon and use to interpret others' actions (Orlikowski 2007; Schatzki, 2006). As such, practices affect both strategy development and outcomes (Vaara & Whittington 2012). In other words, practices can both enable and constrain (Feldman & Orlikowski 2011; Vaara & Whittington 2012) servitization actions. Previous servitization research mainly considered practices in terms of cultural change (Rabetino et al. 2017) and the shift from a goods to service business logic (Vargo & Lush 2008; Kowalkowski 2010).

Practitioners in this context are a firm's strategists; they influence the servitization process through their speech and actions (e.g. Whittington 2006). Practitioners include anyone involved, such as managers at different levels, external advisers (Whittington 2006), and lower-level employees (Jarzabkowski et al. 2007). Middle managers play a key role in the process, serving as mediators between the top management and other members of the organisation (Floyd & Wooldridge 2000). Practitioners with different roles and expertise within an organisation shape the strategic change process (Mantere 2008). Research has focused on practitioners in terms of their competence in a servitization process (Bjurklo et al. 2009) or new roles in sales (Kindström et al. 2015). However, research on practitioners who drive servitization is sparse.

A praxis constitutes the activities that practitioners perform to formulate and implement a strategy over time (Jarzabkowski & Spee 2009; Whittington 2006). A praxis can be described as 'the intra-organizational work required for making strategy and getting it executed' (Whittington 2006 p. 619); it involves the doing or the interactions that take place when working towards servitization. Praxes often occur within specific strategising episodes (Whittington 2006), such as meetings (informal and formal), presentations, general conversations (Whittington 2006), decision-making processes, and workshops (Jarzabkowski & Spee 2009). Praxes are central to our view of servitization as a strategic change process in which firms intend to shift to a service business logic, and were thus a focus of this study.

The literature on servitization (Fang et al. 2008; Gebauer 2005; Visnjic & Van Looy 2013) and strategy highlights the importance of strategy implementation. According to Kaplan and Norton

(2006), how a firm implement its strategy, rather than the strategy itself, is what leads to a competitive advantage.

3. RESEARCH METHODOLOGY

To answer the purpose of this study, the servitization processes of two case firms – PackageCo and HydroCo – were studied over a four-year period. PackageCo did not reach their intended servitization outcomes or make progress towards a service business logic (constrained servitization), whereas HydroCo achieved their intended outcomes and made significant progress towards a service business logic (enabled servitization).

Data were collected from interviews, PowerPoint presentations, firm meetings, and workshops. We conducted several interviews with each participant (42 interviews in total; 27 at PackageCo and 15 at HydroCo) to gather and analyse the companies' servitization processes systematically over time. We used data from three episodes; 1 (2018), 2 (2019) and 3 (2021). To analyse the data, we utilised process tracing (Beach & Peterson 2013). This method is used to understand causal mechanisms (in this study, the interplay between practices, practitioners, and praxes) between a phenomenon X (servitization implementation) and an outcome Y (enabled or constrained servitization).

4. SERVITIZATION AT THE CASE FIRMS

PackageCo, at the time of the study, had reached its production limit and intended to create growth through solutions. Offering solutions had been on the agenda for some time; however, the daily business focus primarily remained on products. HydroCo was founded in the 19th century and the firm's service business dates back to the early 2000s when services were introduced to support its installed base. As product sales were decreasing, the firm turned to offering services to compensate for the loss, focusing on the Internet of Things and digital solutions.

4.1 Practices

Guiding the servitization process was found to be a long-term focus at HydroCo, a family-owned business, whereas it was evidently a short-term focus at PackageCo, a listed firm. Despite this difference, the practices adopted by the traditional manufacturing firms were very similar. A *product-oriented mindset* implies that products are seen as superior to services; consequently, customers and employees are used to working in a certain way. At HydroCo they explain themselves to be typical product sellers and consequently often miss out of the 'big picture'. At PackageCo, product-oriented mindsets were deliberately retained by the employees, and they stuck to their own way of selling and interacting with customers.

Although *adaptability to new market conditions* allowed the practitioners at PackageCo to begin engaging in servitization, employees' daily tasks were still focused on product sales. At HydroCo, the inability to adapt was a significant challenge: 'We have to adapt to new market conditions. ... We cannot continue in the same way and think in the same way as before.' However, most employees continued to do business as before. Consequently, *reactivity* among HydroCo employees created frustration. Reactivity was also exhibited at PackageCo, as employees lacked the ability to discern customers' unspoken needs.

In both firms, *internal tension* created an 'us-and-them' feeling. For example, there was a clear division between HydroCo's sales force, which focused on selling developed offerings, and its technicians, whose responsibility was to solve problems. In addition, PackageCo was organised into silos, and product sales were separated from solutions. *Product-oriented structures and systems* in both firms did not support solutions.

4.2 Practitioners

We identified five practitioner types in our study: authoritarians, sponsors, supporters, opponents, and rationalists. *Authoritarians* within the firms had the mission and authority to implement a servitization strategy. Their service-oriented mindsets allowed them to drive servitization with a strong focus on creating long-term business relationships when solving customer problems. *Sponsors* were practitioners who believed in and drove servitization based on their convictions. *Supporters* were employees who focused on solutions rather than technical aspects. They adopted strategic, long-term mindsets and focused on information sharing, cooperation, and adjusting to market change. Even though they were in favour of servitization, they were not the ones driving the strategic change process.

Opponents were employees who resisted servitization and focused on products, large sales, and technical aspects. There was also resistance from *rationalists*, who unintentionally slowed down servitization due to short-term perspectives and a lack of resources, which led them to focus on immediately profitable business. The rationalists were also characterised by a somewhat preconceived notion of built-in resistance within the organisation.

At PackageCo, the sponsors constituted a handful of employees who believed in servitization and were eager to drive the process based on their convictions. The top management were found to be both supporters and rationalists depending on the situation. The sponsors were supported by the top management when they themselves acted as supporters. However, the sponsors' lack of a mandate possibly led to more resistance from both opponents and rationalists within the organisation. At HydroCo, authoritarians were in charge of the servitization process, indicating a clear connection between authority and the responsibility for delivering results. They could manage resistance more efficiently than the sponsors at PackageCo.

4.3 PackageCo's process

In this section, we detail the praxes that made up PackageCo's servitization process. The first episode (2018) provided a fragmented image of the process being both open and concealed: It was open because the CEO provided clear directions for servitization, and a new head of solutions was hired to lead the work. However, this involved an internal recruitment process, and the head had many other assignments to handle, which meant that he could not fully focus on servitization; this created frustration among the sponsors. The open part of the process also included increased external visibility of the service business on the firm's website, the formation of an innovation agenda, and the creation of new lab services. Due to the presence of *product-oriented structures*, the services were not charged for but viewed as ways to increase product sales. The concealed part of servitization consisted of the work conducted internally and how the firm was organised for service offerings. The servitization strategy was driven by sponsors who worked more or less under the radar, which allowed them to function freely without resistance from their coworkers. This also meant that their servitization work lacked performance requirements, something they appreciated during this episode but proved to be a disadvantage in the long run. To formulate a service strategy during this first episode, the sponsors' focus was on capturing more of the value they were giving away for free. Lacking a clear idea of how to illustrate customer value, they jumped straight into developing a business model to capture more value through value-based pricing. This led to massive resistance from sellers who were not willing to change their selling approaches. At this time, the sponsors were rather preoccupied with the idea that the sales process had to be changed to create value.

During the second episode (2019), the sponsors had limited time and resources to conduct servitization activities and also continued to handle the resistance from sellers. This was hard on the sponsors: 'So yes, it's tough. I have been working on this for 1.5 years now, and nothing happens. I feel that I may give up...', and one of them even chose to leave the firm. The sponsors handled the resistance by satisfying the sellers and letting them work with customers in their preferred ways.

The top management continued to conduct visible efforts to make the company look more servitised than it actually was, such as by changing the name of the business area to emphasise solutions rather than products. This did not help the sponsors, who still experienced the lack of a clear servitization strategy. They continued their work by creating a detailed customer journey to explain the service process and to help their coworkers visualise how their part of the service could affect customer experience. The latter triggered several insights among the coworkers, helping them realise the importance of their work.

During this episode, a reorganisation of the firm was carried out, and a separate division for solutions was created. This resulted in the servitization process being subjected to performance measurements for the first time, including internal follow-ups and continuous reporting to the finance department, something that had previously been avoided due to sponsors working under the radar. Being clearly divided from the product division created challenges due to a need for products and the latter's know-how. The sponsors solved this by finding allies in the product division through whom they could take part of their resources. In addition, a service board was created with people from different business areas within the firm. Much emphasis was placed on future offerings of solutions and the practitioners gained important insights when they realised the importance of understanding their customers' needs.

During the third episode (2021) of their process, PackageCo experienced high demand for their products and a decreasing focus on servitization from the top management; thus, the top management could be considered rationalists who prioritised short-term profitability. Nevertheless, the sponsors continued their work, and an important praxis during this time was their cooperation and collaboration with others. They formed a joint venture that was designed to innovate new packaging solutions. They also succeeded in their attempt to gain knowledge about customers by conducting 10 in-depth interviews to test the value proposition. This time, they chose appropriate respondents, which allowed them to create an 'outside-in offer' and ensure that they were speaking the same language as their customers. Through the interviews, the sponsors also gained insights into what customers found important and what they wanted, which were both important when working to meet customers' needs.

To reduce resistance, the sponsors transferred some of their responsibilities to the sales directors, thus transforming the latter into sponsors. With the sales directors on board, the sponsors and the servitization team coached the sellers by, for example, clarifying how to sell solutions. Consequently, a value proposition was established and communicated internally and sponsors also developed different tools to demonstrate value to customers.

Towards the end of the research period, the sponsors realised the importance of a new mindset to ensure servitization success. One noted, 'We cannot build the roof until we have the foundation'. This awareness, together with a new directive from the management team demanding a quadruple turnover from the solutions division within four years, caused the sponsors to begin working in a more structured manner.

4.4 HydroCo's process

At the time of the first episode (2018) of this study, HydroCo had already begun its servitization change process, and managers with service-oriented mindsets had already been employed. Servitization was considered a long-term change process, in which the most important subgoal was to change mindsets within the organisation. All employees were educated to think in a service-oriented way. The authoritarians at HydroCo mainly focused on identifying challenges and planning the process. The identified challenges included moving from reactive to proactive, predictive, and, finally, preventive service offerings. Services were being given away for free at the time, so the authoritarians tried to make salespeople with long-term customer relationships see service offerings as business opportunities and to charge for them. One of the biggest challenges that HydroCo faced during this episode was to manage the internal resistance of both opponents and rationalists.

To address the challenges and move forward with servitization, the planning process included the creation of a clear goal and strategy. The goal focused on establishing a service-oriented mindset within the organisation: 'It's about culture, so in addition to the usual everyday challenges, there is something that is much bigger. That's the mindset.' Once the goal was set, the process to be followed was documented. The authoritarians identified and formulated arguments to convince organisational members of the necessity of servitization. These arguments focused on the advantages of increased business opportunities and the risks associated with avoiding servitization. The message was to focus on customers' needs, even if they were not explicitly expressed. To have the right information and be able to interpret it was crucial for employees to identify new business opportunities. HydroCo's servitization process was continuously followed up on and evaluated.

The second episode (2019) was characterised by changes made to address the challenges identified in the previous episode. More resources were dedicated to the development of digital solutions; as some of these solutions were implemented, the firm extended its offering to proactive services and started the development of a value-based pricing model. By 2018, service growth had desisted, and during the second episode (2019), a number of organisational changes were made that were considered crucial to follow the growth plan. This led to better communication within the firm and increased cooperation between units, something that was emphasised by the authoritarians as central to the implementation of servitization. Moreover, the digital solutions division was no longer a business line with profit-and-loss responsibility but a supporting unit for other business lines. It no longer focused on sales but on development only. Despite the progress made in offering more solutions, establishing organisational changes, and improving communication, which were all highlighted as important areas for driving servitization during this episode, facilitating the required mindset change among employees remained a challenge. The authoritarians still found it challenging to manage resistance within the firm, as some employees refused to cooperate.

During the third episode (2021), some challenges were overcome, and the firm moved on to offering proactive solutions. Looking back on the progress they had made; the authoritarians were convinced of the necessity of a clear goal but realised that they needed to adjust the process occasionally. The authoritarians still found the mindset change to be the biggest challenge, and even though relationship building was important when offering solutions, it constrained servitization. Services were often provided for free to maintain customer relationships, which prevented the firm from creating business: 'There is established communication and relations with customers, so there is a lot of goodwill. You answer the phone, [and] you solve things. But we need to move from this relationship to a business [opportunity] somehow.' For some employees, this mindset change was not achieved and they were offered new positions.

Except for such drastic measures to continue the servitization process, the third episode was primarily characterised by a balance between the existing product-oriented mindset among engineers, for example, and the service-oriented mindset necessary for servitization. The authoritarians found concrete ways of maintaining a balance in the coexistence of the different mindsets. During this episode, servitization was slowed down by changes in the top management. These changes influenced the strategy and direction of the process, and resources were withdrawn; the authoritarians now made efforts to visualise and present the value of solutions not only to managers and employees but also to the top management. Consequently, the servitization process was driven by the authoritarians and managers who had the courage to take on the responsibility for changes, as the top management would not.

5. FINDINGS

There were important differences in the strategic change processes of the two case firms, particularly in (1) the driving practitioners and performed praxes, and (2) the outcome – enabled (HydroCo) or constrained (PackageCo) servitization. For example, PackageCo prioritised

extending the service offerings, ensuring customer proximity, and implementing service strategies. However, they lacked a structured strategic plan. HydroCo had a documented, well-structured strategic plan for the entire servitization process. For instance, they aimed to extend their service offerings, and to do so, the establishment of a service culture was considered the key. A holistic perspective guided their strategic change process.

We identified five practitioner types in our study: authoritarians, sponsors, supporters, opponents, and rationalists. Although they were all present in both companies, there were differences in the practitioners who drove servitization. At PackageCo, sponsors drove the process. Even though they were supported by the top management, the lack of a mandate led to massive resistance within the organisation. At HydroCo, authoritarians drove the change process and were able to manage the resistance more effectively.

The intended outcome for the servitization process at PackageCo was to capture more value. This intention was based on a product-oriented mindset – that is, the purpose of value was to increase the firm's wealth through an internal and output-oriented focus. Customers were left out of the value-creating activities. Considering the definition of servitization as a shift from a goods to a service business logic, PackageCo's intended outcome led to constrained servitization. At HydroCo, the intended outcome was to shift the mindset of employees towards responding to customer needs and creating better business opportunities. This means that customers' needs became central to the process, requiring close relationships to be maintained among the actors involved, which, in turn, increased the odds of value being realised for all involved actors. Thus, HydroCo's approach resulted in enabled servitization.

6. DISCUSSION

Based on our conceptual framework and findings, the interplay between practices, practitioners, and praxes involved in the enabled and constrained servitization types are illustrated in Figure 1. In this study, we focused on the practitioners who drove servitization in the case firms (authoritarians and sponsors) and their praxes. The process also involved other practitioners who either enabled (sponsors and supporters) or constrained (opponents and rationalists) servitization through their participation in the firm's activities. Moreover, practices influenced both practitioners and praxes and either enabled or constrained servitization (Vaara & Whittington 2012). At the same time, practitioners influenced practices by preserving common behaviours and through the activities they performed (i.e., praxes). Due to these enabling and constraining forces in each organisation, the outcome was either enabled or constrained servitization.

Consequently, we view servitization as an ongoing process that could result in a service business logic (c.f. Åkesson & Löfberg 2021; Kowalkowski et al. 2017). The relationship between practices, practitioners, and praxes is dynamic and changes over time (see e.g., Jarzabkowski et al. 2007; Vaara et al. 2004). Since practices develop over time and are difficult to change (Jarzabkowski 2004), hard work is needed to establish new practices based on a service business logic if servitization is to be enabled. New employees may join the team, and practitioners may continue to constrain servitization. Therefore, *doing* strategy is an ongoing process, and practices, practitioners, and praxes must be continuously evaluated, maintained, and developed.

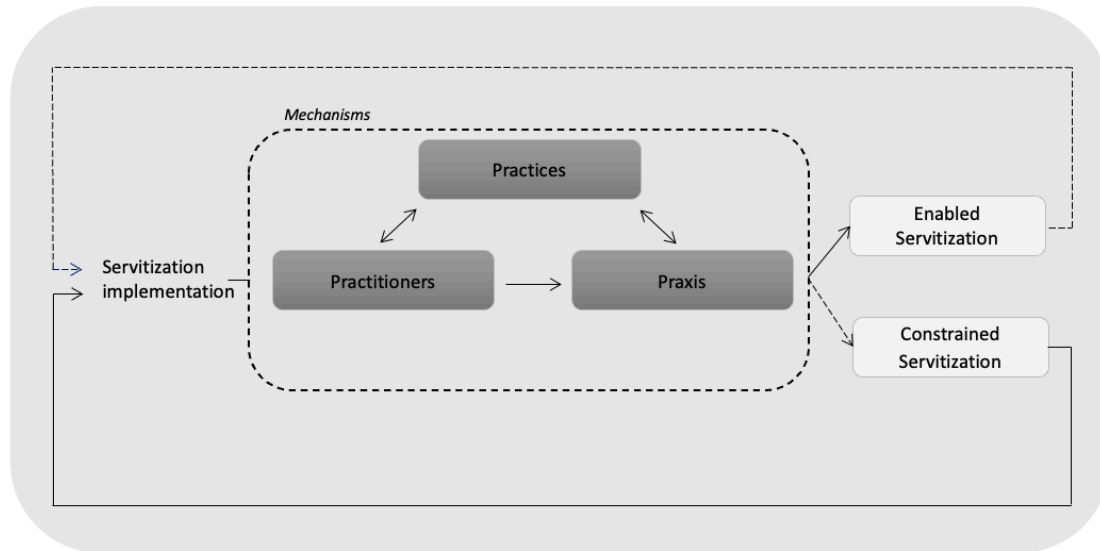


Figure 1: Framework illustrating the interplay between practices, practitioners, and praxes in enabling or constraining servitization

6.1 Theoretical and practical contributions

By exploring servitization as a strategic change process, this study makes three theoretical contributions: it (1) shows that servitization outcomes may be enabled or constrained based on the interplay between practices, practitioners, and praxes, (2) provides a typology of practitioners involved in servitization, and (3) reveals the importance of changing product-oriented practices into service-oriented ones to enable servitization. Viewing servitization as a strategic change process provides a holistic perspective of practitioners' authority to perform praxes that lead to the shift from product-oriented practices to service-oriented ones, in turn increasing the possibility of enabled servitization.

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DETERMINANTS OF FDI LOCATION CHOICE OF FIRMS WITH HYBRID OFFERINGS

Jelena Jovanovic & Dirk Morschett

ABSTRACT

Purpose: The purpose of this paper is to understand the determinants of location choice for the service activities of firms with hybrid offerings to engage in FDI.

Design/Methodology/Approach: Different firm-, location- and industry-specific determinants are studied using a logistic binary regression on a sample of 1530 location decisions.

Findings: We find a significant influence of servitization, digital readiness of the host country, agglomeration economies and the relevance of product-related services on the decision to do FDI for service activities.

Originality/Value: This paper sheds new light on the location choice literature by examining what it entails for firms with hybrid offerings.

KEYWORDS: Servitization, Hybrid Offerings, FDI, International Location Choice

1 RELEVANCE OF THE TOPIC

Servitization of manufacturing companies has been identified as a strategic research priority (Kowalkowski, Gebauer et al. 2017). Numerous studies have been conducted on topics like “service offerings”, “strategy and structure”, or “service development, sales and delivery” (see the overview article of Raddats, Kowalkowski et al. 2019). The servitization literature is nearly silent on the internationalization aspects, although the importance of studying internationalization of the service function has been highlighted by different authors (Parida, Sjödin et al. 2015, Kowalkowski, Gebauer et al. 2017, Vendrell-Herrero, Gomes et al. 2018). Among the most critical internationalization decisions, and one of the most studied topics in international business (IB) research, is deciding on the foreign operation mode (FOM) (Brouthers and Hennart 2007). Hereby, the location choice (LC) is core to the managerial decisions of MNEs when engaging in foreign direct investment (FDI). The existing IB studies have mainly focused on either companies selling goods or services. Manufacturing companies which increasingly offer services or even combine their goods and offered services to so-called hybrid offerings (Baines, Lightfoot et al. 2009, Ulaga and Reinartz 2011), has been neglected. Therefore, the purpose of this paper is to understand the determinants of LC for the service activities of firms with hybrid offerings to engage in FDI. For this, we study different firm-, location- and industry-specific determinants. We investigate whether hybrid companies with a service focus value other determinants. We apply logistic binary regression on a sample of 1530 location decisions (30 companies in 51 countries). This paper sheds new light on the LC by examining what it entails for firms with hybrid offerings. One purpose is to evaluate if the factors of the FDI LC for different firm activities of companies with hybrid offerings can be explained using theoretical insights for pure manufacturing companies, or whether hybrid offerings impact the LC differently. Besides, our paper follows the call for studies that integrate firm resources, industry agglomeration economies, and location specific characteristics to better understand the multi-faceted drivers of FDI LC (Nielsen, Asmussen et al. 2017). The subsequent section gives an overview of the existing literature and sets the theoretical background. After this, the methodology is explained and results are presented. Our conclusions are drawn in the final section.

2 THEORETICAL BACKGROUND & LITERATURE REVIEW

2.1 LC and FDI

Deciding on the FOM is one of the most critical internationalization decisions (Brouthers and Hennart 2007). It is crucial because it shapes the company's activities, determines the level of control and impacts their strategic success or failure (Schellenberg, Harker et al. 2018). Hereby, the LC has an

essential impact, mostly because LC decisions are either irreversible or expensive to modify (Li, Quan et al. 2018). With Dunning's eclectic paradigm (Dunning 1980) highlighting the importance of location for MNE, the topic gained in interest and relevance. This framework is also called the OLI framework, because it explains that firms' FDI behavior is determined by having advantages in ownership, location and internalization. Ownership and internalization advantages are both firm-specific, while the location advantages result from host country specific factors. Given the economic efficiency and location-specific advantages, firms are motivated to exploit them through internalizing their firm-specific advantages – resulting in the decision for FDI (Dunning 1998).

While traditionally the OLI framework was meant to explain the FDI decision of the producing companies, Dunning (1989) explained how to apply the paradigm to other companies, such as service providers. He highlighted the importance of the LC for goods-related services and argued that where the service provision is located might influence the buying decision of customers.

2.2 Differences between goods and services

Most studies emphasize attributes that differentiate goods and services (Jack, As-Saber et al. 2008). This is, however, no longer possible since many manufacturing companies, especially those active in mature industries (Cusumano, Kahl et al. 2015), are increasingly combining their goods and services to hybrid offerings (Baines, Lightfoot et al. 2009, Ulaga and Reinartz 2011). The type of product (manufactured good vs. service) has been found to have an impact on the international market entry mode (Erramilli 1990), that is, service firms follow different internationalization strategies than manufacturers and value other LC factors (Grönroos 1999). When internationalizing, hybrid firms face the choice of the FOM for the distribution of goods and for the provision of related services. The existing IB literature on the distribution of goods is suitable to explain the first. But it is not evident whether previous findings can be transferred.

2.3 Influence factors

MNEs consider a wide range of factors when making FDI LC and the relative importance of each factor varies depending on the industry, the specific company, and the country in question. Previous research has identified a number of influence factors (Dunning 2015), which can be grouped into firm-, industry- and country-specific (Jain, Kothari et al. 2016). There has been an increasing consensus that it is important to understand not just how aggregate FDI responds to fixed characteristics of host locations, but to include the influence of firm characteristics, such as the company's strategy (Cantwell 2009). Many international decisions are not strictly a reaction to exogenous host country conditions, but are influenced by the characteristics of a company and their strategic aim (Duanmu 2012). Nevertheless, the literature still lacks a thorough understanding of the LC influence factors (Kim and Aguilera 2016, Li, Quan et al. 2018). One of the reasons is that the study results often depend on the empirical context (Kim and Aguilera 2016, Li, Quan et al. 2018). So far, companies with hybrid offerings have not been studied. For a successful servitization strategy, the way how products and services are developed, manufactured, marketed and delivered needs to be adapted (Luz Martín-Peña, Díaz-Garrido et al. 2018). To complete the understanding of the influence factors with insights for firms with hybrid offering, we investigate different firm-, industry- and country-specific influence factors influencing the LC for industrial goods manufacturers.

2.3.1 Firm-specific variables

Servitization

Selling more and more services or even product-service combinations has become the competitive strategy for industrial goods manufacturers (Baines, Lightfoot et al. 2009, Raddats, Kowalkowski et al. 2019). Several approaches to servitization exist. While some manufacturers only complement their product offerings with individual services, more advanced ones create customized and long-term offerings (Baines and Lightfoot 2013). Scholars argue that a company's strategy, in particular its competitive strategy, influences the entry mode selection (Kogut and Singh 1988). According to the resource-based view (RBV), resources generating competitive advantage should be kept internally. Thus, we expect that the higher the servitization, the more is FDI preferred.

H1: Servitization will have a positive relationship to choosing FDI for the service activity.

Co-location of activities

Some firm activities have important complementarities and therefore require intensive coordination. Sales and service activities are both market-seeking activities (Enright 2009). Therefore, a geographical separation would cause high coordination costs. In this case, co-location of those activities might be beneficial. Enright (2009) has found that the activities service activity is tightly geographically linked to sales activities, but not to production activities for manufacturing companies. Thus:

H2a: The firm activities sales and services are co-located.

H2b: The firm activities production and services are not co-located.

2.3.2 Location-specific variables

Market size of the host country

According to Hymer (1978), companies choose bigger markets for their FDI. Most of the studies on LC include this economic factor in the analysis (Nielsen, Asmussen et al. 2017). This is especially the case for sales and service activities, since a bigger market size signifies market opportunities (Dunning 1998). Therefore:

H3: Market size of the host country will have a positive relationship to choosing FDI for the service activity.

Digital readiness of the host country

IB researchers have mostly concentrated on individual aspects of digitalization, e.g. big data, cloud computing, artificial intelligence, or internationalization (Bergamaschi, Bettinelli et al. 2020). The interconnectedness of both is relevant for the FOM choice of hybrid companies. Not only do servitization and digitalization depend on each other (Porter and Heppelmann 2015), but it also allows some services to be provided remotely, reducing the importance of geographical distance (Bergamaschi, Bettinelli et al. 2020). Jovanovic and Morschett (2022) have found that companies with a servitization strategy choose FDI for their service activities in countries which have a high digital readiness. Companies with a servitization strategy offer base, intermediate and advanced services, whereby intermediate and advanced services typically are or have a digital component. This is why they can only be provided in countries which are able and willing to receive them (Wunderlich, von Wangenheim et al. 2013). Thus:

H4: Digital readiness of the host country will have a positive relationship to choosing FDI for the service activity.

2.3.3 Industry-specific variables

Agglomeration economies

Prior research has shown that industrial clusters in a specific country or region can foster FDI, i.e. the presence of other firms attracts more investment in the same region (Jain, Kothari et al. 2016). One of the reasons is the close geographical proximity to other companies from the same industry which results in knowledge spillovers. The latter occurs as result of imitation, networking between employees from different companies or job market fluctuations. This positive effect is known as the agglomeration economies in the literature (Cantwell 2009, Jain, Kothari et al. 2016). Thus:

H5: Agglomeration economies will have a positive relationship to choosing FDI for the service activity.

Relevance of product-related services for the host country

For MNCs intending to invest in a new market, the export activity of the host nation might be a key factor. If the host nation already exports goods or services to other markets, this may be a sign that there is interest in such goods or services outside (Kastratović 2020). As a result, the country may be a desirable destination for FDI due to the availability of access to a developed export market. In the context of the present study, the magnitude of the export of product-related services by the host

country is expected to evaluate the attractiveness for FDI. Therefore, we expect that if a country has itself a high output of goods-related services, that it is also willing to receive such. Thus:

H6: The magnitude of product-related services exports by the host country will have a positive relationship to choosing FDI for the service activity.

Control variables

Two control variables are included in the study: Host country size and geographical distance to home country. The FDI decision has been found to be positively influenced by market size (e.g., Erramilli 1990). This is especially the case for sales and service activities, since a bigger market size signifies market opportunities (Dunning 1998). Geographic distance measures physical distance between home and host countries and is found to negatively influence host country LC (Jain, Kothari et al. 2016). Managing geographically distant locations typically cause high spatial transaction costs (Dunning 1989), which mainly encompass the travel time for managers. Because interacting is easier with geographically close markets, firms tend to choose FDI in these markets (Boeh and Beamish 2012).

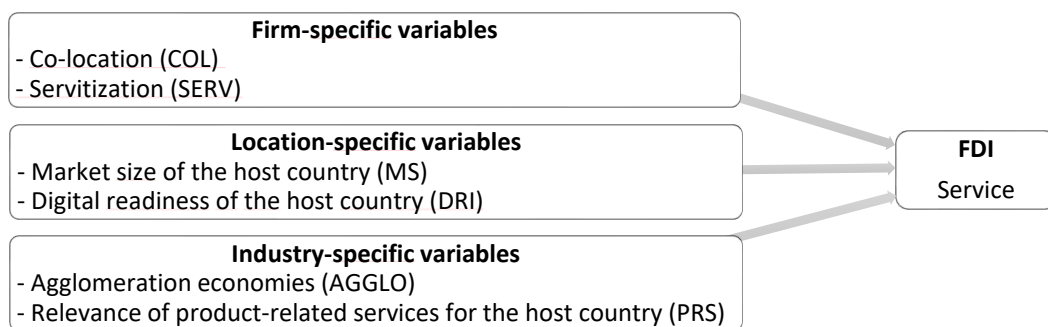


Figure 1: Conceptual Model

3 METHODOLOGY

3.1 Sample and data

For the analysis, we have built a database consisting of 1530 firm location decisions including firm characteristics, country and industry characteristics. To gather firm locations, we have investigated the currently available locations of sales and service activities of 30 companies. To choose the companies of interest, i.e. companies providing product-related services, we proceeded as follows:

1. Extract the list of all public companies with HQ in Switzerland and Germany in the FactSet database for the industries “Electrical Products”; “Electronic Equipment/Instruments”; “Electronic Production Equipment”; “Industrial machinery”; “Medical Specialties”; “Trucks/Construction/Farm Machinery”.
2. To complement the firm characteristics, we screened the annual reports for service revenue, FDI locations (with an ownership of >51%) and their functions. This results in a total sample of 30 companies, 15 with HQ in Switzerland and 15 with HQ in Germany. The data collected refers to the year 2019 (annual reports) in order to exclude a potential bias in firm-specific information (revenue) due to the Covid-19 pandemic. The basis for the selected countries build the entirety of the collected FDI locations. Then, based on the available data on the countries, some were excluded for the analysis. This results in 51 countries from different world regions.

3.2 Operationalization of variables

The dependent binary variables of the FDI decision for service. The variable equals 1 if the company reports having at least one subsidiary with ownership of >51% of that activity in the given host country. The operationalization of the location-, firm-, and industry-specific variables is given in Table 1.

Table 1: Operationalization of the independent variables

	Variable	Measurement	Source
Location-specific	Market size (MS)	Value added by the industry, % of GDP	World Bank
	Digital readiness of the host country (DRI)	DRI index, 0 to 25	Cisco
Firm-specific	Servitization (SERV)	% service revenue on total revenue	Annual reports
	Co-location of activities (COL)	FDI or not (0/1) for sales, service & production	Annual reports
Industry-specific	Agglomeration economies (AGGLO)	% of firms in industry "NACE 28" in host country k	ORBIS
	Relevance of product-related services (PRS)	Value in Mio. USD (2019) (Manufacturing services, Maintenance & repair services)	World Bank
Control variables	Host country size (HCS)	GDP of the host country, in USD (2019)	World Bank
	Geographical distance (DIST)	Distance to the home country in km	CAGE

4 DATA ANALYSIS

The analysis of co-location involves nominal variables (FDI or not). To determine if there is a significant correlation between two nominal (categorical) variables, the Chi-Square test of independence is utilized (Bouquet, Hébert et al. 2004). To test the hypotheses 1, 3, and 4, we applied the commonly used logistic regression in management research (Huett, Baum et al. 2014). This technique is typically used to forecast the odds of an observed dichotomous result for the dependent variable, using one or more independent variables (categorical and/or metric) (Anderson and Blair 1982). Binary logistic regression analysis has been used to examine various firm internationalization decisions, as for the entry mode (Kogut and Singh 1988) and LC (e.g., Huett, Baum et al. 2014). The probability of choosing FDI for the respective company activity is calculated as:

$$P(Y) = \frac{1}{1 + e^{-Z}} \text{ with } Z = b_0 + b_1 * x_1 + b_2 * x_2 + \dots + b_n * x_n$$

with b_i being the regression coefficients, x_i the explanatory variables and b_0 the intercept.

All the coefficients that were significant were studied. Positive coefficients represent the probability of choosing FDI, whereby negative coefficients indicate a tendency to choose cooperative modes. We used one-tailed tests because they are more suitable for assessing directionality.

5 RESULTS

A chi-square test of independence was conducted to examine the relationship between production and service (Table 2). The chi-square test statistic 229.187 (df=1, p<0.01) indicates a significant association between the production location and the service location. Therefore, H2a can be accepted. The same test has been done for the relationship between the sales and service activity. The result also indicates a significant association between the sales location and the service location (Chi2=998.343, df=1, p<0.05). H2b is also accepted.

Table 2: Chi-square test of independence

	Production & Service			Sales & Service		
	Value	df	Asymptotic significance (2-sided)	Value	df	Asymptotic significance (2-sided)
Pearson-Chi-Square	229.187 ^b	1	0.000	998.343 ^c	1	0.000
Continuity correction ^a	225.760	1	0.000	994.126	1	0.000
Likelihood-Ratio	187.803	1	0.000	1005.010	1	0.000
Linear-by-linear association	229.038	1	0.000	997.690	1	0.000
N of valid cases	1530			1530		

a. Computed only for a 2x2-table

b. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 27.38.

c. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 102.49.

Table 3 shows the results of the logistic regression analysis that aims to predict the likelihood of a certain outcome based on several predictor variables. The outcome is binary for the decision to choose FDI for the service activity (yes or no), and the predictor variables include SERV, MS, DRI, AGGLO, PRS, HCS and DIST. The model is statistically highly significant since the Chi2-value is significant (p=0.000).

This means that all our variables discriminate well between FDI and non-FDI operation modes. Nagelkerkes R² (0.231) indicates a good explanation of the variation in the choice of the operation mode for the service activity. The model fit for the model is also very good, with a classification percentage of 78%. The null hypothesis of the Hosmer-Lemeshow test can be rejected ($p=0.236$). Thus, the model is not significantly different from the observed data. Therefore, we conclude that the overall fit of the model is good. The results show that HCS (0.538, $p<0.01$), DRI (0.191, $p<0.01$), SERV (0.438, $p<0.001$), and PRS (0.536, $p<0.001$) are all significant predictors of the outcome. This means that as these variables increase, the odds of the outcome also increase. AGGLO (-0.304, $p<0.05$) is a significant negative predictor of the outcome, meaning that as concentration of firms increases, the odds of the outcome decrease. This result is opposing to our hypothesis, assuming that the concentration has a positive impact. MS (-0.142, $p>0.05$) and geographical distance (0.089, $p>0.05$) are not significant predictors of the outcome.

Table 3: Results of the logistic regression

	Regression coefficient B	Std. error	Wald	df	Sig.	Exp(B)
SERV	0.438***	0.073	36.112	1	0.000	1.550
MS	-0.142	0.096	2.182	1	0.140	0.868
DRI	0.191**	0.079	5.830	1	0.016	1.211
AGGLO	-0.304**	0.148	4.211	1	0.040	0.738
PRS	0.536***	0.122	19.208	1	0.000	1.709
HCS	0.538**	0.189	8.067	1	0.005	1.712
DIST	0.089	0.074	1.457	1	0.227	1.093
Intercept	-1.212***	0.076	254.945	1	0.000	0.298
Chi-square	220.790 (df=7, $p=0.000$)					
-2 Log-Likelihood	1256.859					
Cox & Snell R-Squared	0.157					
Nagelkerkes R-Squared	0.231					
Hosmer-Lemeshow-Test	10.426 (df=8, $p=0.236$)					
Classification table	78%					

* < 0.1; ** < 0.05; *** < 0.001, one-tailed test

6 CONCLUSION

What pulls FDI to particular countries is a crucial question for researchers, managers of global companies, as well as countries willing to attract FDI (Kundu and Contractor 1999). Therefore, the interplay of geographical location, FOM and a firm's competitive advantage, as highlighted by Dunning (1998), is at the core of this article. This paper investigates the impact of different firm-, industry- and location-factors on the decision to choose FDI for service activities of firms with hybrid offerings.

Both the location of sales and services (H2a) and production and services (H2b) is highly correlated – whenever the company invests into a country for their sales or production activities, it does the same for the service activities. This finding is in line with Enright (2009) who also finds that sales and service are typically co-located. Also, Jovanovic and Morschett (2022) show that companies invest into having own service resources in each country in which own sales resources are available. Another reason for the high correlation between the location of sales and services can be the administrative heritage of the organizational structures (Bartlett and Ghoshal 1988).

Servitization clearly increases the probability of choosing FDI for the service activities, confirming that the RBV holds and that the competitive strategy impacts the operation mode (Kogut and Singh 1988). The resources to provide the services of firms with hybrid offerings are clearly generating the competitive advantage and tend to be kept internally in the host market to protect the know-how. Contrary to the hypothesis, the agglomeration economies have a negative influence on probability to choose FDI for service activities. The more competitors are present, the less probable is it to choose FDI for service activities. A more competitive market could result in lower profit margins and a diminished motivation to invest. Furthermore, due to the nature of the offer of hybrid companies, the good is dependent on the related services. Since industrial goods are costly investment goods and

typically purchased for a longer period of time, they bind the customer to a company for a long period. Therefore, the first-mover advantage applies in this case (Leischnig and Geigenmüller 2018).

The results confirm the positive relationship between the digital readiness of the host country and the probability to choose FDI for services. This finding confirms that a servitization strategy is enabled through digitalization (Parida, Sjödin et al. 2015). When providing digital services across borders, the customers in the host country must be able and willing to receive them (Wunderlich, von Wangenheim et al. 2013). This can explain the choice of countries with a high digital readiness when focusing on the provision of services. Contrarily and surprisingly, the market size of the relevant industry does not have a significant impact on the FDI decision. However, the export of product-related services by the host country does have a significant positive impact. The higher the level of export of product-related services, the higher is the demand of the country for such services, leading hybrid companies to prefer FDI as the operation mode for services. Therefore, it can be concluded that in the context of hybrid companies, the importance of the service offerings is more important than the general size of the industry. This finding further underlays the importance of providing services.

7 CONTRIBUTION

This paper contributes both to the research on the internationalization of companies with hybrid offerings and on the LC theory by integrating firm-, country-, and industry-specific variables (Nielsen, Asmussen et al. 2017). This paper follows the call of Paul and Feliciano-Cestero (2021) more research on FDI characteristics, such as the location, across different industries and countries. Most of the LC research is focused on the US or Asian countries. This study is focused on the global location decisions of machine manufacturers headquartered in Switzerland and Germany and therefore adds knowledge on the location strategy of European MNCs (Flores and Aguilera 2007). Less studied countries are included and there is not a focus on one single country (Nielsen, Asmussen et al. 2017). Besides, our paper follows the call for more studies that integrate firm resources, industry agglomeration economies, and location specific characteristics to better understand the multi-faceted drivers of FDI LC (Nielsen, Asmussen et al. 2017). By adding digitalization-related variables, such as the digital readiness of the host country, we respond to the call of Bergamaschi, Bettinelli et al. (2020). As pointed out by Vendrell-Herrero, Gomes et al. (2018), including the international angle in servitization research, and especially for the service provision in foreign countries, is an important avenue for research. Finally, the unique database has been carefully built up using the annual reports of firms as the main source. We do not rely on the commonly used paid databases such as Bureau van Dijk (Nielsen, Asmussen et al. 2017).

8 LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Our research design is subject to several limitations, which however offer avenues for research.

We study the service function as a whole and do not differentiate between the individual service activities. Yet, the industrial services are very heterogeneous and can be categorized into base, intermediate and advanced services (Baines and Lightfoot 2013). These categories might impact the FDI decision, because for each of them, other country-related factors might have an impact. For example, advanced services are highly digitalized and complex and might impact the location decision. Many companies do not have one location for all services, but service competence centers for specific service activities (Sklyar, Kowalkowski et al. 2019). Although our findings have relevant implications for location research, we only study factors leading to choosing FDI and do not deliver an understanding of which activities are offshored to which countries (Kim and Aguilera 2016).

We define a location as the chosen country and do not study whether these companies all locate in the same city or region within the country. According to global city theory, MNCs tend to choose global cities because they are highly interconnected to local and global markets, their cosmopolitan environment and their high level of advanced producer services (Nielsen, Asmussen et al. 2018). This helps them to overcome the liability of foreignness. Our paper investigates the variables influencing the investment decisions for different corporate activities, but it does not investigate the sequence of investments. Since the internationalization is a process, future research should investigate how the previous location decision impacts the subsequent.

Our data, although unique in nature, has some limitations. It is cross-sectional and provides only a snapshot of the LCs at a given point in time (2019).

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SERVITIZATION AS AN ENABLER FOR SUSTAINABLE BUSINESS DEVELOPMENT - A QUALITATIVE STUDY BASED ON THE SUSTAINABILITY ACCEPTANCE MODEL (SAM)

Götz H. Gladisch, Benjamin Biesinger, Mareike Ahlers & Karsten Hadwich

ABSTRACT

Purpose: This study helps to understand how servitization can facilitate sustainable business development (SBD). In particular, the SAM identifies barrier patterns of three different segments that help service providers to formulate corresponding value propositions.

Methodology: A qualitative research study was conducted with 23 companies from different industries in both B2B and B2C sectors. The data obtained was analysed by using the categorical framework of the SAM, which opposes the barriers and benefits of a SBD by incorporating the two concepts of business model and business case. Based on the finding, extant literature was used in order to hypothesize the application of servitization.

Findings: The study finds barrier patterns inherent in the business model across three different sustainability strategies that allow to propose the application of servitization and PSS.

Originality/Value: For service providers, the SAM and the results of this study provide guidance in formulating an appropriate sustainable value proposition, taking into account patterns of user needs in specific customer segments, that could therefore enable their SBD.

KEYWORDS: servitization, business case, sustainable business model innovation, perceived barriers, perceived benefits, value proposition

1. INTRODUCTION

Companies as pivotal actors to pave the way to a sustainable future, aim at the business case for sustainability (Hahn, 2022). However, 98% of them fail and do not exceed nor achieve their sustainability targets formulated in the strategy (Schaltegger & Wagner, 2006; Davis-Peccoud et al., 2016).

To overcome this strategy-business case gap, innovating the current business model, that links strategy and business case, is evident (Schaltegger et al., 2012). Nonetheless, companies fail to adopt sustainable business models (Geissdoerfer et al., 2018). Servitization seems to foster sustainable innovations and therefore sustainable business development (e.g. Baines et al., 2007; Mont 2001). Yet, the actual role of servitization with regard to sustainable business development remains unclear.

This study therefore aims to examine the perceived barriers and benefits of a SBD. In this way, the resulting Sustainability Acceptance Model (SAM) helps to identify barrier patterns across different sustainability strategies of companies and therefore elaborates the role of servitization. The resulting typology facilitates the formulation of appropriate value propositions by service providers for their corresponding customer segments.

2. THEORETICAL FRAMEWORK

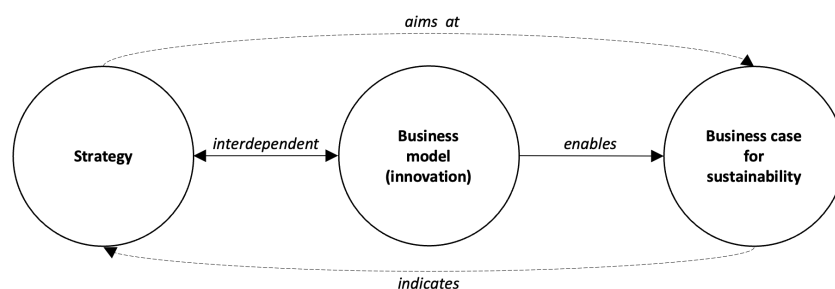
2.1 The Process of a Sustainable Business Development

One of the main reasons for companies to address the issue of sustainability is the business case for sustainability (Hahn, 2022). Schaltegger et al. (2012) defined three requirements to attain a business case for sustainability: Firstly, these should be based on voluntary actions to solve environmental or social problems, rather than just meeting legal requirements. The second requirement is that these actions have a measurable positive impact on economic success. Finally, the economic effect has been created *through* and not just *with* social or environmental activities. Speaking in the language of strategic management, the first requirement refers to a strategy that aims at business case for sustainability in the second step. The last requirement can be seen as a link between the strategy and the business case for sustainability. Therefore it relates to a business model for sustainability. It integrates sustainability into the business model and translates it into a blueprint for the business, facilitating the business case for sustainability (Zott & Amit, 2010).

Hence, the underlying theoretical concept for the sustainable business development (SBD) is a tripartite model [Figure 1]. It starts with companies' strategy that aims at a business case for sustainability, where business success and contributions to sustainable development are linked, and

which is facilitated by an appropriate sustainable business model (SBM) (Dyllick & Hockerts, 2002). Depending on firms' individual responsiveness to sustainability they formulate strategies that vary with its intention and the level of the required business model innovation (Mitchell & Coles, 2003). The intention changes with the extent to which a sustainable venture is intended to pay off, as the business case for sustainability has a variety of drivers. Next to costs, risk, profit margin and attractiveness as an employer, the innovative capabilities might also be improved (Christmann, 2000; Schaltegger & Wagner, 2006; Porter & van der Linde, 1995; Jones & Rubin, 1999; Ehnert, 2009; Cohen & Winn, 2007). The degree to which these want to be achieved by the firm depends on whether a *defensive*, *accommodative* or *proactive* strategy is pursued. According to Mitchell and Coles (2003), the level of business model innovation links and enables the strategy to the respective business case drivers [Figure 1]. There are three types of sustainability strategies and their complementary degrees of business model innovation as proposed in the *framework for business model innovation for the business case for sustainability* by Schaltegger et al. (2012). By only complying with legislation, the *defensive* strategy only *adjusts* the current business model. Therefore just modest changes are made to address the drivers of risk reduction, also partly related to issues of costs and communication.

Figure 1: SBD-Model based on Schaltegger et al. (2012)



The *accommodative* strategy integrates sustainability measures in the majority of business processes. Though, without affecting the underlying revenue-logic of a firm. By doing so, companies *improve* their business with a focus on eco-efficiency and increase reputation of both brand as well as employer attractiveness. Within the *proactive* strategy, the business model is *redesigned*. Here, the revenue logic is also questioned and could be changed in order to achieve outstanding sustainable performance and realise the business case for sustainability and all its drivers. However, the creation of complementary business model configuration for the respective strategies seem to be challenging (e.g. Schaltegger & Wagner, 2006; Davis-Peccoud et al., 2016; Hahn, 2022)

2.2 Sustainable Business Model Innovation and the Role of Servitization and PSS

In order to close the strategy-business case gap it is not sufficient to change *what you do*, but rather to change *the way you do business* (Amit & Zott, 2012). Hence, sustainable business model innovation (SBMI) is vital to leverage sustainable ventures (Abdul-Rashid et al., 2017). It describes a modification of existing or creation of completely new business models that either reduce negative or create positive impacts on environment and society (Schaltegger et al., 2016).

Bocken et al. (2014) present “deliver functionality, rather than ownership” as one of eight archetypes of sustainable business models. It concerns the satisfaction of user needs that is created by a service rather than a product-ownership. This archetype is based on the literature on product-service-system (PSS) and servitization (e.g. Tukker, 2004, Baines 2008). Servitization is defined as the process of business model innovation that allows to create value through selling PSS (Baines, 2008). The concrete form of the PSS can vary along the *PSS-continuum* (Oliva & Kallenberg, 2003; Tukker, 2004): A product-oriented PSS focuses on the traditional transaction of a product. Additional services (e.g. after-sales service) ensure the functionality, longevity and optimal use of the product. By means of a *use-oriented* PSS, not the ownership of the product is sold to the customer, but rather the use or availability to also extend the lifetime. A *results-based* PSS sells an outcome or a capability. The company offers an individual service mix while retaining ownership. The customer, however, only pays for the provision of the agreed outcome. A company defines its specific position on this *product-service continuum* in its value proposition and according to customers' needs (Gebauer et al., 2008). Therefore, two parties are involved in creating a viable PSS. The company that (would like to) offer(s) PSS and the customer who receives this PSS accordingly.

Hence, to support the customers in their SBD it is on the hand crucial to understand what sustainability strategy they pursue. And on the other, depending on the strategy, what barriers

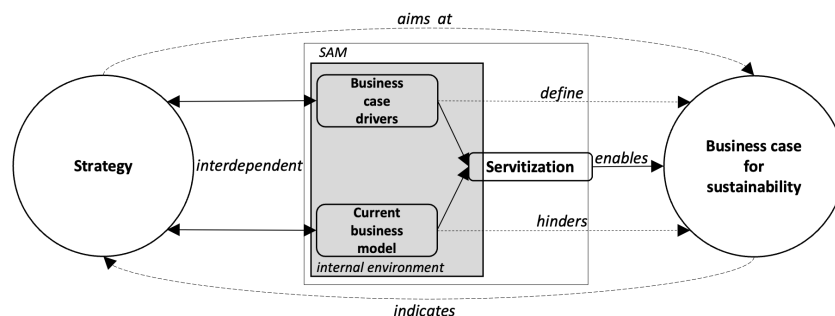
inherent in their business model hinder them to achieve the business case for sustainability. These insight could be vital for service-providers to formulate a sustainable value propositions according to customer needs.

2.3 Sustainability Acceptance Model (SAM)

As work in progress, the extant literature does not provide a framework that explains the role of servitization with respect to the sustainable business development by taking into account the four concepts (i.e. sustainability strategy, business model innovation, business case (drivers), servitization) as well as its assorted characteristics (i.e. defensive; adjust; cost; product-oriented). Therefore, in order to comprehend the tripartite SBD-process, the conceptual framework should first incorporate and tackle the sustainable strategy, business model and business case. Thereafter, a gateway to servitization ought to be built, as the goal would be to elaborate the interdependencies between the *framework for business model innovation for the business case for sustainability* and the *PSS-continuum*. In this way, the role of servitization in relation to SBD should be enlightened.

The Sustainability Acceptance Model (SAM) has been developed in order to investigate the interrelations between the three components of the SBD-process. As this is the condition to create a “triple-win” situation in which ecological, social and economic value is created (Elkington, 1998; Boons & Lüdeke-Freund, 2013). While being aware that sustainability can also pay off economically (Hahn, 2022), most of the companies fail to achieve the goals stipulated in the strategy that aim at the business case for sustainability (Davis-Peccoud et al., 2016). The former usually refers to the business case drivers according to Olve et al. (1999), whereas the problem seem to be rooted in the current business model of a firm (e.g. Christensen, 1997; Christensen & Rayner, 2003). Although the SBD-process is not a technological innovation *per se*, the acceptance approach and the basic dichotomous structure of the TAM by Davis (1989) seems viable to investigate these obstacles and merits. Consequently, the SAM opposes barriers and benefits in light of the business case according to Olve et al. (1999) and the business model concept proposed by Osterwalder and Pigneur (2005) and specifically by Richardson (2008). In this way, the SAM integrates into the SBD-process, such that the business case drivers are contrasted with the business model concept between the components of strategy and the business case for sustainability [Figure 2]. Subsequently, the SAM should serve as a tool in the analysis phase of a typical innovation process of (sustainable) business models (Chesbrough, 2007)

Figure 2: SAM integrated into the SBD-Process



Particularly, an application of the SAM follows a *three-step approach*: Firstly, based on the SAM the business case drivers for sustainability should be elaborated to allocate the firm to one of the three corresponding strategies. This could allow a possible identification of barrier patterns. Secondly, based on extant literature, these patterns are matched with the potential of servitization. That provides a gateway to build a bridge between the *framework for business model innovation for the business case for sustainability* and the *PSS-continuum*. Ultimately and thirdly, this could provide managerial implications for the design of service providers’ value proposition.

3. RESEARCH METHODOLOGY

Due to the current lack of extensive empirical research on the link between servitization and the three strategies for Sustainable Business Development (SBD), qualitative research methods present an appropriate method for investigating this research inquiry (Corbin & Strauss, 1990). Accordingly, a grounded theory approach was used to generate theories inductively by studying the data while remaining open to novel themes that may arise from the data, following methodological recommendations from reputable qualitative researchers (Glaser & Strauss, 1967). Data was collected

from 23 interviews with top, senior, and mid-level managers across a diverse range of 16 large corporations and 7 small and medium-sized enterprises who are responsible for or significantly involved in their company's (sustainable) strategic development. Drawing on extant theory regarding the barriers and benefits of business model innovation in general (Chesbrough, 2010) and sustainable in particular (Bocken & Geradts, 2020), an interpretive research approach was employed to extend and enhance existing theory (Suddaby, 2006).

To tackle the first topic and make use of the interrelations of business case drivers and strategy, the data collected was coded following a three-step approach with MAXQDA. Staying close to the data, first order codes and provisional categories were built. These open codes were clustered to sets in the next step. In the last stage, the sets retrieved were sorted into the categorical framework (Olve et al, 1999; Osterwalder & Pigneur 2005; Richardson, 2008). Following the *framework* by Schaltegger (2012), the final coding was then evaluated for each company in order to assign it to a strategy, which also allowed conclusions to be drawn about firms' willingness to innovate the current business model. To follow up on the second topic, the coding has been analysed for any potential patterns in the data by taking into account both the assigned strategy and identified parallelisms in the barriers. To address the third subject area of the study, the SAM helped to make use of the patterns between strategy and barriers. Accordingly, extant literature was used in order to hypothesize the application of servitization and the *PSS-continuum* by taking into account the type of strategy and the level of business model innovation. Ultimately, this enabled to merge the *framework for business model innovation for the business case for sustainability* by Schaltegger et al. (2012) with the *PSS-continuum* based on Oliva and Kallenberg (2003) and Tukker (2004).

4. RESULTS

4.1 Identification of obstacles and merits for strategy allocation

The SAM, while being integrated into the SBD-process, served as a tool to investigate the interrelations of strategy, business model innovation and business case. With reference to the underlying current business models of the firm, the findings suggest that firms face major difficulties to realise a business case for sustainability. Specifically, interviewees described the existence of issues in every building block and components of a business model. In the value proposition, product and service requirements were mentioned by most interviewees as part of the offering, next to a lack of demand from the target customers. The heart of the business is impaired by a lack of human resources and a missing sense of urgency, being part of the resources and capabilities. Besides the issue to align sustainable measures to the existing activities and processes, a lack of data and information across the value network appears to be problematic. Difficulties also seem to arise at capturing the value. Some of the customers are not willing to pay a price premium for sustainable products and the current cost structure of the firm compromises investments into sustainable ventures for the majority of the interviewed companies. The results demonstrate the need for business model innovation to make the business case for sustainability, as current business models contain manifold barriers. Despite the difficulties, the companies see various opportunities to pursue SBD. In fact, the drivers of a business case for sustainability that have been aimed at by the vast majority of interviewees, deal with risk, costs, reputation. The potentials of higher revenues and competitive advantage are not perceived by every firm in the sample. And just roughly a third see the opportunity that sustainability could foster the capability of innovation.

The business case drivers were addressed by the interviewees with a different intensity and diverse quantity of narratives. Therefore, the relevance (i.e. number of codes in total) of drivers has been analysed in order to approximate the importance for each company. Figure 4 in the appendix provides an overview of the relevance of barriers and benefits for each sustainability strategy. Following the framework by Schaltegger et al. (2012), the perceived benefits (i.e. business case drivers) allow to infer the underlying strategy of a firm to address sustainability. As the strategy aims at a business case for sustainability and addresses its drivers (Schaltegger & Wagner, 2006; Hahn, 2022). Like proposed by the framework, the defensive strategy or "compliance-strategy" is characterized by the aim to comply with legislation and cost (reduction) aspects (Roome, 1992). Thus, preventing any reputational or legislative risk.

Accordingly, 6 companies could be allocated to the *defensive* strategy, as the respective interviewees emphasised the importance of compliance (i.e. risk reduction) by multiple narratives. The *accommodative* strategy or "compliance plus-strategy", however features also some concrete opportunities next to the driver mentioned before. For 11 companies sustainability was seen as an opportunity for cost reduction and the sustainable measures were more communicated to underpin the standpoint of the firm. The remaining 6 companies were assigned to the *proactive strategy*. In

contrast to the other companies of the study, they heavily focused on opportunities in terms of innovative capabilities and its benefits. Appropriately, Roome (2011) describes this strategy as the most open form of innovation, driven by the need for more radical requirements (Sandström & Tingström 2008).

4.2 Recognition of barrier patterns for strategies

However, the realisation of the business case for sustainability is hindered by manifold barriers in the current business model. As the determining factor for both strategy as well as the business case itself (e.g. Chesbrough, 2010), it is not unexpected that these vary within these groups [Figure 4]. As before, these barriers were analysed based on the relevance, to allow conclusions on the group level (existence has been also taken into account to avoid overweighting).

Companies that were allocated into the *defensive strategy* seem to have a lack of human resources, followed by missing funds to finance the higher upfront costs of sustainable solutions. The majority of the *compliance plus*-firms in addition have to deal with product and service requirements and a lack of customer demand, just like high up-front costs. The *proactive* firms seem to be also hindered by their position in the value chain. In addition, each type has to cope with obstacle related to culture and staff shortage, though the proactive ones significantly have less to contend with regards to the urgency. The latter is in line with Adams et al. (2016), who describes that sustainability is incorporated into the culture especially in more advanced strategies.

4.3 Linking Servitization to SBD

The SAM opposed the current business model to the business case drivers, and therefore allowed to elaborate barriers and benefits of a firm. This in turn facilitated making inferences to be made about the underlying strategic approach. Also based on the framework by Schaltegger et al. (2012), this can be used to conclude the disposition of the companies to innovate their business models. Based on this, the level of “service infusion” is proposed accordingly. (Gebauer et al., 2008).

Servitization as the process of innovation that changes the capabilities and processes of a firm in order to facilitate the shift from selling products to selling PSS (Baines et al. 2008), entails a change in the value proposition accordingly. The servitization therefore implies a *redesign* of business models, as the whole business model is oriented toward the value proposition. This provides the first opportunity to link the *PSS-continuum* to the *framework for business model innovation for the business case for sustainability*.

According to the latter, just firms with *proactive* sustainability strategies would come into question for *servitizing* the own business model and offering PSS via their value proposition [Figure 3]. For these companies it is vital to formulate their value proposition diligently as it defines their position on the service continuum. To do so, it is important to consider the client's needs in order to follow up on this (Gebauer et al., 2008). Depending on the individual willingness of clients to change the current business model, the decision to offer a PSS should therefore also take into account the clients' respective strategic approach. This states the second gateway of linking the two models. In fact, the *PSS-continuum* and the underlying level of service infusion can be integrated into the framework by Schaltegger (2012) such that it starts with product-oriented PSS at the defensive strategy, proceeds by paralleling use-oriented PSS to the accommodative strategy and ends with result-oriented PSS at the proactive strategy [see abscissa and second ordinate in Figure 3]. Following the notion of Baines and Lightfoot (2013), the users of PSS have different needs. Figure 3 provides an overview about the linkage to servitization.

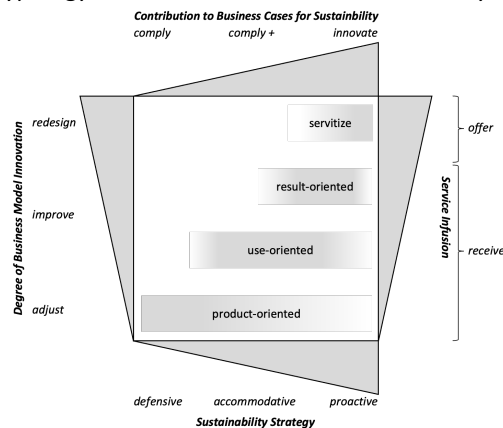
As *product-oriented* PSS are transactions based, not even major adjustments in the cost structure are required (i.e. economic model), as they “do it themselves” and only demand basic services as an “add-on”. Therefore suitable for all companies including those that only want to *adjust* their business model to the smallest extent. However, to receive an *use-oriented* PSS the economic model as well as resources and capabilities would have to be changed since it does not underly a transactional business anymore. Depending on one's individual position on the continuum, this could partly exclude some of the most *defensive* companies, as the companies “do it with” the provider here. Additionally the position in the value network has to be adapted to receive *result-oriented* services. Here a strong partnership with the supplier is necessary to design services individually for the own needs (Merz et al., 2009). It is suitable for companies that “want the job to be done for them”. According to which this only seems to be applicable for very open *accommodative* and *proactive* companies. Ultimately, moving along the PSS continuum, the user group becomes narrower due to the higher degree of business model innovation required.

5. DISCUSSION AND CONCLUSIONS

5.1 Theoretical Contributions

Now that the link between the has been established, the next point is to elaborate how servitization and the PSS could provide an answer to the obstacles inherent in the current business model. Therefore, extant literature has been used to hypothesize how the benefits of receiving PSS could remove the perceived barriers to and in a next step amplify the chances of a business case for sustainability. In order to illustrate the linkage between the two models, each strategy and corresponding application of PSS will be examined successively [see abscissa in Figure 3]. Companies with a *defensive strategy* ultimately strive for risk reduction by meeting the (minimal) market requirements in various aspects. Next to compliance with legislation this could also include the prevention of customer churn by meeting the requested demand for more sustainable products or services.

Figure 3: Typology to Link Servitization to Sustainability Strategies



For those candidates *product-oriented PSS* already might be helpful [see first step in Figure 3]. The shared knowledge of the PSS provider or a maintenance contract can help to increase the useful life of the product and decrease the environmental impact of its operation, even though incrementally (Tukker, 2004). In addition to that, the reduction of environmental burden might reach the customer requirements and could even increase their satisfaction (Beuren et al., 2013). If it is not just about risk reduction with regard to eco-efficiency but also relocating the risk of ownership, *use-oriented services* already come into play [see second step in Figure 3]. These transfer the risk to the manufacturer and thus outsource financial, technical and organizational jeopardy (Meier et al., 2010). The non-ownership transfers the creation of value to the use-phase. Therefore, by selling the utility rather than transferring the ownership, the barrier of high upfront costs and large investments into products and services could also be eluded (Mont, 2001). That directly leads to companies with an *accommodative strategy* where high upfront costs is of major interest as these deliberately aim at eco-efficiency. An *use-oriented PSS* could also help these to foster the driver for cost reduction. However, the product and service requirements of these companies, that seem to be based on conventional assets or raw materials, might prevent them from achieving the business case for sustainability. Here the customer focused *use-oriented PSS* seem to be viable. These deliver tailored solutions and desired outcomes for its customers and therefore could allow to meet the specific needs of *accommodative firms* for their product or service (Baines & Shi, 2015). The same could be applied to the *proactive companies* in this sample, for whom this was also perceived as a relevant barrier. Next, what is closely related to latter, they strongly emphasize missing sustainable products and service offerings by their suppliers that seem to detain their strong focus on possible innovation capabilities. These are manifold and where expressed in terms of eco effectiveness and partnerships in syndicates (SDG 17). By doing things differently they see potential for differentiation and competitive advantage. However, a shortage of sustainable solutions that meet their product requirements appears to be prevent them from achieving this. In order to surpass this barrier, while also facilitating such potential of innovation, a *result oriented PSS* could remedy this [see third step in Figure 3]. A further step to value-in-context, where the company helps the PSS provider to improve the quality of the service (Vargo & Lusch, 2008), could increase the development of innovations. This is due to a mutual exchange of knowledge between customers and suppliers (Khanaga et al., 2015) or even competitors may be potential partners (Day, 1992).

5.2 Managerial Contributions

The various use cases for PSS with regard to the business case for sustainability have been discussed. As *product-oriented* services do not require major changes in the underlying business model, it is the PSS with the widest user group of customers. Concretely, for example the reduction of environmental burden and long lasting assets might be of interest for all types. A broad applicability also counts for the *use-oriented* services, where the implementation might deliver benefits regardless of strategy. Particularly, it could support the more open cohort of *defensive* customers with regards to risk reduction, that however would be relevant to the other companies as well. Especially for the other two strategy types, it can foster meeting customer requirements and eco-efficiency (for defensive companies could mainly being related to risk reduction and not eco-efficiency per se) as it could reduce the barrier of product and service requirements and high-upfront costs respectively. A *result-oriented* PSS in the context of sustainability seem to be most and / or only applicable to the proactive customer type, as it demands customers to be willing to redesign their business model to a certain extent. It focusses on tailormade outsourced solutions or a high degree of knowledge exchange, whereas the latter is particularly suitable for customers aiming at innovation. Ultimately, there is barrier inherent in the business model that are of concern to all companies in the sample. Specifically the lack of human resources, that could be tackled by all of the PSS by a different degree. A company that uses PSS for specific tasks, could save manpower and allocate it to its core competencies, (e.g. Tukker, 2004) and could even strengthen the employer attractiveness (Campbell, 1995).

These implications deliver vital insights for companies that strive for the adoption of servitization and also for those that reconsider their value proposition to tackle sustainability. The value proposition describes the value that the company may offer to customers through products and services (Resta et al., 2017). Therefore, finding out the customer needs with respect to sustainability is pivotal, as customer segments require different value propositions built on different attributes (Gebauer, 2008). The typology based on the SAM helps service providers to design viable sustainable value propositions according to its corresponding customer segments and therefor enable their sustainable business development.

The findings of the study also indicate where a step into the next category might be worth considering. Given their current strategic positioning, it is unlikely that the firms will be able to overcome some of their existing obstacles or that they will achieve the targeted opportunities. For the *defensive* companies that struggle a lot with high upfront costs for more sustainable solutions, a step towards *use-oriented* services should be reflected upon and maybe offered by the service provider [see Figure 3 from step one to two]. In addition, for those with an *accommodative* strategy that face a lack of customer demand (that might be driven by the commoditisation) a *proactive approach* might be worth considering to *servitize* and offering a *product-oriented* services. However, the *proactive* companies differ from the others in that they are also open to new business models in order to strengthen the addressed differentiation and being the leading edge. For those companies a own *servitization* might be also worth considering, which could facilitate circular business models (Bocken et al., 2017) [see Figure 4 last step].

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APPENDICES

Figure 4: Coding Results of Qualitative Study – Chances (Business Case Drivers) and Barriers (Business Model)

Codesystem	DEFENSIVE	ACCOMMODATIVE	PROACTIVE
- Chances - Business Case - Risk & Risk Reduction - Regulative Readiness as a License to Operate - Market Standard - Long-Termism & Sustainable - Higher Resilience - Cost & Cost Reduction - Eco-Efficiency - Sales & Profit Margin - Meeting Customer Requirements - Generating Customer Requirements - Reputation & Brand Value - Image & Communication - Ethical Obligation - Employer Attractiveness - Employer Branding - Innovative Capabilities - Leading Edge & Differentiation - New Business Models - Eco-Effectiveness - SDG 17 - Partnership			
- Barriers - Business Model - Value Proposition - Offering - Product & Service Requirements - Strategy & Competitive Advantage - Current Competitive Advantage - Target Customer / Market - Lack of Demand - Double Edged Sword of Green Communication - Value Creation & Delivery - Resources & Capabilities - Organizational Culture - Missing Sense of Urgency - Missing Guiding Coalition - Short-Termism - Lack of Human Resources and Know-How - Activities & Processes - Silo Thinking - Availability & Allocation of Resources - Complexity of Integration - Position in Value Network - Lack of Data & Information - Interconnectedness & Path-Dependencies - Lack of Sustainable Products / Services - Value Capture - Revenue Model - Willingness to Pay - Downstream "Never change a running System" - Economic Model - Higher Up-Front Costs - Lack of Economic Incentive - Willingness to Pay - Upstream - Higher Cost of Operation - Costly & Complex Regulation			

INTERDEPENDENCIES OF SERVITIZATION AND INTERNATIONALIZATION: A QUALITATIVE-EMPIRICAL STUDY

Timon Urs Knapp & Jens Poeppelbuss

ABSTRACT

Purpose: Investigating the interdependencies between servitization and internationalization in German engineering companies and identifying configurations that describe how firms orchestrate their activities related to both transformational processes.

Design/Methodology/Approach: As empirical research at the intersection of servitization and internationalization is still very limited, we follow an explorative research methodology in this research-in-progress study. 17 expert interviews have been conducted and analyzed so far.

Findings: We find that the interdependencies between both transformations can be categorized into three areas of mutual influence, namely capability-related, market-related and process-related interdependencies. Based on our preliminary results, we formulated propositions on the strategic implications of servitizing internationally and internationalizing with advanced services.

Originality/Value: The propositions provide impulses for future servitization research including quantitative empirical studies that consider internationalization as a relevant contextual factor. Practitioners gain a better understanding that strategic decisions regarding both transformations cannot be made independently from each other.

KEYWORDS: Servitization, internationalization, international business, organizational change, interview study

1. INTRODUCTION

Servitization is a commonly observed strategy of manufacturing companies to cope with increasing customer expectations and to build up market entry barriers towards competitors. Vandermerwe and Rada were the first to explore the concept of servitization in 1988, positioning services as a “pervasive part of [the] strategic mission and corporate planning” in companies (Vandermerwe and Rada 1988, p. 314). In a simple way, servitization can be described as “the process of creating value by adding services to products” (Baines et al. 2009, p. 547). However, it represents a complex transformation and it is still considered as a concept with a “nascent nature” (Kohtamäki et al. 2021, p. 14). While it has become clear that servitization can lead manufacturing companies towards more profitability and sustainable competitive advantage (Lee et al. 2016), this is not achieved easily as this transformation also implies change within a company’s structure (Peillon 2021). Moreover, the creation of new, previously unknown capabilities is required for successful servitization (Oliva and Kallenberg 2003). These requirements characterize servitization undoubtedly as a complex and intricate transformation, but it is certainly not the only transformation undergone by companies throughout their lifecycle.

One of the most prominent example of servitization is Rolls Royce. The British aircraft engine manufacturer deployed its power-by-the-hour concept already in 1962, only 10 years after entering the market. It is, however, not so commonly known that not long after this step, Rolls Royce also began internationalizing its production activities, making use of joint ventures and risk-and-revenue sharing partnerships – again much earlier than its industry peers. It is commonly assumed that only due to its early and firmly enforced concentration on service-based business models, Rolls Royce was able to also dive into the process of internationalizing its business. Its strategic focus had already shifted from production capacity towards business model innovation (Smith and Williams 2012). Of course, other factors might have also been involved in these strategic decisions, but a certain interdependency between servitization and internationalization can hardly be neglected looking at this example.

The internationalization of business has been a core topic of organizational research since the 1960s (Holtbrügge and Welge 2010) and can take on various forms, such as portfolio investments, trade

activities or the engagement in foreign direct investments (FDI) (Mello et al. 2012). Internationalization can be considered a profound and long-lasting transformation process that influences a number of organizational dimensions, such as culture, size, activity profile, financial performance, value creation mechanisms and marketing channels as well as organizational structure (Moric Milovanovic et al. 2022; Ogbechie et al. 2018; Li 2001). Hence, servitization and internationalization appear more than comparable regarding their influence on the organization from a strategic, structural, cultural and economic viewpoint. Additionally, both transformations show a very similar process character, both lack defined end points, and both can also be reversed under certain circumstances (Lim and Mandrinos 2023; Kowalkowski et al. 2017).

Research has so far hardly explored interdependencies between servitization and internationalization (Child et al. 2022), although both processes equally influence various dimensions of organizational context and therefore constantly change the premises for the respective other transformation. Because strategic change always implies organizational change, but is also driven by it (Mintzberg 1990), an interdependence of both transformation processes is more than probable (Agnihotri et al. 2022). Hence, we assume that internationalization activities provide a context for the servitization process in companies and vice versa. As stated by Kohtamäki et al. (2021), research on the context of servitization (e.g., Dmitrijeva et al. 2020) is as significant as incomplete, enunciating a call for additional research. Similar calls exist in research on internationalization of businesses (e.g., Korsakienė et al. 2015). With this qualitative-empirical study, we aim at a deeper understanding of the links between both concepts. Therefore, our research question is: *How do the two transformations of servitization and internationalization interrelate?*

Pursuing this research question, we drew on an explorative research design, using a qualitative interview study among practitioners in the German engineering industry. By investigating their servitization and internationalization processes, we identified common areas of strategic influence by both transformations. We formulate a set of propositions on the interdependencies of servitization and internationalization that we expect to spark further research in this field. While the data collection and a preliminary data analysis has been completed, our research is still in progress.

The remainder of this article is structured as follows: Section 2 takes a closer look at related research at the intersection of servitization and internationalization. Section 3 outlines the research method, before we present our preliminary findings in Section 4. Then, we derive a number of propositions from our findings in Section 5. Finally, Section 6 briefly concludes this paper.

2. RELATED WORK AND PURPOSE

Knight and Liesch (2016) were among the first to see the need for investigating the linkages between servitization and internationalization, stating that “research should examine how digitalization and servitization optimize [...] international performance” of born global firms (Knight and Liesch 2016, p. 100). Only very few researchers have since taken up this topic, for example Shleha et al. (2023). Based on previous thoughts from Buckley et al. (2020), they assumed that servitization practices diverge from established internationalization paradigms (Shleha et al. 2023). Their findings point to an integration-responsiveness dilemma between globalized integration and market responsiveness (Shleha et al. 2023) and conclude that a hybrid internationalization of single organizational functions can increase the sales success of a service-based portfolio. Kolagar et al. (2022) conducted an exploratory multiple case study among Scandinavian SMEs to understand how digital servitization enables internationalization. As a result, they present “three different paths toward increasing [...] sales in the international market” (Kolagar et al. 2022). While the authors do recognize the special situation of SMEs seeking to servitize and digitalize their business, they do not fully distinguish between different settings of international business. They also assume that digital servitization must always have a positive effect on firm internationalization and all consequences on the organization would be fully intentional. Like Shleha et al. (2023), they concentrate on a positive financial outcome as an indicator for successful internationalization.

Other than Shleha et al. (2023) and Kolagar et al. (2022), Agnihotri et al. (2022) present a conceptual work that assumes that servitization “is likely to have an antagonistic effect on the requirement of FDI

for entering international territories”, e.g., because many digital services can be provided remotely. The authors also “assert that for a servitization-driven decision for internationalization, it is probably the host country’s macroenvironment [...] influenc[es] entry mode decisions” (Agnihotri et al. 2022). They present multiple recommendations for internationalization strategies based on two dimensions of servitization. Like the other studies, Agnihotri et al. (2022) mostly neglect the potential reciprocity of interdependence between servitization and internationalization.

A related but different stream of research deals with the internationalization of service (e.g., Jensen and Petersen 2014). While some similarities to service organizations within manufacturing companies are obvious, it can generally be assumed that pure service providers act differently, particularly when taking into account capabilities and assets (Jensen and Petersen 2014). Therefore, while this field of research offers a valid perspective on dynamics and pathways of service internationalization, its findings might not be generally applicable to manufacturing firms that find themselves in the middle of the servitization process

While some recent studies have begun investigating how servitization affects internationalization, none has taken an exploratory approach to understanding how both transformations reciprocally affect each other. Recognizing the dynamic character of both transformations, it is the purpose of this study to investigate the character of both transformations in German engineering companies. We assume that internationalization activities provide a context for the servitization process in companies and vice versa. Our intention is to uncover their interdependencies and to identify configurations that describe how firms orchestrate their activities related to both transformational processes (e.g., regarding timing or collaboration with other market actors like customers and partners).

3. METHODOLOGY

Our study follows an exploratory, qualitative-empirical approach, which is generally applicable whenever there are no or only few results of other studies on the topic. We conducted 17 interviews with experts from practice following a purposive sampling approach. We focused on companies that are active in the engineering industry and headquartered in the DACH region (German-speaking areas of Europe). Within this industry, we tried to capture as many relevant perspectives on the topic as possible, e.g., from general managers, service leaders, service strategy/business development managers and sales executives. With a preliminary desk research, potential companies from the engineering industry that have undergone or still experience both a transformation towards advanced services and an internationalization of business were identified. Using LinkedIn and e-mail, we contacted potentially relevant experts. The interviews were conducted as video meetings with a duration between 50 and 90 minutes following a semi-structured interview guideline that we also developed further continuously during data collection. Table 1 provides some basic information on the companies, which we pseudonymized, and the positions of the interviewed experts.

In this research-in-progress study, we are currently in the process of coding the interview data using the Gioia methodology, which provides a commonly accepted procedure to grounded-theory-based interpretive research (Gioia et al. 2013). We are on the way of generating a data structure from our coding (including first-order concepts, second-order themes and aggregate dimensions), which will be followed by the development of a theoretical model that depict the interdependencies between servitization and internationalization. So far, we have been able to draft a set of aggregate dimensions that outline three areas of interdependencies, which we present in the next section. The propositions that we present in Section 5 indicate possible interdependencies that might be part of the theoretical model to be developed.

Table 1: Sample of interviewees

Pseudonym	Number of employees	Annual revenue (€) in 2019	Number of branches in foreign countries	Position of interviewed expert	Product portfolio	Interview Duration (min)
Pump	5,000-10,000	1-5 bn	50-100	Head of Service	Pumps and pipes	88
CarParts	> 25,000	> 10 bn	> 100	Head of Aftermarket	Climate Systems and modules for cars	52
AutoModule	15,000-20,000	1-5 bn	50-100	Head of Service	Process control and automation systems	81
Heat1	15,000-20,000	1-5 bn	10-25	Head of Service Strategy	Heating Solutions	79
MachineTool	5,000-10,000	< 1 bn	10-25	Business Development Manager Aerospace	Precision tools for metal processing	57
LiteBulb	5,000-10,000	< 1 bn	10-25	Head of Service	Lighting solutions for industrial applications	57
Heat2	10,000-15,000	1-5 bn	10-25	Head of Service	Heating Solutions	93
LargePlant	< 5,000	< 1 bn	25-50	Head of Service BD	Production plants for wood processing	83
Clean	10,000-15,000	1-5 bn	50-100	Head of Strategy	Cleaning Solutions	67
WeighScale	15,000-20,000	1-5 bn	25-50	Head of Service	Precision Weighing Solutions	74
Lock	15,000-20,000	1-5 bn	25-50	Regional Head of Service	Access Control Solutions	76
ChemParts	< 5,000	< 1 bn	< 10	Managing Director	Systems and modules for chemical processing	90
PressPrint	5,000-10,000	1-5 bn	50-100	Head of Sales Excellence	Printing presses for industrial applications	58
DrivePulse	20,000-25,000	1-5 bn	50-100	Head of Sales BD	Drivetrains for industrial and mobility applications	60
PressPrint	5,000-10,000	1-5 bn	50-100	Head of Service	Printing presses for industrial applications	81
FarmTool	10,000-15,000	1-5 bn	25-50	Director Production Systems & Head of Service	Farming equipment	85
Intrallog	10,000-15,000	1-5 bn	25-50	Manager Strategy	Intrallogistics Solutions	84

4. FINDINGS

We were able to identify various influences of servitization on firm internationalization and vice versa from the interview data. As one interviewee remarkably pointed out “the interdependence between servitization and internationalization is the biggest and most complex you will find” (PressPrint). In our preliminary data analysis, we grouped the interdependencies into three aggregate dimensions, which are (1) capability-related, (2) market-related, and (3) process-related interdependencies.

4.1 Capability-related Interdependencies

The *capability-related interdependencies* relate to the organizational capabilities of servitizing and internationalizing firms. Our interview coding in this aggregate dimensions include themes like culture, innovation, and complexity. Looking at the culture theme specifically, getting employees across different countries and cultures to promote new service offerings was perceived as a challenge, especially when considering “different service maturity levels between countries” (Pump). The interviewees also saw obstacles to cultural change rooted in their companies’ “heritage in the German

engineering industry" (LargePlant). There might also be intercultural issues as interviewees pointed out that sometimes colleagues from foreign countries struggle to understand service offerings or "hesitate to offer them to their long-lasting, loyal customers" (Pump). However, maintaining a global network of branches was also seen to make companies more attentive to global trends, e.g., climate change and sustainability. Hence, international impulses can be of help to cope with the transformation towards becoming service and solution providers, further accelerating servitization. Few interviewees also recognized the internationalization of business as an influence on the employees' mindset that generally enables innovation and change.

A major source of innovation was seen in adopting services that are requested by customers in one country but not in others, e.g., "cleaning services demanded by customers in China but never even considered by customers in Germany" (Heat1). Hence, customer demands in foreign markets can result in new service concepts to potentially be used across the organization. Another major source of innovation originates from acquiring digital technologies (e.g., sensors or platforms) or capabilities for servitization (e.g., financial skills) by purchasing smaller firms across the globe. This concept was commonly shared in the interviews and implies an immediate interdependence between servitization and international growth. The interviewees also pointed out that learning from partners and local competition in international markets can boost their own servitization progress. An example that was mentioned is "how competitors close maintenance agreements via WeChat in China" (Heat1).

The complexity described by the interviewees refers to the dilemma of centralization vs. decentralization and the dilemma of standardization vs. customer centricity. While the first dilemma takes a strategic viewpoint on how to organize a globalized, servitizing business; the second outlines the operational implications of these strategic decisions. Nearly all interviewed companies saw the dilemma between lean and standardized processes and local autonomy as "a continuous battle" (Heat1). This was not so much the case in companies that exclusively serve global corporations that particularly request "the same service from Brazil to China" (MachineTool), e.g., in the aerospace industry, but rather in companies that serve a diverse customer base with heterogeneous characteristics in every country. While the former strive to show "one face to the customer" (AutoModule), the latter struggle to find a balance between fulfilling reporting duties and achieving global standards and allowing local branches to serve their customers best. Varying local service maturity adds to this complexity, requiring very distinct service development strategies that adapt to the local "service thinking" (LiteBulb). Hence, most interviewees from service departments saw a need for the "exchange of best practices between countries" (Heat2) and digital platforms that help "managing data generated from our installed base" (WeighScale). The majority of interviewees also recognized that there are no optimum solutions to the dilemmas. Most try to centrally provide "a framework and safety fence" (Heat1) in which local branches can act autonomously. The complexity of providing an evolving service portfolio in an international setting is therefore remarkable. This is further amplified by the increasing need for improved collaboration of the service department with other internal functions and external stakeholders, which can mean "to potentially end up with different partners for the same task but in different countries" (Pump).

4.2 Market-related Interdependencies

The *market-related interdependencies* relate to customers, partners and competitors as relevant actors in international markets. Several interviewees pointed out that an international customer base can act as a multiplier of market success for new service concepts. Still, market heterogeneity needs to be considered. On the other hand, several interviewees appreciated their global network for the opportunity of "using foreign, smaller countries as a testbed for service concepts" (Heat1) before rolling them out globally, decreasing servitization risks. The interviewees also mentioned that having a service-oriented mindset allows for better adaptation to foreign markets and building a reliable international standard offering which reduces risk of internationalization. Markets that "simply cannot offer the skilled workforce, like Africa" (Pump) can be served using new, digital technologies and altered internationalization modes.

Moreover, interviewees stated that their global reputation would improve by offering advanced services. Some also pointed out that an enhanced “holistic system thinking” (LiteBulb) achieved during servitization can lead companies to expand their customer base “into new industries” (MachineTool) as the “self-definition transitions from product to solution provider” (ChemParts). The degree of internationalization can also increase when “following customers into new countries” (CarParts), e.g., when existing customers open new production facilities abroad. New market barriers can be built up when a company is able to offer not just a new service, but a new global service. This drastically alters their global competition. When asked about how they deal with their global partner network in light of servitization, nearly all interviewees pointed to the importance of acquiring new partners with companies that “don’t have to be persuaded” and make it “easier to develop new business models and ideas” (Pump). Many also underlined the need to “take existing partners with us” (Heat2) on the servitization journey because “when you swap horses at a gallop, you lose [...] knowledge, skills and even customers” (MachineTool). There also is a risk of a knowledge drain to international partners, leading to “some partners becoming competitors” (WeighScale).

4.3 Process-related Interdependencies

Finally, we identified *process-related interdependencies* that focus on the dynamics and timing of servitization and internationalization. All companies within the sample conducted business globally before beginning to strive for servitization. Rooted in the DACH region, the majority of companies began their internationalization journey between 1950 and 1970, starting with “export trade activities to European markets” (FarmTool). A majority of interviewees pointed out that the current speed and magnitude of internationalization efforts has either decreased or remained constant lately. When acquiring foreign firms, the companies now seek for digital know-how or acquire local service providers by purchasing much smaller firms than before, reducing the investment volume. When expanding into new markets, this is now done by “building up small branches with a handful of employees” (Lock) that provide service and sell locally, or “opening a data intelligence center in Eastern Europe” (Heat1). This represents a fundamental change from previous high-investment internationalization modes to “more smaller hubs, more local products, to be closer to the market and logistically and energetically more efficient” (Pump). Interviewees saw an “increased network-orientation” (FarmTool) and some even expressed a vision of a “follow-the-sun approach” (PressPrint).

The interviewees were much less precise when talking about their servitization process as they were unsure “where to begin and where to end” (Pump). Generally, they described international effects on the servitization process as a mixture between using ideas from foreign branches and strategically implementing new concepts from the headquarter across their global network. Most interviewees also saw digitalization as a crucial enabler of future servitization, but only a small minority identified it as an actual driver of it. The interviewees described the changing role of service within their company’s strategy, e.g., service no longer being “the ugly stepdaughter” (WeighScale). While some experts pointed out that “service used to always follow the product” (LargePlant), others said that “service and product strategy have to be equivalent” (PressPrint) and even proposed “one integrated strategy” (PressPrint). Rather paradoxically, all experts affirmed that their companies do not strategically consider servitization and internationalization as transformations that go on in parallel despite the mutual influence they reported themselves in the interviews. Only one of the experts recognized a correlation in the vision of internationalization and the changing role of service.

5. DISCUSSION

We outlined three main areas of interdependencies between servitization and internationalization from our preliminary data analysis. Some of them appeared to be highly specific to the interviewed company or even the position of the interviewed expert. In the following, we derive a set of more general propositions about the relationships between servitization and internationalization by discussing our findings with existing literature.

The interviewees described how servitization can support the growth of international presence, international financial success and an increasing international customer base. Especially market-based

elements support this development, including companies following customers into new markets, introducing new global service offerings, and improving their global reputation. Additionally, risks related to internationalization can be decreased through the acquisition of foreign service providers and access to foreign skilled personnel. While there is a risk of weakened international performance due to failures of managing complexity, none of the interviewees recognized this as an actual problem for their companies. Responding to the findings of Agnihotri et al. (2022), we can agree to their assumption that servitization has an “antagonistic effect on the requirement of FDI for entering international territories”. However, we cannot entirely agree with the result of the study carried out by Shleha et al. (2023) that manufacturing operations would be re-integrated into the home market. All interviewees were consent that they do not plan on closing down international production facilities, some even indicated the expansion of existing factories. Instead, we see a growing diversity of internationalization modes that might be required for servitizing businesses. We therefore come to our first proposition P1: *Servitization enables engineering companies to improve their international performance and presence while significantly altering the modes and drivers of internationalization.*

Examining this link in the opposite direction, i.e., the influence of internationalization on servitization, we conclude that innovation from various sources within and outside a global organization supports the servitization process. Moreover, we see that access to a global market can support the success of innovative service concepts while also reducing risks due to foreign markets acting as testbeds. In turn, the structure of markets regarding competition, partners and customers can change through servitization. The effects of innovation and partner networks have also been indicated by Kolagar et al. (2022). We therefore state P2: *An internationalized organization can accelerate servitization by leveraging innovation capability and utilizing the access to partners and networks in foreign markets.*

However, the increased complexity of offering advanced services in a global network has been clearly stated by all interviewees. While process standardization is required to maintain a level of control, customers are often too heterogenous to be served with a one-fits-all solution. This integration-responsiveness dilemma was already flagged by Shleha et al. (2023), who, however, only addressed it using an entry-mode perspective on internationalization. Taking up on this, we can see from the interview data that an overly decentralized approach hinders knowledge exchange and therefore progress, while an overly centralized management approach of “pushing standardized services” (Lock) into foreign markets hinders local adaptability and innovation capability. Accordingly, there is a need for “building a framework for autonomy” (Heat1), which can provides a certain degree of ambidexterity between centralization and decentralization. This concept was also recently brought up by Shafique et al. (2022) in a quantitative study outside the service research field who identify “innovation ambidexterity as a valued dynamic capability” and propose “knowledge management capability as a potential predictor” of this ambidextrous strategic practice (Shafique et al. 2022). We therefore propose P3: *The success of servitization in an international setting is related to the company’s capability to manage the ambidexterity concerning centralization and decentralization.*

Finally, our interviewees recognized that the service function is increasingly taking a leading role in complexity and knowledge management within their companies. They described the service function as an orchestrator, “conductor” (AutoModule) and “innovator” (Heat1). This enhanced role of the service function was justified by the interviewees due to its access to “the best and first-hand customer knowledge” through a global service network while also having the responsibility for managing the complexity of the corresponding global service organization. Considering this changing role of the service function within manufacturing companies, alongside an increased customer centricity in the mindset of their management and employees, the strategic focus these organizations has begun to change. We therefore propose P4: *The success of servitization in an international setting is related to the company’s willingness to allocate adequate resources and responsibilities to a global service function.*

6. CONCLUSION

With this interview study, we identified a variety of interdependencies between servitization and internationalization of German engineering companies. We interpreted that these interdependencies are largely mutually positive but also bear significant challenges in terms of complexity management. By linking the interview findings with recent literature, we provided a set of four propositions about the strategic implications of servitizing internationally and internationalizing with advanced services. We are content that academic research will be able to build on these propositions as starting points for further research. The managerial implications of our research include that servitization and internationalization should be managed as an integrated strategy, which, however, has often not been the case in the interviewees' companies yet.

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INDUSTRIAL SMART SERVICES FOR CIRCULAR ECONOMY

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ABSTRACT

Purpose:

This paper will examine the economic and ecological value creation in production ecosystems with a focus on the B2B relationship between a supplier of equipment and a customer who uses this equipment. Smart services and product service systems have the potential to generate environmental value, thus covering at least two out of three dimensions of the triple bottom line. Approaches for a sustainable production, such as circular economy and cradle-to-cradle are available in theory and practice, yet those concepts are not systematically applied. For this reason, this paper examines the following hypothesis: companies have quantitative KPIs for economic and ecological value creation, however, they lack a systematic methodology for joint optimization of economic and ecological value. In particular, they optimize primarily on the economic value.

Design/Methodology/Approach:

The analysis is based on literature study accompanied by a field research based on in-depth interviews in a qualitative sample of five companies (four SMEs and one larger company), which are active in various industry sectors. The qualitative insights from the different interviews are combined to a coherent picture. Given this, recommendations are elaborated for the companies how to proceed in order to leverage the information available for fostering servitization steps supporting both economic and ecological goals.

Findings:

The qualitative field research revealed that most companies are familiar with the terms circular economy, cradle-to-cradle or triple bottom line. Although companies record ecological KPIs, sustainability still plays a subordinate role in decision-making. It has also become evident that the concept of the circular economy is not generally applicable to every corporate situation and that other approaches are necessary. However, all of the company cases offer some services that would enable a transition towards circular economy.

Originality/Value:

The findings in this study support the quantitative model approach for determining the ecological value for different service constellations. Therefore, the quantitative framework proposed in (Meierhofer & Stucki, 2022) can be used as a tool by manufacturing firms to calculate the economic and ecological benefit of planned service concepts.

KEYWORDS: smart service, sustainable servitization, product service system, circular economy, triple bottom line

1. INTRODUCTION: SUSTAINABILITY ASPECTS OF PSS

1.1 Product-Service Systems

Product-service systems (PSS) are a combined offering of products and services to fulfil the customer's needs (Tukker, 2015) and consist of three elements: 1) product, 2) service and 3) the interaction between products and services (Beuren et al., 2013). Some studies use PSS as a synonym of servitization and others differentiate between those two terms (Doni et al., 2019). In this paper, these terms will be used as synonyms.

Scholars believe that PSS can have an impact on the aspect of sustainability. It is possible to reduce the impact on the environment and balance economic, ecological, and social aspects. By developing an integrated system of products and services, better ecological performance can be achieved (Doni et al., 2019). By replacing a product with a service or by adding a service to an existing product, revenue can be increased without selling additional products. This is a first step in moving away from linear business activities. Additional revenue can also be generated, for example, by converting old goods into new products (remanufacturing or reconditioning). This also means that the manufacturer takes responsibility for the goods it produces (Han et al., 2020). However, some scholars argue that PSS itself do not automatically improve sustainability. In order to generate sustainable benefits, these aspects have to be specifically in mind when designing, developing and delivering a PSS (Vezzoli et al., 2017).

The "World Business Council for Sustainable Development" (WBCSD) has even included "expansion of services" as one of the four key components of eco-efficiency. Therefore, the potential relationship between servitization and sustainability should not be underestimated. Servitization creates incentives for companies by providing improved value creation opportunities through the extension of the product lifecycle. Additionally, this can lead to a reduction in environmental impacts during the use phase (middle of life phase) (Doni et al., 2019).

1.2 Sustainable Value Approaches

The triple bottom line (TBL) applies the principles of sustainability to the ecological, social, and economic dimensions (Elkington, 2018). The ecological aspect of the TBL deals with the impact on nature, mainly on the use and renewal of resources. For companies, this means that resource use and emissions fall into this category. The goal is to consume only the amount of resources that can be reproduced by nature and to reduce emissions to a level that can be absorbed by the environment (Glavic & Lukman, 2007; Ruggieri et al., 2016). The social dimension deals with the company's attitude towards preserving and developing the human and social capital of communities. Social sustainability contains internal job satisfaction, social integration of involved communities, quality of life, as well as equality and justice (Littig & Griessler, 2005; Kiel et al., 2017). Here, the focus is clearly on human beings. The last dimension refers to the way in which companies generate their profits (balancing of costs and revenues) (Littig, 2005). These three dimensions can complement or conflict with each other (trade-offs). For example, higher expenses to reduce the environmental impact of the production process can lead to economic losses. For a company to truly act sustainably, all three dimensions of the TBL must be considered (Norman & Macdonald, 2004; Littig, 2005; Evans et al., 2017). This still poses difficulties for many companies (Carrillo-Hermosilla et al., 2010; Kiel et al., 2017).

A possible approach to move away from the currently linear-driven economic system is the cradle-to-cradle principle. This was developed by Braungart and McDonough in the late 1990s (Böckel et al., 2022). The concept is based on the natural nutrient cycle. The focus for the developers is not on efficiency, but on (eco-)effectiveness. Neither the production nor the use of the product should generate waste. On the contrary, they should serve exclusively as raw materials for other products. The cradle-to-cradle approach is based on two cycles, a biological and a technical cycle. The former considers the life cycle of products and ingredients that are biodegradable. At the end of their life cycles, these products should be safely reintroduced into the ecosystem through biological decomposition processes. All other substances that cannot be decomposed by biological processes are assigned to the technical cycle (Böckel et al., 2022).

Another framework for a sustainable value approach is the circular economy (CE). In the academic world, there are different definitions of the CE (Tecchio et al., 2017), each of which takes into account different aspects. In many definitions, only 1-2 dimensions of the triple bottom line are taken into account (Hagberg & Magnussin, 2021). As previously mentioned, this means that a proper sustainable value cannot be created. One of the definitions that takes into account all three dimensions is the one of (Van Buren et al., 2016). According to their definition, the aim of a circular economy is to create economic value (through

products or services), minimize the destruction of social value, and generate ecological value (resilience of natural resources). Interesting are also the different perspectives. For example, in certain definitions, the ecological and social value should be maximized, while in other definitions, the negative impact should be reduced as much as possible. These are two different conceptual ways of thinking (Tecchio et al., 2017). The focus of the circular economy lies in the implementation of closed-loop cycles such as reuse, remanufacturing and recycling (r-strategies) (Braungart et al., 2007).

However, there are also other views on this. As mentioned earlier, servitization or the implementation of PSS can already generate social and environmental value. (Vargo, 2021) argues that the old linear thinking of goods-dominant logic (GDL) corresponds to the traditional way of doing business. This mindset implies that the producer creates value and the consumer destroys this value when using/consuming the product. This mental model is the root of the sustainability problem. As an alternative model, there is the service-dominant logic (SDL). It does not focus primarily on goods and companies, but on the provision of services. By adopting the SDL, business models are implemented where circular economy is not required (Vargo, 2021).

1.3 Sustainable Value Creation

There is comprehensive literature on value creation by services, e.g., (Kowalkowski & Ulaga, 2017; Baines & Lightfoot, 2013). Moving from base services, to intermediate services and then to advanced services gradually changes the way how value for manufacturers and the customer is generated. Instead of focusing on product provision, advanced services prioritize the performance of the product. This leads to new revenue models for the manufacturer, such as risk and revenue sharing and rental agreements (Baines & Lightfoot, 2013).

Similarly, asset efficiency services (AES) operate on the principle of focusing on machine performance rather than simply repairing them when they break down. Providers of AES, for example, promise a certain operating time or availability level. The value proposition centres around a specific level of performance rather than a specific activity. Typical representatives of this service type include remote monitoring, predictive maintenance, or on-site monitoring (Kowalkowski & Ulaga, 2017). Advanced services or AES typically increase the lifecycle of products and reduce resource consumption, potentially leading to ecological value (Kowalkowski & Ulaga, 2017; Baines & Lightfoot, 2013).

However, by definition, PSS are not necessarily more resource-efficient or circular than pure product systems (Tukker, 2015). Therefore, the ecological and social dimensions should be explicitly considered in the development of a PSS (Vezzoli et al., 2017). Tukker distinguishes between three main categories of PSS: 1) product-oriented services, 2) use-oriented services, 3) result-oriented services (Tukker, 2004). This categorization is similar to that of (Kowalkowski & Ulaga, 2017; Baines & Lightfoot, 2013). The focus shifts from the product to what is achieved with the product (outcome).

Based on Tukker's categorization (Tukker, 2004), (Bressanelli et al., 2018) investigate the influence of the three different business models on the three CE value drivers identified by the (Ellen MacArthur Foundation 2016): resource efficiency, extend the lifespan, and close the loop. The paper deals primarily with usage-focused business models. In their framework, they propose eight different digitally technology-enabled functionalities that support different CE value drivers in the three lifecycle stages (beginning of life, middle of life, end of life).

1.4 Quantification of Economic and Ecological Value

An analytical model is proposed in (Meierhofer et al, 2022) to describe the value creation for providers and customers based on the data intensity of services offered in each phase of the customer relationship lifecycle. Through multi-objective optimization, the model can find quantitatively optimized service configurations for both providers (V_P) and customers (V_C). The customer lifetime (CLT) is divided into four

phases: 1) Initiate, 2) Expand, 3) Stabilize, 4) Terminate & win-back. A detailed description of all phases can be found in the paper (Meierhofer et al, 2022).

In (Meierhofer & Stucki, 2022), the two-dimensional model (V_P , V_C) is extended with the ecological value dimension (V_{Eco}). In the end, all ecological parameters are aggregated into a CO₂ equivalent (V_{Eco}). The contributions for the three value components are accumulated over the lifecycle phases. The formulas for each phase i can be found in (Meierhofer et al, 2022) and (Meierhofer & Stucki, 2022). The three values are as follows (1):

$$V_P = \sum_{i=1}^4 V_{P,i} \quad V_C = \frac{1}{CLT} \sum_{i=1}^4 V_{C,i} \quad V_{Eco} = \frac{1}{CLT} \sum_{i=1}^4 V_{Eco,i}$$

The positive ecological value is determined by the variables "travel" (e.g. field service trips), "scrap" (also concerns waste volume), "spare parts" (less due to better maintenance and monitoring), "machine" (longer machine lifetime). On the other hand, emissions caused by the IoT are labelled as "IoT" (Meierhofer & Stucki, 2022).

In addition to examining the functionalities used (as proposed in (Bressanelli et al., 2018)), the empirical survey in this study also aims to better understand the applicability of the model in practice and to draw conclusions from it.

2. RESEARCH METHODOLOGY

In order to get a better understanding of sustainable practises of Swiss companies, a field study was conducted in the German-speaking part of Switzerland. 22 companies from different industry sectors were asked to conduct in-depth interviews. Of the companies requested, five companies agreed to be interviewed, three companies declined and 14 companies did not respond. The three rejections are based on different reasons. One company does not use toxic materials and the machines have a long life cycle and require low maintenance. For this reason, they do not deal with this issue (sustainable aspects) any further. Another company did not have time to deal with a questionnaire at that time, yet alone to participate in an in-depth interview. The last rejection was due to a lack of ecological KPIs. However, the company wants to introduce them later in 2023. This indicates that interest in the topic is not yet well established. This is consistent with the findings of a study by (Stucki & Wörter, 2021). Of the 8,000 companies they contacted, the response rate was 29.1 %. According to the survey, only 12 % of Swiss companies have specifically integrated circular business activities into their business models (Stucki & Wörter, 2021).

The five companies that participated are active in the following industry sectors: conglomerate, electrical engineering, telecommunications supplier, real estate company, printing company.

3. FINDINGS

3.1 Conclusions from Field Research

The qualitative field research revealed that most companies are familiar with the terms circular economy, cradle-to-cradle or triple bottom line. One company (printing sector) is even "cradle-to-cradle" certified.

Although companies are increasingly focusing on sustainability, following the terminology of (Hagberg & Magnussin, 2021), other factors such as cost, performance, quality and knowledge are more important when it comes to decision-making (in this case in the selection of providers and suppliers). Quality is also important, but a trade-off must be made between cost and quality. The exception here is the printing company, as the sustainability aspect is in the foreground. In the concept of the triple bottom line, the term sustainability encompasses the economic, ecological, and social dimensions. As expected, economic value plays a central role in the context of the triple bottom line, and is seen as the foundation for creating

ecological and social value. For two of the SMEs, the social dimension is also a main focus. However, this refers mainly to the working conditions of employees within the company, rather than social responsibility towards society.

The interviewed companies already have relevant ecological KPIs (Table 1) that could serve as a potential basis for decision-making.

Table 1: Quantitative ecological KPIs that are actively used in the companies

Company	KPIs
conglomerate	Energy consumption (electricity, water, heat), the amount of waste (recycling concept), CO2 emissions.
electrical engineering	Resource consumption, electricity consumption, water consumption, petrol consumption of field service vehicles etc..
telecommunications supplier	Energy consumption, amount of waste, recycling of certain materials and CO2 emissions.
real estate company	CO2 emissions, energy consumption, water consumption, waste volumes and other KPIs relating to the managed properties.
printing company	Use of resources, CO2 emissions and energy consumption.

This section discusses the situation with respect to the model described in chapter 1.4. Two companies track their resource consumptions and one also monitors the fuel consumptions of their field service vehicles. Accordingly, not all companies have yet the variables used in the model. There is also the question of the company level at which the KPIs are available or measured. For the model, the information would need to be available at the process level in order to compare different service combinations with each other.

The second part of the field study dealt with the eight functionalities already available, as described in (Bressanelli et al., 2018):

- 1) Improving product design
- 2) Attracting target customers
- 3) Monitoring and tracking products activity
- 4) Providing technical support
- 5) Providing preventive and predictive maintenance
- 6) Optimizing the product usage
- 7) Upgrading the product
- 8) Enhancing renovation and end-of-life activities

A strong focus is observed in the mid-life phase (Table 2), with monitoring and tracking of device activity mentioned most often (by 4 out of 5 companies), which helps to increase the efficiency of the equipment and extend its lifetime. Two of the companies apply preventive and predictive maintenance, which also extends the lifetime of equipment. It should be mentioned that the printing company does not offer any products (packaging and printed products) where monitoring could be used. The green colour in table 2 indicates that this functionality was offered to their customers.

Table 2: Functionalities offered

Company	Functionalities offered								CE value drivers addressed
	1	2	3	4	5	6	7	8	
conglomerate									- Increased resource efficiency - Extend lifespan
electrical engineering									- Increased resource efficiency - Extend lifespan - Close the loop
telecommunications supplier									- Increased resource efficiency - Extend lifespan - Close the loop
real estate company									- Increased resource efficiency - Extend lifespan
printing company									- Extend lifespan - Close the loop

In two cases, data is used to improve product design in the beginning of the product's life, which can serve as a base for more durable products and closed material cycles. Table 2 also lists functionality 1 for the printing company, even though it does not rely on the use of digital technologies such as IoT and Big Data & Analytics. However, in the course of the cradle-to-cradle certification, all toxic substances were removed from the production process and products. This fulfils a growing need for environmentally responsible paper products, and therefore, the functionality of "improving product design" is considered to be implemented. The sample shows no evidence of circular services in the end-of-life phase.

The companies find it particularly difficult to implement circular services in the end-of-life phase. Typical products of the electrical engineering company include safety switches and surge protection mechanisms, which have plastic components that are destroyed when triggered. The company already takes back such parts free of charge, but customers rarely return them and the products usually end up in the trash. The telecommunications supplier wants to focus more on end-of-life functionalities. However, since the company covers only a small part of the value network, all actors involved would need to work together on a solution for enhancing renovation and end-of-life activities. The printing company faces a similar problem. In this case, there is already a government-mandated recycling program for paper products. However, the problem with this paper recycling system is that the printing company's uncontaminated products come into contact with contaminated ones again. It is also difficult for the company to track where their products ultimately end up. However, they have individual customers who try to close this cycle differently. Together with them, they develop a concept of how this return should take place and support them accordingly. Even so, it may be difficult to compete with a government based recycling system.

In the case of the electrical engineering company not all aspects of the circular economy can be implemented due to the nature of the products, especially for safety switches and surge protection mechanisms (destroyed when triggered). Since their products cannot be reused, refurbished or remanufactured, they are only at the level of recycling. Their customers don't want recycled products (plastic parts), even if they were offered at a lower price.

3.2 Strategic and Organisational Impact

In this chapter, recommendations are elaborated for the five companies on how to proceed in order to leverage the information available for fostering servitization steps supporting both economic and ecological goals.

3.2.1 Conglomerate

The conglomerate operates in numerous industries, such as "Digital Industries", "Mobility", "Healthcare", and "Smart Infrastructure". Depending on the sector, four out of the eight result-oriented functionalities are already offered, including "Monitoring and tracking products activity", "Providing technical support", "Providing preventive and predictive maintenance", and "Optimizing the product usage". All functionalities relate to the middle of life phase. This paper focuses on the "Smart Infrastructure" sector, which is divided into "Smart Home," "Smart Building," and "Smart Energy" areas. The company aims to focus more on the ecological aspect in the future. The external social dimension is less tangible for the Swiss branch compared to the economic and ecological dimension, as resource extraction, for example, takes place in other parts of the world. This once again highlights the need for uniform frameworks across the entire value network. The "Smart Infrastructure" division naturally generates data, and the conglomerate has the necessary know-how and resources to collect, analyse, and feed it back into the processes. The use of such intelligent infrastructure can reduce the resource consumption of buildings. Thus, expanding the already existing offerings would cover all functionalities of the middle of life phase. The two functionalities of the beginning of life phase, "Improving product design" and "Attracting target customers," should be implementable within the conglomerate. As "Optimizing the product usage" is already offered, operational data is available that can also be used to improve product design (hardware components). These can also be used for specific marketing to cover the functionality of "Attracting target customers" (closing the loop is now also considered). However, when improving product design, durability and ease of maintenance must be considered. A modular design would be desirable to support the functionality of "Upgrading the product." The most important part of "Smart Infrastructure" is the software component, which can be easily updated. For these software updates to be installed, an automatism or at least a user-friendly design is required. Since data is already collected throughout the entire lifecycle, information regarding the condition of hardware components could be shared with their respective manufacturers so that they can apply the adequate r-strategy for their components. This would also cover the functionality of "Enhancing renovation and end-of-life activities."

3.2.2 Electrical engineering

The products of this company play a central role in device connection technology and individual complete solutions are developed together with their customers. The functionalities "Improving product design", "Monitoring and tracking products activity" and "Providing technical support" are already offered. As mentioned in chapter 3.1, the scope for a circular economic model in this company is rather limited. The functionality of "Improving product design" is already a core competency of the company. However, it is assumed that individual customer needs are given priority and potential recycling aspects are neglected. Typical products are safety switches and surge protection mechanisms. When the surge protection is triggered, connected electronic components are destroyed and only r-strategies of the lowest level can be applied. Even if these products could be repaired, customers would not want them because they perceive the risk to critical and expensive machines as too high. However, take-back agreements could already be negotiated with the customer during the cooperation phase, so that the customer actually sends back the parts and the materials can be reused (recycling level). The company already takes back the parts, but practically no customers do so. This could be counteracted and the raw material cycle could be closed as effectively as possible. In the middle of life phase, the already existing services increase resource efficiency and the service life of the products.

3.2.3 Telecommunications supplier

The telecommunications supplier specializes in creating fibre optic networks for data and heat in the B2B sector. They already offer "Improving product design", "Monitoring and tracking products activity", "Providing technical support", and "Providing preventive and predictive maintenance". This company also wants to focus on the ecological aspect, especially on resource reuse and the reduction of transportation routes. In addition to the fibre optic networks, the company also offers all products required for operating such a network. These include, for example, wall distribution boxes, rack distributors, and splice boxes. It can also be assumed that the ecological aspect is also in the background in the "Improving product design" functionality. In the middle of the life phase, the already existing services increase resource efficiency and product lifespan. Also in this company, the main challenge is to ensure that the products are appropriately returned to the material cycle.

3.2.4 Real estate company

The real estate company manages properties worth around CHF 13 billion, mainly consisting of offices (44% of the total area) and sales spaces (26% of the total area). Currently offered are "Monitoring and tracking products activity" and "Providing technical support". With the help of the six action areas (Ecology, Stakeholders, Infrastructure, Innovation, Employees, and Finance), the company aims to create sustainable living spaces. By increasing the use of cradle-to-cradle building materials, the cycle is partially closed. Especially in the middle of life phase, as with the conglomerate, resource efficiency can be increased through the implementation of smart infrastructure. The construction industry generates a lot of waste, so when constructing buildings, materials should be used that can be added back to the resource cycle after the building is demolished.

3.2.5 Printing company

In addition to normal printing products, the printing company also offers packaging for goods. As the company is cradle-to-cradle certified, they have replaced all toxic components in their production processes and products with harmless materials. Thus, only "Improving product design" is currently being implemented. The certification considers five main criteria: material, material cycle management, renewable energy & energy management, water management, and social justice. Since the printing company does not sell machines but rather printed products and packaging, the functionalities of the middle of life phase are eliminated. Through the certification step, the functionality "Improving product design" has already been fully implemented. The functionality "Attracting target customers" is not considered as it refers to IoT-gained information. However, cradle-to-cradle certification is a decisive point in marketing and serves as a unique selling proposition for the company. In addition, they want to support their customers in implementing circular principles through their gained knowledge. This can be seen as "Enhancing renovation and end-of-life activities". The problem with returnability in this case is not the lack of willingness on the part of customers, but that there is already a well-established recycling system for paper products. As a single company, it may be difficult to establish a parallel return system.

4. CONCLUSIONS AND FURTHER DEVELOPMENT

There are already conceptual frameworks for circular economic systems (such as cradle-to-cradle and circular economy). In transitioning to such a way of doing business, it is also imperative to adjust the mindset within the company. This leads to a change in the business model or the way in which the company wants to create value for itself and its customers. The adoption of SDL already represents an important step in changing the mindset and how the company wants to generate value in the future. This replaces product-oriented business models with usage-oriented or result-oriented business models. Here, the producer owns the machines, which creates an incentive to increase resource efficiency and to design

the machines to be easy to maintain. This already covers two (resource efficiency, increased lifespan) of the three value drivers of the circular economy.

In the interviews, it has been shown that companies are familiar with such circular concepts and would like to increasingly consider the ecological and social dimensions. However, these still play a subordinate role in decision-making, despite the presence of quantitative ecological KPIs. This confirms the first part of the hypothesis (ecological KPIs are available). A systematic methodology for optimizing economic and ecological value still seems to be lacking (second part of the hypothesis).

The surveyed companies already largely cover the middle of life phase, thereby increasing resource efficiency and product lifespan. However, there is still catching up to do in the beginning of life and especially the end of life phase. In the "Improving product design" functionality, longevity and ease of maintenance must be taken into account. Additionally, the product should be designed so that in the end of life phase, the "Upgrading the product" functionality can be as easy as possible (e.g. modular product structure). It has been shown that companies have particular difficulty closing the loop. This is due to the fact that the manufacturing depth of certain products is very high and all companies in this value network must be involved. Additionally, it may still be too difficult for customers to return the product. In the case of the printing company, there is already an established return loop, even if it is not sustainable. Competing against this is difficult. The concept of the circular economy cannot be fully introduced in all industries, and alternative approaches are required.

There are several aspects that can be addressed in future work. Firstly, more companies should be surveyed to identify specific challenges Swiss companies face in each phase (beginning/middle/end of life) in order to develop specific frameworks. The companies surveyed in this study appear to face particular challenges in the end of life phase. It needs to be verified with further surveys whether this is a coincidence or generally applicable to Swiss companies.

The second aspect concerns the model proposed in (Meierhofer & Stucki, 2022). According to the interviews, certain companies already have the required ecological KPIs for the model. However, the question arises as to at which aggregated level the numbers are available and whether they can be used in the model as such. The model could then serve as a decision-making basis for companies to maximize the combined economic and ecological value with different service constellations.

Furthermore, the validation of the model from (Meierhofer & Stucki, 2022) against the practical cases points to further improvement potential of the model on the one hand and additionally provide specific and quantitative recommendations to companies how to optimize their services with respect to the triple bottom line. Potentially, the model could also be extended to incorporate social benefits for complementing the application to the triple bottom line.

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ENVIRONMENTAL CONFIGURATIONS FOR SUCCESSFUL DIGITAL SERVICIZATION

Jonathan Rösler, Eva Lexutt & Thomas Friedli

Purpose: The purpose of this study is to examine the role of contextual factors for superior performance with digital servitization and to identify environmental configurations suitable for different combinations of service offerings and digitalization.

Design/Methodology/Approach: To account for complex causality and in line with recent recommendations in the literature, a state-of-the-art fsQCA is applied to a sample of 88 industrial companies.

Findings: The analysis of sufficiency resulted in six configurations that consistently lead to servitization success in the examined cases. A service offering focused only on services supporting the product (SSP) does not require a strong focus on digitalization and can lead to success in a favorable environment. An extensive offering of both SSP and services supporting the customer (SSC) leads to success in a similar environment only when combined with digitalization. Interestingly, under conditions of high market uncertainty, an advanced service offering of SSP and SSC consistently leads to success as well, but only without a strong focus on digitalization. Finally, companies offering only SSC, with a strong focus on digitalization, can be successful in an environment of high market complexity.

Originality/Value: This study expands our understanding of the role of digitalization for servitization success. It adds to the sparse literature on environmental success factors, providing a detailed view of the complex interplay of service offering, digitalization, and environmental conditions for servitization success. By applying a state-of-the-art fsQCA, it contributes to the methodological variety of the field. For managers, knowledge on which market conditions are favorable for different combinations of service offerings and digitalization can help avoid the service paradox.

KEYWORDS: digital servitization, organizational environment, fsQCA, configurations, success

1. INTRODUCTION

Digital servitization (DS) is a fast-growing stream in servitization research and a pressing topic for practitioners (Rabetino et al. 2021). Despite the growing interest in DS, the causal mechanisms leading to superior performance with DS remain unclear.

Indeed, industrial firms' ability to turn DS into positive outcomes arguably depends on many, often interrelated factors that lie both within and beyond providers' organizations (Alghisi & Sacconi, 2015; Salonen et al., 2021). Various scholars demonstrated that businesses undergoing service growth and DS perform better by developing or acquiring distinct organizational capabilities (Marcon et al., 2022; Münch et al., 2022; Story et al., 2017), as well as certain competencies and resources (Böhm et al., 2017).

Contextual factors pertaining to the organizational environment also play an important role in companies' abilities to turn service growth into success (Fliess & Lexutt, 2019). However, environmental factors are often overlooked, as servitization-focused academic research has only recently begun to study the contexts of providers and how these contexts affect firm performance metrics (Fliess & Lexutt, 2019). These shortcomings are unfortunate, as a better understanding of the context-related elements that affect DS positively or negatively and their interaction may significantly increase knowledge on the success and failure of organizations pursuing DS (Lenka et al., 2017; Rabetino et al., 2018). An understanding of different combinations of environmental conditions could be helpful or decisive in the quest to successfully adopt DS and integrate it into industrial businesses serving global business markets. Considering the impact of contextual factors, more knowledge would allow managers to specify coping mechanisms and create more efficient business models, thereby improving the likelihood of their company's DS success.

To fill these knowledge gaps and to cover new ground in DS research, the purpose of this study is to examine the role of contextual factors for superior performance with DS and to identify environmental configurations suitable for different combinations of service offerings and digitalization.

Servitization is considered to have a causally complex nature for which the recipe to success is more important than the ingredients (Kohtamäki et al., 2019; Lexutt, 2020). Similarly, several paths might lead to DS success, rather than one single ideal approach. For this reason, knowledge obtained through configuration logic methods is required to better understand DS and how it is shaped by contextual factors. Unfortunately, most existing research on servitization and DS does not consider causal complexity. Consequently, following recent recommendations (e.g. Salonen et al., 2021), this study adopts a configurational approach to capture the complex causalities of DS success. Accordingly, a state-of-the-art fsQCA is applied to a sample of 88 industrial companies.

By disentangling the complex causalities enveloping DS success, this empirical study adds new knowledge to the literature. Specifically, it clarifies how the examined factors 1) influence overall servitization success, 2) interact with each other to produce these effects, and 3) are connected to the presence of digitalization. Through sufficiency analysis, several causal paths are detected that turn DS into positive outcomes. The findings also show that regardless of the type of service offering, investments in the extension of the service portfolio pay off in the sampled companies.

2. CONCEPTUAL BACKGROUND

To account for the configurational nature of servitization success (Lexutt, 2020), this study adopts a configurational approach. It is hypothesized that there is no single best configuration of DS and contextual factors leading to better outcomes for providers undergoing DS, but that there are several possible configurations of causal constructs (equifinality). It also assumes that the conditions display their causal effects in conjunction with one another, rather than independently (conjunctural causation), and that the configurations that account for the presence of success are different from the configurations that account for the absence of success (asymmetry).

The configurational model contains digitalization, type of service offering, and four context conditions. The construct of overall servitization success (Lexutt, 2020), which contains financial as well as non-financial aspects of success, is used as the outcome measure. Figure 1 depicts the configurational model for this study.

The use of digital technologies encourages industrial firms to conduct service and business model innovation, especially in the context of servitization (Gago & Rubalcaba, 2007; Rabetino et al., 2015). Digitalization might interplay with servitization as digital technologies might have a stronger performance impact when firms reach a certain maturity on their servitization journey. Similarly, contextual variables might strongly affect causal relationships between digitalization, servitization, and performance.

To capture different stages of the servitization journey, this study measures the type and scope of different service offerings (Homburg et al. 2003). Specifically, it distinguishes between services supporting the customer (SSC), and services supporting the product (SSP) (Mathieu, 2001).

The service and digital business of industrial companies is impacted by the market and technological environment in which a company works, and a firm's context is a crucial domain when looking for the best organizational configurations (Kohtamäki et al., 2019). To capture different organizational environments, four contextual conditions, that have previously been associated with servitization performance, are considered: Competitive intensity (Ambroise et al. 2018), market turbulence (Fang et al. 2008), market uncertainty (Souder et al., 1998) and market complexity (Neu & Brown, 2008).

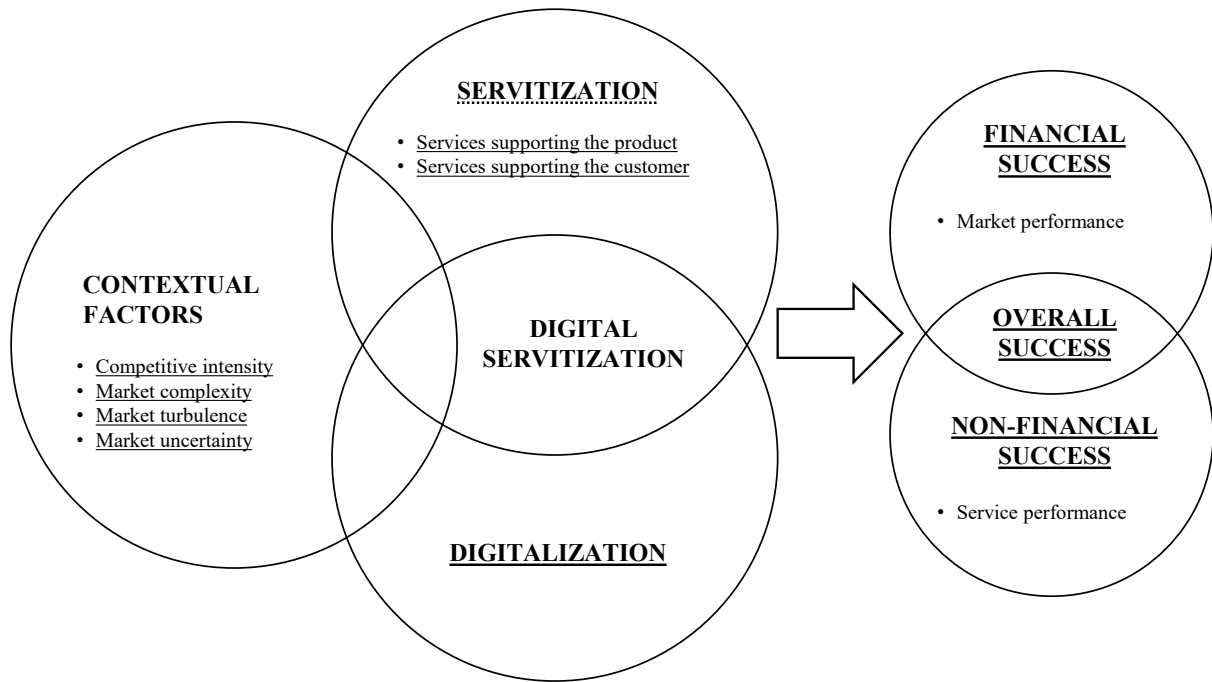


Figure 1: Configuration model

3. METHODOLOGY

To account for complex causality and in line with recent recommendations (e.g., Salonen et al. 2021), a state-of-the-art fsQCA, following the approach delineated in Lexutt (2020), is conducted. Data were collected in an online survey between January and June 2021, targeting B2B companies in Germany, Austria, and Switzerland, operating in the industrial sector and undergoing DS. Respondents were C-level executives and senior management with an in-depth understanding of the service industry and the company's financial performance. The sample consists of 88 industrial companies of different size and from different industries.

For construct measures, operationalizations from previous studies were used. To ensure that the respondents understood the questions, a small-range pretest was undertaken with nine participants. The data was checked for internal consistency.

To convert the data into fuzzy set values for fsQCA, direct data calibration was used (Pappas & Woodside, 2021). Theoretical justification and the researcher's in-depth understanding of the constructs should always guide calibration (Ragin, 2008). To set the threshold values for SSP, SSC, and DI, full membership was assumed at 95%, intermediate membership at 50%, and full non-membership at 5% (Fiss, 2011). A case must actively offer a greater quantity of services in each category than is typical (Antioco et al., 2008) to be deemed more in the set than out of the set. As a result, the crossover points for SSP, SSC, and DI were set at 5, 3, and 4, respectively. Complete non-membership was the result of not using any services, while full membership was the result of using all services. For the other constructs, the crossover point was set at 3.9 on the Likert scale, which means that cases that "agree" or "fully agree" (4 or 5 on the scale) are seen as being more in the set than out of the set, whereas cases that "neither agree nor disagree", "disagree" or "fully disagree" (3, 2, or 1 on the scale) are seen as being more out of the set. The outcome overall success is measured as the conjunction of financial and non-financial success and did not require calibration.

Analyses of necessity and sufficiency were conducted in fs/QCA 3.0.

4. FINDINGS

The necessity analysis identified the absence of competitive intensity as a necessary condition for overall success. However, after closer examination of the cases' distribution, low competitive intensity is a constant in this research context and is therefore rejected as a necessary condition (Schneider &

Wagemann, 2012). Further research under more diverse competitive conditions is required to draw conclusions on the role of competitive intensity for servitization success.

Table 2 displays the identified configurations for the presence of overall success. The analysis of sufficiency resulted in six configurations that consistently lead to overall success in the examined cases. The causal pathways to overall success are shown in Figure 2.

Table 1: Sufficient configurations for the presence of the outcomes

Conditions	Outcome: Overall success					
	1	2	3	4	5	6
SSP	●	●	●	●	○	
SSC	○	●	●	●	●	●
DI	○	●	●	○	●	●
MT	○		○	○	○	○
CI	○	○	○	○	○	○
MC	○	○		○	●	●
MU	○	○	○	●		○
Cons.	0.965	0.965	0.944	0.996	0.955	0.969
Raw cov.	0.181	0.209	0.241	0.220	0.162	0.264
Unique cov.	0.056	0.010	0.000	0.072	0.014	0.001
Sol. cons.	0.946					
Sol. cov.	0.507					

● Indicates the presence of the condition, ○ the absence of the condition, and an empty cell that the condition not causally relevant. Large circles indicate that a solution appears in a complex and parsimonious solution. Cons.: Consistency; Cov.: Coverage; Sol.: Solution

A service offering focused only on SSP (configuration 1) does not require a strong focus on digitalization and can lead to success in a favorable environment, characterized by the absence of all the examined context factors. This shows that servitization is possible also without a strong focus on digital aspects (Vendrell-Herrero et al. 2017), particularly when the service offering is related to the product business. In contrast, an extensive offering of both SSP and SSC leads to success in a similar environment only when combined with digitalization (configurations 2 and 3). Digitalization is not a requirement to be successful with product-oriented services, but becomes relevant with an extensive offering that includes, often digitally enabled, advanced services. As the environmental conditions are largely similar in configurations 1, 2, and 3, it becomes clear that, digitalization is a decisive causal factor for success with an extensive service offering.

However, digitalization is not a panacea for a combined offering of SSP and SSC. Interestingly, under conditions of high market uncertainty, an advanced service offering of SSP and SSC consistently leads to success only without a strong focus on digitalization (configuration 4). An unpredictable outlook of a market's development can affect the behavior of market actors, making them more conservative (Hoppe, 2000). Under such conditions, it appears to be preferable to not focus too strongly on digital elements, as they might increase the perceived uncertainty.

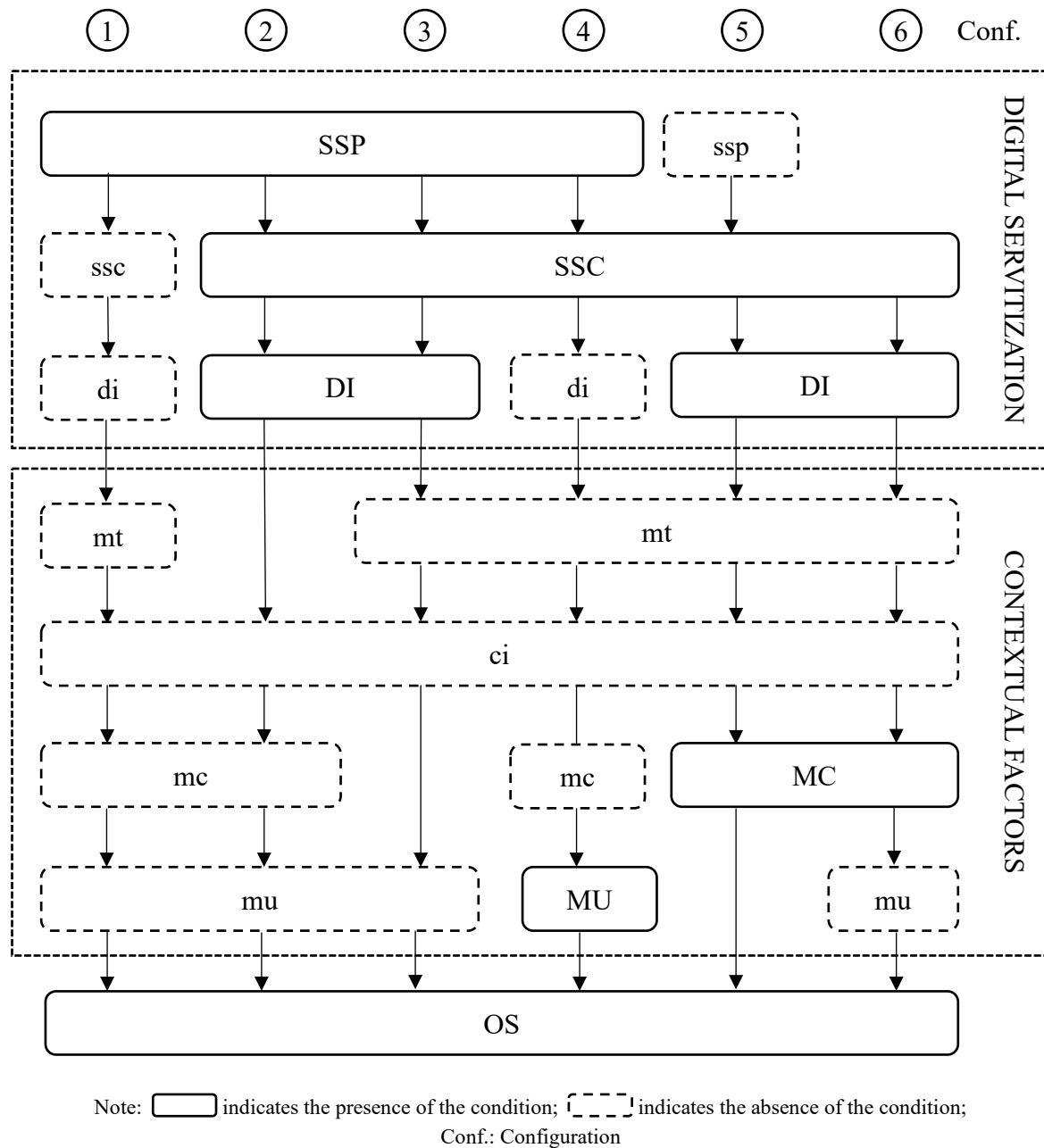


Figure 2: Causal pathways to overall success with digital servitization

Finally, companies offering only SSC, with a strong focus on digitalization, can be successful in an environment of high market complexity (configurations 5 and 6). Particularly advanced services are often knowledge-intensive, labour-intensive and difficult to standardize (Kohtamäki & Partanen, 2016), leading to higher risks and costs. These effects are exacerbated by a complex, difficult to understand environment. Utilizing digital means can reduce resource requirements and mitigate costs associated with servitization (Kharlamov & Parry, 2021). Consequently, digitalization is a decisive causal factor for success with advanced services in a complex environment.

5. DISCUSSION AND CONTRIBUTION

5.1 Theoretical Contribution

This study expands our understanding of the role of digitalization and environmental factors for servitization success. More specifically, the research findings advance the literature in three ways.

First, this work narrows the existing gap in the literature regarding the influence of contextual factors and their performance effects on firms that transition toward services (Eloranta & Turunen, 2015; Hsuan et al., 2021; Kohtamäki et al., 2022; Lexutt, 2020). Our study provides a more refined answer to a main research question in the literature: the influence of (digital) servitization on firm market performance (Eggert et al., 2013; Lexutt, 2020; Visnjic & van Looy, 2013). The findings reveal that 1) digitalization is beneficial for a) offering SSP and SSC under favourable market conditions, and b) offering SSC in a complex market; 2) digitalization is not beneficial for success with a) an offering focused on SSP under favourable market conditions, and b) offering SSP and SSC under uncertain market conditions; and 3) both SSP and SSC (separately and/or combined) can lead to overall success in the right market conditions. Recent quantitative research postulates that firms combining servitization and digitalization tend to achieve higher performance (Kharlamov & Parry, 2021; Aboufoul et al., 2020). This study shows that it is the right fit between type of offering, digitalization, and environmental conditions that is causally relevant for success. This demonstrates that also digital servitization is best understood from a configurational perspective, adding to the growing configurational research in servitization (Kohtamäki et al., 2019; Lexutt, 2020; Brax et al., 2021). Furthermore, the findings illustrate the relevance of the organizational environment for servitization success, adding to the explanation of the servitization (Gebauer et al., 2005) and digitization paradox (Gebauer, Fleisch, et al., 2020).

Second, this study extends and enriches prior findings on the role of servitization in capturing the financial potential of digitalization. Its findings, following Luoto et al. (2017) and in line with the observations of Kohtamäki et al. (2020b) and Zhou et al. (2021), suggest that digitalization and servitization strongly affect each other. On the one hand, the findings show that digitalization alone does not lead to success in the examined cases, but only in combination with servitization. This observation confirms prior case-study-based research (Gebauer, Arzt, et al., 2020) and supports one of the key assumptions of the “young oak” DS research field, namely that the investigation of servitization and digitalization calls for an integrative approach. On the other hand, the findings indicate that firms facilitate servitization and digitalization nearly parallelly. The more firms extend their portfolio with services, the more they digitize. However, what is new about this research is that firms still reach low digitalization levels even with highly sophisticated portfolios. This indicates that digitalization is rather an enabler to unlock further efficiency gains but not necessarily a prerequisite for a portfolio extension. This learning is an addition to the existing literature. In this regard, the study addresses recent calls to uncover the trajectories of companies undergoing DS (Favoretto et al., 2022; Luoto et al., 2017).

Third, this study methodologically advances the body of literature as it demonstrates the suitability of studying complex phenomena of DS in combination with selected contextual factors. Following Lexutt (2020), this work includes studies of the sufficiency and necessity of the outcome's presence, as well as examinations of membership distributions and logical inconsistencies. In the process, unlike the majority of quantitative studies, an integrated performance assessment covering financial and non-financial determinants was conducted (Bigdeli et al., 2018; Lexutt, 2020). In contrast to conventional techniques, fsQCA analyses how several influence factors interact (Fiss, 2011), which makes it the ideal tool to examine the impact of contextual factors on a firm's DS trajectory. As a result, beyond what is possible with conventional statistical methods when focusing on the performance implications of single factors (e.g., the type of service offering), the six identified configurations offer a more nuanced perspective of the causal relationships between combinations of DS and context variables.

5.2 Managerial implications

For managers, knowledge of which market conditions are favorable for different combinations of service offerings and digitalization can help avoid the service paradox. Knowledge of these market conditions facilitates the adaptation of market-specific strategies and the adjustment of the business model. The results show that servitization and digitization are worthwhile when approached with the right strategy. Our results suggest that companies can by no means rely on investments and capability

building alone when striving for turning their investments into digitalization and services to pay off. On the contrary, under certain environmental conditions, it seems to be unequally difficult to push servitization and digitalization. Accordingly, managers should closely align their strategies with their context and not only decide what to do but also what not to do in the context of digitalization and servitization.

5.3 Limitations and further research

Our research is not free of limitations. Two main limitations offer opportunities for further research. On the one hand, our sample is focused on German-speaking countries. This limitation calls for further exploration, i.e., through large-scale, global survey research. Such an approach would also allow contributing to a better understanding of the industry-specific differences in the perception of environmental factors and the factors they depend on. On the other hand, our sample consists of providers of SSP and SSC only. The inclusion of intermediaries and customers, and how they approach servitization and digitalization could help draw a better picture of the complex phenomena of DS.

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NOTHING STAYS FOREVER? THE POST-PANDEMIC NEW NORMAL OF INDUSTRIAL SERVICE OPERATIONS

Mark Hoebertz, Jens Poeppebuss, Christian Kowalkowski & Martin Ebel

ABSTRACT

Purpose: Investigating the coping strategies of industrial service providers during and after the COVID-19 pandemic.

Design/Methodology/Approach: Following a grounded-theory, interpretive research approach, we conducted 22 interviews with decision-makers of industrial service providers. Interviews took place during the pandemic 2020/2021 and in the post-pandemic times in 2022/2023.

Findings: Two main structural changes were found as a result of the pandemic. First, *closer partnerships* between industrial service providers and their customers due to the support given during the pandemic and the retention of direct customer contact. Second, *crisis-resilient company structures* characterized by diversification of existing portfolios, implementation of digital and hybrid business settings, investments in training and team-building activities, and continuous documentation of lessons learned.

Originality/Value: This study provides new insights into post-pandemic changes in industrial service operations and presents coping strategies for generating crisis-resilient structures while maintaining the importance of personal exchange between business partners in the new normal.

KEYWORDS: COVID-19, service operations, digital service provision, coping strategies

1. INTRODUCTION

The COVID-19 pandemic has significantly impacted global societies and economies since early 2020, leading to economic challenges such as disruptions to field-service operations and supply networks (Rapaccini et al., 2020). Industrial service providers have had to implement adequate coping strategies as planned service operations could not be maintained due to travel restrictions, plant closures and supply chain interruptions.

Although the pandemic may not yet be fully resolved, businesses and supply chains have adapted to what can be regarded as a “new normal” (Pedersen et al. 2020) or “next normal” (Rapaccini et al. 2020) state, partly returning to pre-pandemic business practices with more direct customer contact again. However, industrial service operations differ from pre-COVID-19 times due to accelerated digital transformation, changes in corporate culture and work processes, and implementation of resilience strategies (Amankwah-Amoah et al., 2021). While servitization has been touted as a means for manufacturing firms to stabilize business during turbulent times and become more resilient (Kwak & Kim, 2016; Rapaccini et al., 2020), there is conflicting empirical evidence from the COVID-19 pandemic (Bond et al., 2020; Li et al., 2022): Manufacturing firms with more revenue from service businesses record higher losses on the stock markets and need more time to recover. This impact is even more severe for manufacturing firms providing product-oriented services than for customer-oriented service providers. Against this background, we investigate two main research questions:

1. What coping strategies have industrial service providers employed during and after the pandemic?
2. How have industrial service operations changed?

2. THEORETICAL BACKGROUND

2.1. Industrial Service Operations in Manufacturing

Manufacturing firms rely heavily on service sales and accompanying promised profit margins. The shift towards value-adding services and solutions has proven to be a meaningful and advisable strategy, especially during uncertain times like financial crises and the recent pandemic (Rappaccini et al. 2020). However, this shift is not without barriers and obstacles (Brax et al. 2021; Visnjic et al. 2016). In addition to potential benefits, servitization entails a change and realignment of processes, resources, and capabilities that do not only concern the restructuring of service operations but also means an overarching change for manufacturers. According to Durugbo and Erkoyuncu (2016), poorly managed service operations can reduce profits due to high delivery costs. Furthermore, service operations directly influence perceived service quality and affect service success. Therefore, cost-effective service operations have become and will most likely remain a relevant research stream for B2B industries (Wirtz and Kowalkowski 2023). Large organizations try to mitigate upcoming uncertainties, for example, with a strong after-sales orientation, a focus on lifecycle-oriented contracts, and a relationship-oriented strategy, especially regarding intelligent service provision based on data usage and knowledge sharing (Durugbo and Erkoyuncu 2016). Thanks to digital innovations, manufacturing firms are undergoing an ongoing shift towards advanced services (Coreynen et al. 2017) that are no longer purely product-related but rather support customers in their value creation. Besides managing existing service contracts efficiently, organizations today face constant pressure to innovate their offerings. These shifts towards integrated solutions bring the challenge of providing individualized offerings and taking high risks for providing firms (Bond 2020).

2.2 Impact of the Pandemic on Service Operation

There are only a few studies that have already investigated the impact of the pandemic on industrial service operations. The literature describes two possible influences on service-oriented companies experienced in the context of the pandemic. First, through the integration of technologies, which often increases with the level of servitization, companies are not as dependent on local restrictions (Rapaccini et al. 2020). Papadopoulos et al. (2020) discuss the implications of the use of new technologies to secure business continuity, especially for small and medium-sized enterprises (SMEs). Digital, data-based services might only be marginally affected and could continue to be provided. The respondents of an early empirical study by Rapaccini et al. (2020) indicated that especially those kinds of services that are traditionally delivered physically by field technicians (e.g., maintenance and training) greatly suffered from travel and contact restrictions and also a decrease in demand. As a response to these restrictions, many firms greatly increased their digitization efforts. Those firms that had been already ahead with digitalization and servitization were found to be more resistant to the pandemic's disruptions (Rapaccini et al. 2020). In a recent study, Bettiol et al. (2022) find that the increased use of digital technologies has helped SMEs on the one hand by using ICT (e.g., web-based technologies or information systems such as customer relationship management systems) to advance product innovation and on the other hand by using Industry 4.0 technologies (e.g., big data, Internet of Things, and artificial intelligence) to enhance their servitization processes to overcome pandemic challenges.

Second, companies that provide services that involve the assumption of operational risks are more affected by uncertain events such as a pandemic. According to Bond et al. (2020), the pandemic left advanced service providers "with excessive costs (e.g., idle equipment), sharply reduced revenues, or no revenues at all (due to lockdowns in customers' countries)." A case in point is the situation of an OEM of compressors to a great share paid for contracted pressurized air, while entire plants and therefore air consumers are at a standstill. In the same vein, a recent study by Li et al. (2022) concluded that manufacturing firms with higher service revenues, especially with product-orientated services, were more affected by the pandemic and it took them longer to recover. Early projections for the "next normal" after the pandemic include the decentralization of resources required for field services, the promotion of customer self-service, as well as the acceleration of digital programs to extend remote assistance (Rapaccini et al. 2020). In addition, it is assumed for the "next normal" that as-a-

service models and performance-based contracting will gain momentum rather than lose importance as a key service growth engine. However, further research is needed to ensure that these models adapt and are designed more resiliently (Bond et al. 2020). This then also applies to the required cost-effective service operations and the respective technologies used (Wirtz & Kowalkowski 2023).

3. RESEARCH METHODOLOGY

We conducted a qualitative-empirical study consisting of two rounds of in-depth interviews, which included a total of 22 interviews with decision-makers in managerial positions up to the C-level. The industries represented in our sample range from turbine cleaning service provision to pallet truck manufacturing. To identify suitable participants, we searched local company directories, business-oriented social media platforms (e.g., LinkedIn), and contacted known experts from previous joint research projects in Germany and Sweden. To encourage participants to share their experiences with us, their companies were anonymized. The key characteristics of our sample are presented in Table 1.

Table 1: Qualitative study sample

Company (Pseudonyms)	Industry	Informant position	Time per interview 2020/21 (Interview ID)	Time per Interview 2022/23 (Interview ID)
CLEANSERV	Industrial Services	Branch Manager	0:41 h (01)	0:33 h (13)
MONITORING	Industrial Services	Internal Sales Representative	1:13 h (02)	-/-
INSPECTION	Industrial Services	CEO	1:07 h (03)	-/-
MULTISERV	Industrial Services	Head of Technical Management Maintenance	0:42 h (04)	-/-
GASTURBINE	Plant Construction	Project Engineer	1:20 h (05)	0:21 h (14)
BLASTFURNACE	Plant Construction	CEO	0:40 h (06)	-/-
WELDING	Plant Construction	Team Leader After Sales Service	1:00 h (07)	0:45 h (15)
CONVEYOR	Material Handling	Service Account Manager	0:48 h (08)	-/-
PUMPSERV	Supply Technology	Product Group Manager	0:55 h (09)	-/-
FORKLIFT	Material Handling	Director of Service	1:30 h (10)	-/-
DIGGER	Construction Machinery	General Manager Service	1:16 h (11)	-/-
WHOLESELLER	Industrial Services	CEO	0:51 h (12)	0:13 h (16)
ITCONSULT	Consulting Services	Senior Consultant	-/-	0:20 h (17)
PALLETTRUCK	Material Handling	Manager Service Business Development	-/-	0:20 h (18)
STEAMTURBINE	Plant Construction	Sales Manager	-/-	0:21 h (19)
CARPARTS	Automotive Parts	Service Manager	-/-	0:24 h (20)
STRATCONSULT	Consulting Services	Senior Consultant	-/-	0:19 h (21)
EXCAVATOR	Construction Machinery	Service Manager	-/-	0:34 h (22)

All interviews of this step were tape-recorded and had an average duration of about 61 min. The first round of interviews was conducted in December 2020 and January 2021, and participants were asked to discuss their companies' measures to maintain service operations during the pandemic. In the second round, which took place in December 2022, we conducted another ten interviews (some with the same interviewees) to determine which measures were maintained after the pandemic. In both rounds, we used semi-structured interview guidelines, which are presented in Table 2. For data

analysis, we employed the Gioia method, a widely accepted approach to interpretive research based on grounded theory (Gioia et al., 2013).

Table 2: Interview Guidelines

Interview guideline in 2020/2021	Interview guideline in 2022/2023
1. Introduction of the participant and interview conductor, interviewee describes his/her employing company, job background and role in the organization.	1. Optional introduction if a participant recently joined the focus group. Otherwise follow-up on the previous interview.
2. Open report about the changes in the company since COVID-19 appeared and coping strategies to react to this incident in general.	2. Open report about the newest events in the company concerning service provision during COVID-19: What is new? What has changed?
3. Problemization concerning the impact of COVID-19 on industrial service provision and the corresponding reaction to keep service provision active.	3. Confrontation with results of the first interviewing round to stimulate talking about aspects that have not been mentioned so far.
4. Outlook towards coming challenges due to COVID-19 and measurements to cope with future issues.	4. Outlook towards long-time changes in service operations.

4 FINDINGS

4.1 Overview

During the first round of interviews conducted in 2020/2021, we identified three distinct coping strategies that were employed to maintain industrial service operations during the peak of the COVID-19 pandemic: Caring for the customer, rearranging internal structures, and relocating (Hoebertz and Poepelbuss 2021). The strategy of caring for the customer implied the permanent effort of service providers to maintain contact with their customers. This effort signaled to the customers that the providers were willing to support them beyond the common business relationship. Moreover, the service-performing companies could choose between two further coping strategies. The first coping strategy was to rearrange the internal structures of the own company to establish a pandemic-compliant infrastructure. As the second coping strategy, companies relocated the place of performing the offered services. Due to contact restrictions, service providers mainly could not visit their customers in the usual way. Therefore, switching to alternative places like the digital space or sending the service object to the provider's place was the other type of coping strategy. Upon analyzing the results of our second round of interviews, we reviewed and condensed our initial data structure. This process resulted in a new data structure, illustrated in Figure 1.

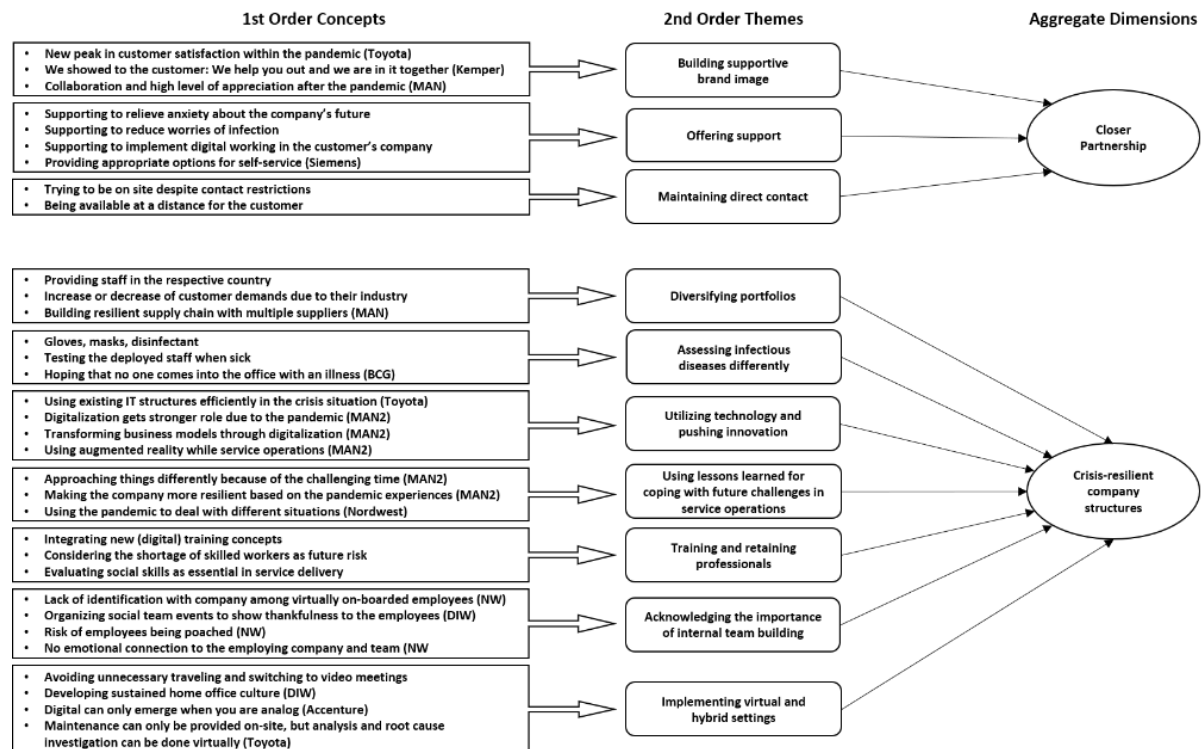


Figure 1: Data Structure

4.2 Closer Partnership

The intensification of the relationship between customers and service operators and the resulting closer partnership were described by every interviewee and seemed to be imperative for every service provider. The interviewees felt the need to maintain direct contact and offer support even during challenging times to show solidarity with their customers. Offering support to customers can be characterized in multiple ways. Some providers described that their key account managers called their customers several times a week just to signalize that they care about the customers' anxieties during the pandemic and are willing to talk about these worries. Besides these conversations, other participants also supported their customers while performing changes in their company structures such as consulting towards digitalization of business processes:

"Therefore, we offered to our customers, if they were interested, to start a digital platform in 24 or 48 hours. The customers only needed to provide us with their companies' data. However, we provided the technical requirements. We made it possible that a customer is actively online in 24 hours." (WHOLESELLER, Business Unit Manager)

Further support can be described by offering opportunities to provide appropriate options for self-service, e.g. providing manuals to the customers for simple maintenance activities. However, our participants reported that these self-service opportunities also embody threats concerning the loss of competencies as unique selling points for the service provider: If the service providers offer too many self-service opportunities, he makes himself obsolete:

"It was never interesting to provide [too much] self-service for our customers because we think that even can be a little bit dangerous [...] to give too much knowledge, it's pretty risky. Even before the pandemic, customers asked for this [...], but that is something that we usually are not discussing. [...] We try to send our own specialists." (STEAMTURBINE, Sales Manager)

The whole process of being a supportive company leads to a certain brand image for the service providers. Customers notice that their business partners are willing to help them through critical situations, e.g. the COVID pandemic. Hence, customers connect the brand perception of the provider's company with this supportive behaviour. Therefore, the interviewees explained that these closer collaborations generate higher customer satisfaction and a greater level of appreciation.

"We saw new highs in the customer satisfaction survey during the pandemic because we were able to respond quickly and purposefully to the needs of the customer as well." (PALLETTRUCK, Manager Service Business Development)

4.3 Crisis-Resilient Company Structures

As our second aggregate dimension, *crisis-resilient company structures* were developed based on the changes to cope with the pandemic. To ensure crisis resilience, our participants explained that diversification of many different portfolios, e.g. customer branches or supply chains, enables to tolerate shocks such as in pandemic times. By spreading the risk through diversification, service operators are not that affected anymore if one of their main customers' branches is about to decrease or one spare-part supplier is currently not able to deliver:

"We diversified our product and industry portfolio. But we have also diversified our supply chains and dependencies. The supply chain was also examined more closely. So we are positioned more broadly. And if one arm breaks off, we still have six other arms and the risk is lower then." (GASTURBINE, Project Engineer)

Furthermore, a different assessment of infectious diseases enables a company to be more resilient against pandemic events. Wearing masks when appropriate and testing the staff are still active

procedures in our participants' companies. Even though using masks and gloves is not needed by everybody, the companies appeal to their employees' rationality to stay at home if they feel sick. Otherwise, the chain of infection cannot be stopped. Admittedly, still some employees seem to not stay at home due to the feeling to let colleagues down.

"I actually hoped that people would become more clever, but I don't know if it's human nature. I thought that no one would drag himself into the office with an illness. Unfortunately, that didn't prove to be the case. [...] I don't know if it's sometimes also a certain group dynamic, that you just have the feeling that you're letting the others down, even though you're not actually doing that." (STRATCONSULT, Senior Consultant)

Besides recording lessons learned to cope with future challenges, using the company's existing digital competencies to push innovation was a further step to improve the company's resilience against crises. Our interviewees reported that many technical skills such as using augmented reality to improve service provision already existed before the pandemic but have not been used extensively. Contact restrictions also forced less digitalization-oriented companies to tap their full digital potential:

"We have commissioned an entire plant in Japan remotely, [...] which would never have worked in the past, I have to say. So this is also a highlight in general, the augmented reality glasses have already established themselves with one or the other customer." (GASTURBINE, Project Engineer)

As the only second-order theme that lasted after the second round of interviews, the training and retaining of professionals stayed in our interviewees' perspective. By integrating new training concepts, companies are able to retain their employees even in pandemic times. One of the biggest fallacies mentioned by our participants is the assumption that field technicians would not seek better working conditions during the pandemic. Therefore, it is important to keep on investing in the company's staff to show appreciation:

"We see a continuous loss of know-how. People are willing to change their employers even during the pandemic. We motivate our employees by showing them that we invest in their competencies. People appreciate that." (PUMPSERV, Product Group Manager)

Due to contact restrictions and arrangements regarding home office, many companies were confronted with a lack of identification with the company among virtually on-boarded employees. Since employees only interact in virtual meetings, no emotional connection between the employing company and the team can be generated. Hence, there is a high risk that these employees are being poached easily by other companies. By organizing (digital) team building events, companies enhanced the commitment of their employees even in pandemic times:

"Whoever sits in the home office, whether he works for A or B, doesn't matter at first. It has to be said that there is a certain slight form of alienation from the company. It has also led to the fact that this year that we have all held massive Christmas parties or similar events in order to bring a certain personal level back into the mix and to simply say thank you to the people who have been working for us for the past two years." (CLEANSERV, Branch Manager)

One additional advantage of the changes due to the COVID-19 pandemic is the implementation of virtual and hybrid settings. While field service activities, e.g. repairing and maintenance services, have to be provided on-site, data-driven processes such as analyzing and root cause investigations of machine failures can be done digitally. Therefore, unnecessary traveling can be avoided:

"[...] the provision of maintenance and repair services on classic machines, that can only be done on-site. But root cause analysis, remote support, that is of course also an area that takes place in the digital space." (PALLETTRUCK, Manager Service Business Development)

4.4 Development in Service Operations from 2020 to 2023

After analyzing our second round of interviews, we observed that caring for the customer has become more intense, with a focus on creating closer partnerships:

"I think that overall, the pandemic has also been a kind of burning glass as far as dependencies are concerned. Of course, the customer buys machines and services, but if these services can't be provided and the fleet is down, it hurts the customer. So that means it's a mutual dependency. You work together, ideally as partners, and price is one dimension of that cooperation. But basically, it's about helping each other [...]. And where it worked, that has been really valued. And that's an asset that you can work with for a long time." (PALLETTRUCK, Manager Service Business Development)

Hygienic behaviour, such as disinfecting hands and staying at home with cold symptoms, is now an established but optimized practice in what was described as a different assessment of infectious diseases: Employees are not always required to wear masks but are encouraged to stay home when feeling sick. While the retaining and training of professionals are still considered highly relevant, other internal changes, especially the focus on relocating, have largely been discarded: Since personal contact was considered crucial in service operations, all companies cancelled contact restrictions and allowed necessary business trips on the one hand. On the other hand, digital business meetings are still seen as an appropriate alternative to costly and time-consuming travel. To achieve greater resilience in the face of current and future crises (e.g., the current Russian invasion of Ukraine), interviewees mentioned diversification of company portfolios as one approach. Furthermore, to establish more crisis-resilient company structures in general, the interviewees reported that their companies used their existing technological competencies to push innovations. Besides the importance of a strong partnership with the customers, the internal perspective of enhancing the commitment to employers also gained importance. All changes made for a more crisis-resilient company structure are being documented as lessons learned for future crises.

5. IMPLICATIONS, LIMITATIONS, AND FURTHER RESEARCH

Our detailed analyses illustrate how the pandemic has brought about fundamental changes in the service operations of industrial service providers, as new coping strategies emerged and existing activities had to evolve. While practices like relocating may have largely been abandoned, digitization in particular has had a profound impact on service processes and has accelerated the adoption of more advanced service business models. Based on our grounded-theory-based interpretative study, we are able to support the hypothesis of Agostino et al. (2021) concerning the importance of digitization competencies during the COVID-19 pandemic by referring to several 2nd order themes, such as utilizing technology and implementing hybrid settings. In times of contact restrictions, the ability of switching to digital skills is a key competence to cope with the pandemic situation. In addition, our aggregate dimension *Crisis-resilient company structures* is consistent with the study of Rapaccini et al. (2020): In their contribution, they point out the importance of developing resilience in order to be prepared for future crises. Furthermore, our interviewees did not report about long economic recovery periods after the beginning of the pandemic. While servitization has been described as a transformation that helps manufacturing firms to stabilize their business in turbulent times (Rapaccini et al. 2020), there is contradictory empirical evidence from the COVID-19 pandemic (Li et al. 2022). Looking at our data, we cannot confirm this contradiction since our participants described themselves more as customer-oriented service providers. This is particularly reflected in their strong orientation to support customers in the pandemic.

Future research should investigate how the coping strategies that were undertaken have affected the servitization of firms. Further research is also needed with a detailed view of the respective servitization level and their implication for service operations. Furthermore, our findings show that companies have gained and are interested in closer partnerships with their customers. The next step is to evaluate the results of such contracts, which are highly customer-centric and address the value-in-use paradigm. It is worth mentioning that such contracts may pose severe financial challenges during a crisis, although they work well when the economy is thriving (Bond et al. 2020).

Our study also has implications for practitioners. Caring for the customer is a key aspect of our aggregate dimension and an essential behavioural requirement for service providers. Service providers who fail to maintain a connection with their customers risk losing them to more attentive providers who offer better support. It is therefore crucial for managers to realize that paying attention to their customers' needs is even more important during a crisis. Even small gestures like extending payment due dates can have a lasting effect on customer loyalty. However, such measures may require a willingness to forgo certain economic gains in the short term. Future research should investigate whether disruptions like the pandemic lead to a decrease or increase in service operation costs, as well as the impact on customers' perceived service quality. Furthermore, changes in customer perception of industrial service quality throughout the pandemic should be examined in future research activities. In addition, a better understanding of the influencing and contextual factors that contribute to the success or failure of servitization as a strategy in uncertain scenarios, such as the pandemic, should be generated.

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THE SOCIAL IMPACT OF SERVICE-BASED REMANUFACTURING: AN ASSESSMENT MODEL

Maria Spadafora, Mario Rapaccini

ABSTRACT

Purpose: development of a model for social impact assessment of a service based remanufacturing business model

Design/Methodology/Approach: literature review and model conceptualization

Findings: social impact model characterized by the identification of stakeholders and social attributes, and criteria for selecting and validating the model with multiple case-based research

Originality/Value: first paper to fulfil the gap of social measurements in service based remanufacturing business model

KEYWORDS: Product Service System; remanufacturing; social impact measurement

1. INTRODUCTION

Being more sustainable and socially responsible is increasingly on the priority list of manufacturing firms (Braungart et al., 2007; Lüdeke-Freund et al., 2018). This prompts managers and scholars to address, for instance, how circular economy paradigms can be adopted in product-centric business, in order to detach economic growth from negative environmental consequences (Bressanelli et al., 2019; Geissdoerfer et al., 2017). In this regard, the remanufacturing of End-of-Use/End-of-life (EoU/EoL) goods can be a promising avenue to comply with the requirements of the triple bottom-line, i.e. creating value in terms of economic, environmental, and social impact (EMF, 2012; ERM, 2015). The literature agrees that the adoption of remanufacturing is facilitated by the shift to a more service-oriented business (Hazen et al., 2017; Michelini et al., 2017). However, it is also said that offering some Product Service Systems (PSS) with remanufactured goods is not necessary a panacea for sustainability (Okorie et al., 2021). For instance, some customer segments could benefit from the offering of remanufactured goods of comparable quality but lower prices than the new ones (Vogtlander et al., 2017). This would also bring economic benefits to the firms. From another point of view, however, this could originate additional consumptions of raw materials and energy, and thus a negative impact for the environment (Cooper et al., 2017). It follows that manufacturing firms should assess the economic, environmental and social impact of their remanufacturing initiatives, before proceeding to their development, on the base of costs/benefits analysis and with the aim of reaching satisfying trade-offs between the three dimensions (Raz et al., 2017). Despite this relevance, integrated assessment models are mainly focused on investigating economic and the environmental aspects, while the evaluation of social impact is rather underexplored (Doualle et al., 2015). The reason lays in the difficulty of implementing a comprehensive social impact assessment (SIA) model. Objects of SIA are in fact the interactions between the company and its numerous stakeholders, such as customers, employees, suppliers, and local communities, for which the identification of social categories and the definition and measurement of adequate key indicators, are more complex activities so far (Halme et al., 2006), particularly when the remanufacturing project is still unclear and under early development stages. Despite these difficulties, the attention of policymakers towards social aspects is gaining more attention: recently, the European Financial Reporting Advisory Group (EFRAG), which is the advisory body of the European Commission on corporate disclosure and environmental, social and governance (ESG) issues, has announced that they are developing the new accounting principles and standards for sustainability reporting, that will also include social aspects. Within this rapidly evolving domain, this paper presents a preliminary SIA model, to be used to assess the remanufacturing, in particular in service-based business models and PSS. Accordingly, the rest of the paper is structured as follows: Section 2 shows a review of previous studies on remanufacturing,

pointing out in particular the linkages to servitization strategies. The same section also presents the concept of social impact, and summarizes the models for its evaluation. Section 3 develops the SIA model that we propose for evaluating the social impact of remanufacturing initiatives, in which the remanufactured good is offered in combination with advanced services (e.g., rental, pay-per-use, use-oriented or result-oriented PSS). The paper ends discussing the avenues through which we will apply and validate this model.

2. BACKGROUND

As above mentioned, this section summarises the literature on remanufacturing (REM) Business Models (BM), with particular focus on those initiatives that are provided in the form of advanced services. In addition, it reviews previous works on SIA models. Since both topics are still in their infancy, we follow the approach of integrative literature review as suggested by Snyder (2019), who claims that *'the purpose [of integrative review] is rather to create initial or preliminary conceptualisations and theoretical models'* (Snyder, 2019 p. 336). This approach is also in line with other studies, such as Rapaccini & Adrodegari (2022).

2.1 remanufacturing and Advanced Services

For OEM's, offering to their customers (also) remanufactured and/or refurbished goods can be viewed as an attempt for embracing and experimenting circular economy paradigms (Accenture, 2014). On the one hand, remanufacturing enables closed-loop production with the reuse of product's materials and components. On the other, extending the life of goods slows down the consumption cycles (Bocken et al., 2016). It is also said that with remanufacturing the focus is no longer on linear value-adding activities (value-in-exchange across the chain actors), but rather on maintaining and preserving the value-in-use of the product (Nasr et al., 2018). More specifically, business models based on remanufacturing are considered the circular economy backbone, since they are the solely that give to products a new and useful (second, third, etc.) life, postponing that moment when the only available options are recycling or disposal (Golinska & Kuebler, 2014; Vogtlander et al., 2017). However, despite the mentioned benefits, some impeding factors hinder the diffusion of remanufacturing business models among OEM's (Ritzén & Sandström, 2017).

Some scholars identify servitization as a key to tackle with these barriers (Hazen et al., 2017; Michelini et al., 2017). In particular, the development of PSS in which goods are remanufactured would allow to:

- 1) increase the customer's value expectations and willingness to receive life long customer support, in the form of maintenance contracts, insurance and warranty extensions (Okorie et al., 2021);
- 2) increase – accordingly with the previous - the capabilities of designing products for serviceability, maintainability and durability (Mont, 2008; Sundin & Bras, 2005);
- 3) build more efficient and effective return logistics and systems to control the status of the installed base (e.g. location, operating conditions, performance, etc.); in fact, in remanufacturing business models, the installed base is the primary source of supply for components and raw materials - the so-called 'cores' (El Korchi & Millet, 2014 ; Okorie et al., 2021), and this moves the OEM's focus, i.e. from managing linear to managing circular flows;
- 4) shift toward advanced services – e.g. rental; pay-per-use, or Equipment-as-a-Service, in which the product ownership remains with the manufacturer (Mont, 2008; Sundin & Bras, 2005); in these cases, the installed base constitutes the primary asset to be efficiently and effectively managed, more than manufacturing facilities (Systemiq, 2021; Tukker, 2015).

This latter point is also consistent with the premise of the so called *Service Economy*, which has the ultimate goal *'to create the highest possible utilisation value for the longest possible time while consuming as few material resources and energy as possible'* (Stahel, 2007).

In sum, remanufacturing seems really promising for a more sustainable world. Unfortunately, several factors hinder its technical feasibility and economic viability (Nasr et al., 2018; Vogtlander et al., 2017). In particular:

- 1) some design and fabrication choices (e.g. welding) could notably affect the efforts and costs of remanufacturing;
- 2) the energy consumed by remanufactured goods in their prolonged life could be higher if compared to the energy consumed by brand new products, that could embed energy-saving solutions;
- 3) extracting raw materials could require less energy than those required for reworking those materials;
- 4) the residual value of goods at the end of their lives could be rather neglectable, so to prefer endpoints (e.g., disposal, dismantling, material recycling, energy recovery, landfilling) other than remanufacturing;
- 5) the cost for return logistics could be higher than the payback from recovered product wastes.

Overall we can conclude that the feasibility and viability of remanufacturing are greatly influenced by design choices, in particular those taken during early design stages (Den Hollander et al., 2017). Indeed, previous literature agrees that these decisions influence more than 80% of environmental and social impacts (Nasr et al., 2018). To reduce this influence, early-stage design choices should be directed to increase: a) the creation and preservation of value-in-use in the primary product life; b) the recovery of value in-use in the second-hand life. This implies the adoption within the engineering department of the OEM, of methods such as design for usability, maintainability, serviceability, assembly, and disassembly (Bocken et al., 2016; Nasr et al., 2018).

2.2 The social benefits of remanufacturing and Advanced Services

The literature highlights the following social benefits that a service-based remanufacturing model can bring:

- job creation due to the manual labour required by remanufacturing processes (Stahel, 2016; Nasr et al., 2018);
- increased supply chain resilience as it allows manufacturers to self-replenish (Bag et al., 2019) with product waste recovered from their customers and becoming the company's main source of supply (Accenture, 2014);
- democratisation of access to high quality products since :
 - due to the fact that they have lower prices, the availability of remanufactured versions of high quality products allows access to market segments that would otherwise not be able to access them (Golinska & Kuebler, 2014; Okorie et al., 2021);
 - advanced services in which the ownership of the product remains with the producer, allowing the initial investment to be eliminated and diluted over the entire product life cycle (Sistemiq, 2021).

The relevance of the benefits described above have greater significance in light of specific SDGs which focus on these aspects. Indeed, the transition to a circular economy can help companies achieve the SDGs contained in the 2030 Agenda, i.e. the strategy issued by the United Nations aimed at achieving the sustainable development goals (Schroeder et al., 2018). From our point of view, remanufacturing in particular enables the achievement of the SDGs related to labour and innovation. In particular:

- SDG 8 (Decent Work and Economic Growth): remanufacturing enables the creation of new jobs; moreover, some estimates show that it is expected to reach 100 billion in Europe compared to 30 billion in 2015 (ERN, 2015).
- SDG 1 (No Poverty): this goal in part is closely related to the previous one, since job creation also indirectly contributes to poverty reduction; on the other hand, one of the cardinal principles of remanufacturing and circularity in general is resource sufficiency (EMF, 2015);

Stahel, 2007), whereby this WB makes it possible to manage resource scarcity in developing countries and thus ensure the subsistence of production processes (Lüdeke-Freund, 2018);

- SDG 9 (Industry, Innovation and Infrastructure): the achievement of this goal implies the development of reliable, sustainable and resilient infrastructure, and thus the adoption of business models such as remanufacturing and servitization.

2.3 The social impact assessment

The debate on how the social impact of economic activities can be measured has recently grown, also stimulated by the hype on Sustainable Development Goals (SDGs) (Mancini & Sala, 2018). Corvo et al. (2021) systematically review the literature and identify 98 SIA models. However, these authors point out that only few are widely used. Among these, the Social Return on Investment (SROI) and models that similarly aim at monetising the social benefits of some business activity. This proliferation is due to the ambiguity that frequently pops up when dealing with social aspects (Arvidson et al., 2014; Manzoor et al., 2019). As claimed by OECD (2021), there is lack of common language regarding the definition of social impact. For the moment being, this presumably hinders the development of the academic debate as well as the adoption of SIA models in industrial applications. When dealing with social impact some authors refer to the consequences of economic activities, in particular to any interactions aimed at creating and/or increasing the wellbeing of any involved stakeholder (UNEP, 2009). Some studies analyse the social impact in comparative terms. In this case, the impact derives as the differences between the consequences of actions with those of non-actions (Clark et al., 2004). Regardless of the meaning given to social aspects, the objective of this literature is identifying which information allow for broadening, deepening, measuring and monetizing the value that is created and shared, not only in respect to economic and environmental aspects but also in social terms, in order to guide decision-making according to the triple bottom line perspective (Grieco et al., 2015; Then et al., 2017). Following this line of reasoning, Sarancic et al. (2022) emphasize the need to integrate the evaluation of economic, environmental and social impact in early design stages. The search for integrated assessment is in line with the concept of shared value proposed by Porter et al. (2011). In this view, economic prosperity is intrinsically related to the opportunity of social progress. However, this latter aspect has been often neglected by servitization scholars (Merli et al., 2018). This is peculiar, as servitization is today viewed as a key strategy for sustainable-oriented innovation (Accenture, 2014; EMF, 2012). Therefore, servitization theories and models cannot disregard the debate on social issues such as labour rights, social justice, wealth of local communities, and gender inequality to mention a few (Chen, 2018). Another reason that prevent widespread adoption of SIA is the difficulty in identifying qualitative and quantitative metrics and KPIs (Abramovic et al., 2014; Golinska & Kuebler, 2014). Indeed, unlike environmental aspects, it is said that social aspects are more difficult to quantify (Halme et al., 2006). Furthermore, academic assumptions appear oversimplistic and difficult to apply in real industrial contexts (Corvo et al., 2021). Overall, the social impact is evaluated in terms of attributes pertaining to the different stakeholders (UNEP, 2009). For example, Golinska & Kuebler (2014) identify the following set of attributes related to internal workers: workplace design, ergonomics, health and safety, training and organizational development, innovation management, corporate image. Abramovic et al. (2014) point out to the need to adopt a life-cycle thinking perspective when assessing the sustainability of servitization strategies. In particular, with regard to the social dimension, they present the following set of attributes: number of training activities; degree of satisfaction of employees, customers and suppliers; health and safety prevention; percentage of accidents; job creation. Raz et al. (2017) refer to the social dimension as social welfare. Specifically, they disaggregate the social welfare into two parts, the first attributed to the production stage (firm-oriented) and the second to the use stage (consumer-oriented). At the end, they compute it as follows: $\text{Social Welfare} = \text{Firm's Profit} + \text{Consumer Surplus} - \text{Externality Cost of Production and Use Phases}$. Using such econometric models has clear advantages: monetizing the overall benefits and costs, these models determine the aggregate well-being for society, thus facilitating policy making and comparison of complex scenarios. It is also relevant to highlight that there is a blurred boundary between the different dimensions. For example, 'work' and 'income' are two social indicators considered by

Gatersleben (2001), while Halme et al. (2006) includes similar attributes into the economic dimension. Conversely, these authors identify the following social attributes: equity; health; safety and security; comfort; social contacts; empowerment; information and awareness. In their interesting review, Contini & Peruzzini (2022) identify 48 social attributes. Some of these indicators, such as health or noise, are common to multiple stakeholders. In fact, they apply to employees, local community, dealers, end users, etc. Other indicators, on the other hand, apply only to one specific category, being the most touched the category of employees. However, Azapagic et al. (2000) emphasise that although abstract frameworks can be developed, it is then necessary to define specifically the metrics and KPIs for each industry/sector/application. These authors propose two macro categories that are generally valid: ethics and welfare indicators. The former refer to the preservation of human and cultural values such as civil rights, equity and diversity. The second group, on the other hand, incorporates aspects such as income distribution and work satisfaction, that pertain to workers, and the wellbeing of the community in which the firm operates (e.g. satisfaction of social needs). Analogously, Dyllick and Hockerts (2002) divide the social aspects into two macro-categories: indicators inherent to human issues and those relating to societal aspects. The former concern factors such as skills, motivation, loyalty of workers and partners. The societal aspect, on the other hand, concerns the impacts on local communities.

In sum, the first issue to be addressed when developing a SIA model for remanufacturing (that is our unit of analysis) is identifying the stakeholders, and then defining the impact measures. The inclusion of numerous stakeholders, as well as their participation in decision-making regarding value creation choices, should in fact ensure that their right to be informed about issues and conditions that impact on their well being is respected (Perdan, 1998).

3. A SIA MODEL FOR REMANUFACTURING

On the base of what discussed in Section 2, SIA should focus on (positive and negative) outcomes that originate from the social interactions between the manufacturing firm and its stakeholders. In particular, a SIA model for remanufacturing should allow addressing any social benefits generated by the economic activities stemming from the remanufacturing of some EoU/EoL goods. This should in particular evaluated in comparison to the benefits connected to a large-scale, and thus presumably more automated and standardized, production of the same (new) goods. On the base of the literature review presented in Section 2, this model should include at least two different stakeholders, namely the provider's and the customer's personnel. Regarding the provider's personnel, it is in fact said that a peculiar characteristic of remanufacturing is the need for highly qualified workforce to perform those labour-intensive and heterogeneous activities that realising remanufactured products requires (Stahel, 2016). This also complies with the fact that in service-based business, workforce are cornerstone of service quality and customer satisfaction (Chou et al., 2015). Instead, with customer's personnel we mostly refer to the end-users of remanufactured goods. In fact, it is said that the success of remanufacturing initiatives is strongly affected by the perception of the quality differences between new and second-life goods (Hubbard, 2009). Achieving customer satisfaction with remanufactured products that are core of advanced services is therefore an additional challenge of servitization strategies, that by their nature are customer-centric (Rapaccini & Adrodegari, 2022; Chou et al., 2015). The rest of this section explores in details the social attributes of the mentioned stakeholders categories. In particular, from the provider's side we consider: a) the opportunities for job creation and b) the impact on health and safety conditions. On the other hand, we focus on those interactions that affect - positively or negatively - the satisfaction of end-users. We can assume that these implications originate in the form of benefits that can be achieved, and/or costs that the user incurs into, from accessing/using a remanufactured products. These in fact could have lower rather than same quality of brand new products.

3.1 Job Creation opportunities

It is said that remanufacturing implies frequently highly skilled manual activities, that can hardly be automated. Therefore, remanufacturing involves often the creation of new jobs (Goodall et al., 2014;

Parkinson & Thompson, 2003). Clearly, this should be evaluated in the entire value chain to which the provider of the remanufactured goods belongs. This aspect takes relevance the more we fear job losses due to automation and Industry 4.0 breakthroughs (Grybauskas et al., 2022; Tsunetomo et al., 2022). Other opportunities for job creation originate from the supply of components and parts for remanufacturing. In remanufacturing, these flows are more heterogeneous and fragmented (Accenture, 2014). Therefore, supply chains for remanufacturing could involve more firms than just few large-scale first-tier suppliers. Last, return logistics is based necessarily on infrastructures that require additional personnel, for instance for pick and return activities, in particular to collect geographically dispersed 'cores' from the customers' premises. Some additional personnel, analogously, would be required also for interacting with customers, for instance to provide support about the ways for returning EoU/EoL products (Nasr et al., 2018). Last, some studies point out that local communities would mostly benefit from jobs creation connected to the offering of advanced services based on remanufactured goods, as there would be incentive and cost-saving to active service shops locally, close to the installed base (Sistemiq, 2021).

3.2 Impacts on health and safety conditions

Goodall et al. (2014) claim that the impact on health and safety conditions should be carefully assessed, due to the greater amount of manual labour of remanufacturing in comparison to the production of new goods. Indeed, remanufacturing processes expose workers to particular safety risks, such as potential hazards in the disassembly process (e.g. in the case of spring-loaded parts), or close contacts with hazardous substances (e.g. chemicals, oils) (Presley et al., 2007).

3.3 Customer satisfaction

Dowlatshahi (2005) emphasises the fact that remanufactured products should fulfil customer's needs such as brand new products. To this aim, it's crucial the quality perceived by customers of both remanufactured products and the related services (Chou et al., 2015). The meaning of quality differs among the circumstances where quality is discussed (Forker, 1991). In particular, it is said that there are five approaches according to which the definition of quality differs (Garvin, 1984): the transcendent approach, in which quality means innate excellence; the product-based approach, in which quality is viewed as a precise and measurable variable; the user-based approach, in which quality is a subjective measure dependent on the needs of the customer or end-user; the manufacturing-based approach, in which quality is related on compliance to standards or requirements connected on engineering and manufacturing practices; value-based approach, which views quality as function of the price. Despite the different meanings attributed to the concept of quality, scholars have identified sets of dimensions that cut across the different approaches (Hazen et al., 2017). Garvin's eight-dimensional framework (Garvin, 1984) is the most popular set of dimensions in the literature and consists of the following dimensions (Sebastianelli & Tamimi, 2002; Yarimoglou, 2014): performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. These eight dimensions can be used to explain the difference between different approaches in defining the term quality. For example: *'the product-based approach focuses on performance, features and durability; the user-based approach focuses on aesthetics and perceived quality; and the manufacturing-based approach focuses on conformance and reliability'* (Garvin, 1984, p. 33). Starting from the latter model, some authors have identified four dimensions with regard to the quality perceived by customers for remanufactured products compared to new products (Hazen et al., 2017; p. 722): *'Lifespan: amount of use before product failure or degradation severe enough to warrant obsolescence; features: degree to which secondary operating characteristics are within standards; performance: degree to which primary operating characteristics are within standards; serviceability: speed and ease of repair'*. It is important to emphasise that the comparison between remanufactured and new products will not concern the objective quality but the quality perceived by customers. As evidenced by the above definition of remanufacturing, the quality of remanufactured products should be equal or superior to that of new products. But the information asymmetries created between the actors in the ecosystem of a remanufacturing process may prevent end-users

from perceiving such "as new" condition (Hazen et al., 2017). In general, information asymmetries are created when the supplier/seller has more information about the quality of a product or service than the end user/buyer (Mishra et al., 1998). In particular, quality information gaps that are created within the remanufacturing ecosystem fall under the phenomenon known as Adverse Selection, which describes all situations in which quality uncertainty exists despite the fact that unobservable quality does not change from one transaction to the next (Mishra et al., 1998).

As mentioned before about the customer satisfaction, it is crucial that the services for returning EoU/EoL products have adequate quality (Opresnik & Taisch, 2015). To this regard, some authors suggest the use of service quality models such as SERVQUAL (Parasuraman, 1988). In general, the attributers that should be considered pertain to the following categories (Yarimoglu, 2014): a) Physical environment, such as facilities, equipment, and visible appearances; b) People mindsets such as responsiveness, courtesy, capacity to inspire trust and confidence, empathy; c) Abilities, such as skills to obtain the promised outcome in a way that is dependable, reliable and accurate.

Finally, another aspect to be considered with regard to customer satisfaction in the offering of advanced services based on remanufactured products concerns safety issues. In fact, provided there are no rules forcing OEM's to adapt second-life products and make them comply with new quality standards and regulations, remanufacturing could also produce an increase of old but still usable products, and these could have lower safety standards and reliability and higher risks.

4. CONCLUSIONS

This article is motivated by the increasing attention that the social dimension of sustainability is receiving among academics and companies, also in view of the upcoming new criteria required by the European Commission in corporate reporting of sustainability information (Goodall et al., 2014). However, there is a lack of tools for measuring social aspects due to the difficulty in assessing and measuring interactions between companies and stakeholders (Halme et al., 2006). Therefore, the objective of this research is the development of a model for assessing the social impact of remanufacturing with advanced services. This paper in particular conceptualizes the stakeholders that need to be taken into account when assessing the social impact, and the attributes that consequently need to be considered. Limitation of this research is that it lacks empirical validation. Next research concerns validating the SIA model in real cases. Some manufacturing companies will be purposively selected on the base of the criteria illustrated in the following box.

Criteria	Options			
Maturity of remanufacturing initiative	Early stage / Conceptualization	Development and Implementation		Well-established
Business Scope (market, scales, ...)	Broad		Narrow	
Perceived Product Quality	Good as new		Not good as new	
Internal drivers	Compliance / Sustainability	Corporate / Finance	Sales / Business Dev.	Aftermarket/Service
External drivers	Regulations	Customers	Suppliers	Local community
Product design	Circular-oriented		Linear-oriented	

Figure 1 -Criteria for case selection

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CAPTURING CUSTOMER UNDERSTANDING WITH THIRD PARTIES IN DIGITAL SERVICITIZATION: RELATIONAL MECHANISMS AND CHALLENGES

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ABSTRACT

Purpose: The advancement in digital servitization enables manufacturers to transform data from their customers' product usage into valuable customer insights. Despite this opportunity, the empirical evidence has shown that manufacturers may struggle in capturing customer understanding (i.e., obtaining and using customer knowledge in service processes) on their own and they need to cooperate with other firms during digital servitization. This study investigates relational mechanisms and challenges of capturing customer understanding in digital servitization.

Design/Methodology/Approach: A qualitative case study was conducted in four large manufacturers that offer complex industrial systems and services to their global customers.

Findings: The findings identify relational mechanisms to capture customer understanding, through considering the scope of the problem and the manufacturer's capability. The findings also reveal relational challenges in capturing customer understanding: industry insights, contractual, operational, and behavioural.

Originality/Value: Capturing customer understanding in digital servitization requires a relational view between the manufacturers and third parties.

KEYWORDS: Digital servitization, Customer understanding, Third party, Relational view

1. INTRODUCTION

Digital servitization, where value is created through products, services, and software, combines the concepts of servitization and digitalisation (Kohtamäki et al., 2019). It is a challenging transition for manufacturers, but essential for future competitiveness (Huikkola et al., 2020). Previous research calls for a value-system perspective in digital servitization, not only firm-centric research (Kohtamäki et al., 2019). While digital servitization emphasises value creation for the customers, manufacturers may need to cooperate with other firms during digital servitization (Momeni et al., 2023). There is a need for more knowledge on how manufacturers capture customer understanding in collaboration with third parties in the value chain during digital servitization.

In this study, customer understanding is seen as a firm's capability to use customer knowledge in service processes. The literature defines customer knowledge to be more than a firm's knowledge about customer needs and it is generated from customer information assets (Varadarajan, 2020). Understanding of various stakeholders' interests in the customer organisation, customer's business needs and business model are identified as important (Tuli et al., 2007). As an addition to this existing view, we consider that customer understanding entails awareness of the customer's operational environment and processes. Some digitalisation capabilities, such as analytic capability, enables manufacturers to transform the data from their customers' product usage into valuable customer insights and gain in-depth knowledge of their customers (Lenka et al., 2017).

During digital servitization, manufacturers involve different third parties such as IT suppliers to provide, for instance, access to relevant information (Momeni et al., 2023). Existing literature already acknowledges the importance of third parties in the upstream value chain during servitization (Huikkola et al., 2020). To be able to utilise the capabilities of these firms in digital servitization it becomes necessary for manufacturers to establish closer relationships with these suppliers. However, little is known about the manufacturers' collaboration with their suppliers.

The goal in this study is to identify relational mechanisms and challenges of capturing customer understanding in collaboration with third parties in digital servitization. In this study, 'relational'

concerns the way in which the manufacturer and third parties are connected. To address the above-mentioned research gaps, this study explores (1) How, through what kinds of relational mechanisms, manufacturers capture customer understanding, and (2) what kinds of relational challenges manufacturers face when capturing customer understanding. We concentrate on manufacturers' digital servitization, not servitization generally. The framework developed in this study can assist managers in implementing mechanisms to support the capture of customer understanding with suppliers during the service process.

2. THEORETICAL BACKGROUND

2.1 Customer Understanding in Industrial Service Processes

Manufacturers' offerings are treated as seller-based concepts instead of applying a customer-based view and understanding services value-in-use (Strandvik et al., 2008). In the context of industrial services, customer understanding is addressed through various closely related concepts. Previous research acknowledges end-user's process-oriented and relationship-based services (Oliva & Kallenberg, 2003), customer orientation (Baines et al., 2009), and customer-centricity and identification of customer needs, when manufacturers move towards integrated solutions (Brax & Jonsson 2009). Service business model studies contain a customer relationship element which includes the firm's capability of deep understanding on customer organisation's internal processes, operations, and organisational structures (Kindström & Kowalkowski, 2014). Even though current literature on industrial services discusses customer relationship concepts, specifically customer understanding has gained notably little attention.

Customer understanding is constructed by multiple actors in manufacturing firms through customer touchpoints. Customer experience management literature emphasises the importance of customer touchpoints and their complex nature in a business-to-business service context (Zolkiewski et al., 2016). Manufacturers' customer touchpoints involve different actors from the supplier and customer organisation, may evolve over time, and may be controlled by the supplier, third party, or customer (Witell et al., 2020). There are multiple actors involved during the industrial product-service systems' operational life in the customer relationship and digital solutions bring a new channel to this interaction process (West et al. 2020).

Manufacturers can capture customer understanding during service development, sales, and delivery phases (Kindström & Kowalkowski, 2014) and use different mechanisms to construct the customer understanding during these phases. In this paper, our focus is on the service delivery phase. Table 1 shows examples of mechanisms manufacturers use to capture customer understanding in the different service process phases. The previous studies mainly discuss the importance and effects of customer participation in new service development (Alam, 2002; Edvardsson et al., 2012; Johansson et al., 2019), and the changes and tools needed in manufacturer's sales function when moving from products to services to be able to construct an understanding of the customer's processes and operations (Kindström et al., 2015; Ulaga & Loveland, 2014; West et al., 2020). While some previous studies acknowledged the criticality of customer understanding and identified enablers needed to capture customer understanding in service delivery phase (Baines et al., 2013; Goh & McMahon, 2009; Lenka et al., 2017; Momeni & Martinsuo, 2018), there is a need for more knowledge concerning the mechanisms applied by manufacturers to use customer understanding in the service process. In the service delivery phase, the ICT capabilities, such as monitoring, enable manufacturers to capture data from customer product usage and processes (Baines et al., 2013) and transform this data into a valuable customer insight (Lenka et al., 2017). Also, the utilisation of in-service knowledge, referring to the use of operational information and experiences by service personnel, enables continuous service improvements if service personnel have an incentive to capture this information (Goh & McMahon, 2009).

Compared to traditional servitization, in digital servitization software components serve as an enabler for capturing the value from customers (Kohtamäki et al., 2019) and therefore bring new possibilities for manufacturers to also capture customer understanding. Manufacturers' installed product base serves as a data source to analyse customer processes and service opportunities

(Kindström & Kowalkowski, 2014). Product usage and customer process data offer manufacturers an important customer insight (Lenka et al., 2017), but manufacturers must also know how to utilise the installed-base data in their service processes. A manufacturer may utilise the data to develop new solutions or to develop internal operations' efficiency (Huikkola & Kohtamäki, 2017). Also, the knowledge from their customers' operations and performance can be used to customise a manufacturer's services (Momeni & Martinsuo, 2018). To be able to grasp these opportunities, manufacturers often need to involve third parties and acquire digital capabilities through collaboration with different technology and knowledge-intensive suppliers (Momeni et al., 2023; Rapaccini et al., 2023).

Table 1. Mechanisms Used by Manufacturers to Capture Customer Understanding

Service process phase	Examples of mechanisms in different service process phases	Example of sources
New service development	Customer involvement - <i>User interviews, user visits and meetings, brainstorming, user observation and feedback, group discussions</i>	Alam (2002) Edvardsson et al. (2012) Johansson et al. (2019)
Service sales	Acquiring new customer-focus competencies, involving new stakeholders from customer and vendor organisation for the sales process, visualising customer process and touchpoints - <i>Establishing connections to new key customer contacts, customer journey mapping</i>	Kindström et al. (2015) Ulaga & Loveland (2014) West et al. (2020)
Service delivery	Utilisation of ICT capabilities such as remote monitoring, service in use information capture by service personnel - <i>Capturing the data, transmitting to communicate the data, storing to maintain the data, data analysis to transmit the data into information and respond to establish needed actions, capturing service in-use information by service personnel</i>	Baines et al. (2013) Goh & McMahon (2009) Lenka et al. (2017) Momeni & Martinsuo (2018)

2.2 Involvement of Third Parties in Manufacturers Digital Servitization

Digital servitization requires new capabilities from manufacturers (Lenka et al., 2017) and often the needed resources and capabilities are managed by different firms in a business network (Töytäri et al., 2018). Lenka et al. (2017) have identified the following digitalisation capabilities in their study which manufacturers need to develop for digital servitization: intelligence capability, connect capability, and analytic capability. Also, Töytäri et al. (2018) have identified the importance of complementary capabilities as an enabler in digital transformation. Momeni et al. (2023) reveal capability building mechanisms for digital servitization in their study: learning, building, and acquiring. Both building and acquiring mechanisms imply the involvement of third parties, whereas learning may occur in-house (Momeni et al., 2023). Thus, to grasp the new opportunities offered by digitalisation, external partnerships in the supply chain play an essential role (Chen et al., 2021) since third parties, such as IT suppliers, often own the needed capabilities. During servitization manufacturers need to re-position themselves downstream in the supply chain and at the same time develop coordinating mechanisms for a reliable supply base (Huikkola et al., 2020).

Current literature indicates that manufacturers need closer collaboration with suppliers in digital servitization (Sklyar et al., 2019). Partnering with, for example, knowledge-intensive firms can support manufacturer's digital servitization journey, such firms may even act as orchestrators in the ecosystem, and collaboration with these firms may even be a key element in manufacturers' digital servitization (Rapaccini et al., 2023). Also, it has been identified that collaborative strategic partnerships in the supply chain mitigate the manufacturer's risks related to the implementation of advances services (Bigdeli et al., 2018). Traditionally upstream firms, especially IT suppliers, have been treated as outsourcing partners, or sometimes even as a competitor risk (Sklyar et al., 2019), referring to transaction-based relationships between the manufacturer and suppliers. The relationships between manufacturers and their suppliers evolve during digital servitization and manufacturers should

establish closer partnerships with selected IT suppliers to support the transformation (Bigdeli et al., 2018; Rapaccini et al., 2023; Sklyar et al., 2019).

A relational view of competitive advantage emphasises the importance of interfirm knowledge sharing routines, complementary resources, effective governance, and relation-specific assets (Dyer & Singh 1998). Previous studies in digital servitization identified the importance of a relational view on the transformation process in digital servitization (Kamalaldin et al., 2020). However, these studies have mainly focused on the manufacturer-customer relationship and identified different relational governance approaches between the manufacturer and customers (Kamalaldin et al., 2020; Sjödin et al., 2019). We lean on the relational view (Dyer & Singh, 1998; Kamalaldin et al., 2020) and contribute by revealing the relational mechanisms manufacturers use when capturing customer understanding in collaboration with third parties and identifying relational challenges.

3. RESEARCH METHODOLOGY

A qualitative case study was conducted in four large manufacturers that offer industrial systems and services to their global customers. The companies were selected based on the increased importance of services in the firm's offering, extensive effort in promoting digital servitization, and active use of third parties such as software suppliers in advancing digital servitization. Fictional names – Intelligent automation, Global Mining, Industrial solutions, and Lifting technology – have been used to maintain anonymity. Table 2 shows some background information of the case companies and interviewees.

Table 2: Background information of the case companies and interviewees

Company	Industry	Net sales	Employees	Interviewees
Intelligent automation	Automation solutions	~ €3,1 M	~ 450	Head of service product management, Head of service business development, Head of field service
Global mining	Mining equipment	~ €306 M	~ 1,400	Head of services business, Director of service solutions, Director of technology, Solution architect
Industrial solutions	Industrial equipment	~ €3 B	~ 13,000	Head of industrial internet, Head of service development, Director of life cycle services
Lifting technology	Heavy lifting equipment	~ €3 B	~ 3,000	Head of digital experience and business design, Digital portal manager

The main sources of data were semi-structured interviews and public documents. The interviewees ranged from top-level executives to mid-level managers who were actively involved in digital servitization. In total, 12 interviews were conducted and lasted between 45–90 minutes. The interview questions were designed to understand the participants' perspectives on digital servitization, including their experiences and challenges in collaboration with third parties.

The interviews were audio recorded and transcribed verbatim. Data analysis was done through thematic coding and cross-case tabulation to identify patterns and themes across the data. The coding process involved identifying key mechanisms to capture customer understanding in collaboration with third parties. Through pattern analysis, these mechanisms were mapped into two dimensions, namely the scope of the problem and the manufacturer's capability (Figure 1). Key challenges were identified in manufacturers' relationships with third parties in capturing customer understanding: industry insights, contractual, operational, and behavioural challenges. Cross-case tabulation was used to compare the findings across the four cases, which allowed for the identification of similarities and differences.

4. FINDINGS

Interviewees emphasised obtaining and using customer understanding for tailored and effective services. Traditional methods such as collaborating with different internal and external actors are still in use, but interviewees highlighted the importance of digital and analytical tools, such as data analytics to understand customer operations, digital tools for analysing service usage and performance, remote monitoring, and hiring knowledge-intensive business firms. To be able to do that,

case companies need to collaborate with third parties such as IT suppliers. The findings first explore the relational mechanisms between the manufacturers and third parties, and then introduce relational challenges in capturing customer understanding.

4.1 Manufacturer-Third Party Relational Mechanisms for Capturing Customer Understanding

To capture customer understanding, the manufacturers had to collaborate with different third parties; they employ various mechanisms to accomplish this. A framework was developed to differentiate between these mechanisms (Figure 1). The framework maps the mechanisms based on the scope of the problem being addressed and the manufacturer's own capabilities. The scope of the problem refers to the level of uniqueness involved in addressing the customer understanding needed. For example, a narrow problem may require creating unique solutions, while a broader problem is a common problem that can be seen in different industries. The manufacturer's capabilities refer to the level of resources and expertise available to the manufacturer to capture customer understanding. This can include factors such as the availability of internal resources, financial resources, and technical expertise.

Mechanisms are grouped into three categories based on the level of third parties' involvement: in-house, collaborative, and sourcing mechanisms. *In-house mechanisms* rely on internal resources to obtain and use customer understanding. For example, Lifting technology uses remote monitoring of customers' operation and discussing with internal and external knowledgeable informants to better understand the customer's process and needs for repair and maintenance service processes where they can rely on their extensive knowledge and capabilities. Collaborative mechanisms involve working with external parties. *Manufacturer-led collaborative mechanisms* can include joint projects with IT suppliers, academic institutions, or collaborations with other knowledge-intensive business firms on a need basis. For example, Industrial Solutions, which has developed a good level of data analytics over time, has been involved in joint projects with IT suppliers to use data analytics in certain customers' operations. *Third party-led collaborative mechanisms* involve working closely with IT suppliers and knowledge-intensive business firms where the third party oversees capturing customer understanding in service processes. Global mining, who does not have enough resources and infrastructure to develop digital servitization, has collaborated with various IT suppliers to develop and use digital tools for analysis of service usage rate and service performance and decision-making about further development. *Sourcing mechanisms* involve acquisition of external resources to capture customer understanding. Intelligent automation that has not been successful in maintaining and upgrading digital solutions, has hired consultants to interview customers and develop research methods to be further applied by the company.

Manufacturer's capability	High	Manufacturer-led collaborative mechanisms e.g., Using data analytics to understand customer's operation; Collaborating with different actors (e.g., customer, business units, local sales, service unit, product management, etc.)	In-house mechanisms e.g., Remote monitoring of customer's operation; Discussing with internal and external knowledgeable informants to better understand the customer's process and needs
	Low	Third party-led collaborative mechanisms e.g., Using digital tools for analysis of service usage rate and service performance and decision-making about further development	Sourcing mechanisms e.g., Hiring consultants to interview customers or use other research methods
		Narrow	Broad
Scope of the problem			

Figure 1: A summary of key relational mechanisms for capturing customer understanding

4.2 Third-Party Relational Challenges in Capturing Customer Understanding

Manufacturers faced several challenges in their relationships with third parties in capturing customer understanding: industry insights, contractual, operational, and behavioural (Table 3). *Industry insights challenges* involve understanding manufacturer's industry and processes, as well as the customers' operations. *Contractual challenges* refer to ownership, intellectual properties, earnings, and confidentiality. *Operational challenges* include understanding the customers' complex organisational

structures, communications, and project management, managing customer interface, and knowledge transfer and retention. *Behavioural challenges* involve establishing trust, remote connection, and ensuring the availability of the right skills.

Table 3: Challenges faced by case companies in their relationships with third parties

	Intelligent automation	Global mining	Industrial solutions	Lifting technology
Industry insights challenges				
- Understanding industry and processes	X	X	X	X
- Understanding customers' operation processes	X	X	X	X
Contractual challenges				
- Solution ownership	X	X		
- Intellectual properties	X	X		
- Earning logics		X		
- Confidentiality			X	X
Operational challenges				
- Understanding the customers' complex organisational structure	X			
- Communications and project management	X		X	X
- Managing customer interface	X	X		
- Knowledge transfer and retention	X	X		
Behavioural challenges				
- Enabling remote connections	X	X		
- Establishing trust	X			
- Availability of right skills				X

Table 3 shows that companies face similar challenges in all four categories, with varying difficulty. Industry insights challenges are common in all manufacturers when collaborating with third parties, such as IT suppliers who may not fully understand the manufacturer's industry and processes, and customers' operations. Thus, efforts must be made to understand partners' strengths and weaknesses and provide support to enhance their knowledge and skills.

Regarding contractual challenges, Intelligent automation and Global mining face challenges with solution ownership and intellectual property. Industrial solutions and Lifting technology are more advanced in digital servitization and have addressed these issues in partnership agreements. Global mining faces challenges with earning logics, which refers to revenue-sharing agreements or other financial arrangements. Industrial Solutions and Lifting technology face challenges with leaking customer knowledge and sensitive information. Thus, proper data security measures, confidentiality agreements and employee training are essential.

Regarding operational challenges, Intelligent automation, Industrial Solutions, and Lifting technology face difficulties with communication and project management with their third parties, resulting in delays, miscommunication, and lower-quality outputs. Intelligent automation and Global mining struggle with managing customer interface and to have a shared view about the customer's needs. These two manufacturers also struggle with sharing of information and insights across teams and with third parties. Intelligent automation, who serves various industrial customers, faces additional challenges with third parties understanding the organisational structures of various customers, resulting from a lack of communication or third party's inadequate market understanding.

Regarding behavioural challenges, Intelligent automation and Global mining face challenges in understanding and adapting to customer behaviour that enables remote connections. Not all customers are willing to facilitate remote connections, specially concerning the connection and communication with third parties. In connection with the previous challenge, Intelligent automation struggles in creating and retaining customer trust in third parties. Industrial Solutions faces a challenge

in ensuring that the right competencies are available in the right place and at the right time. Not all third-party partners have the expected commitment to provide the necessary skills and knowledge to deliver high-quality outputs.

5. DISCUSSION

The first research question investigates relational mechanisms between manufacturers and third parties to capture customer understanding. The findings are framed as four mechanisms: In-house, sourcing, manufacturer-led collaborative, and third party-led collaborative mechanisms. The study complements previous studies of digital servitization, which have mainly focused on the new service development phase and especially customer participation as a mechanism (Alam, 2002; Johansson et al., 2019) for capturing customer understanding, through emphasising the importance of capturing customer understanding in the service delivery phase. This study acknowledges the utilisation of ITC capabilities to capture customer understanding (Baines et al., 2013), and the findings further show that the manufacturers use a selection of mechanisms in relation to the scope of the problem and the manufacturer's own capabilities.

The findings of this study confirm the importance of third parties in digital servitization (Momeni et al., 2023; Sklyar et al., 2019) and show that three of the capturing mechanisms involve third parties and one of them is even third party-led mechanism. The previous study acknowledged the need for a variety of capabilities in digital servitization that are not necessarily possessed by the manufacturers (Lenka et al., 2017). While our findings acknowledged the capability level as one dimension, they show that the scope of the problem also determines the choice of mechanisms. A narrow scope that indicates the uniqueness of the problem demands more collaborative mechanisms with third parties. However, for problems that have a broader scope, the manufacturer may use either internal or external resources to address the need and thus decrease the collaboration costs and challenges.

The second research question investigates the relational challenges in capturing customer understanding. The findings complement the discussion on the relational view in digital servitization that focuses on the manufacturer-customer relationship (Kamalaldin et al., 2020; Sjödin et al., 2019), in this case by offering new insights on the manufacturer-third party relationship and challenges they face in capturing customer understanding. The findings confirm prior research that proposes the need for a suitable governance approach and knowledge sharing routines between different actors (Kamalaldin et al., 2020). However, the findings reveal that capturing customer understanding with third parties such as IT suppliers create a more extensive range of challenges than for customer relationship, including industry insights, contractual, operational, and behavioural challenges.

6. CONCLUSIONS

The findings of this study identified the relational mechanisms for capturing customer understanding in the service delivery phase and the importance of considering the manufacturer's own capabilities and the scope of the problem, and thereby adds to the current understanding (Baines et al. 2013; Goh & McMahon 2009; Lenka et al. 2017; Momeni & Martinsuo 2018). Our findings reveal the increased application of data analytics and digital tools in analysing customers' processes and decision-making, which in turn highlighted the role of third parties in capturing customer understanding. Moreover, this study contributes to the existing literature on the relational view of digital servitization (Kamalaldin et al., 2020; Sjödin et al., 2019) by identifying the challenges faced by manufacturers when capturing customer understanding in collaboration with third parties. There is a need to consider not only the governance approaches but also other relational aspects such as industry insights, contractual, operational, and behavioural challenges.

While advances in digital technologies allow manufacturers to capture huge equipment and customer operation data, manufacturers often need to collaborate with third parties to enable capturing customer understanding. The relational mechanisms framework could help manufacturers to choose an appropriate mechanism and address the specific problem at hand, while also considering

their own capabilities and limitations. The findings of this study indicate that manufacturers require a robust plan to overcome relational challenges. This requires investments in developing knowledge management systems and training programs, building long-term relationships with third-party partners, proper contract management, and data security measures.

A case study with a limited number of companies limits the generalisability of the findings. This study took the manufacturers' perspective, but it would have benefited from additional data from third parties and customers. Further research should investigate the relational mechanisms in a triadic setting to deeper understand the roles, relationships, and challenges between the manufacturers, third parties, and customers. Further research should also explore how the relational mechanisms evolve over time.

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HOW CAN SMALL INNOVATIVE FIRMS SUCCESSFULLY SCALE DIGITAL SOLUTIONS IN TRADITIONAL INDUSTRIES?

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ABSTRACT

Purpose: Small innovative firms hold a privileged position to leverage the opportunities for growth emerging through the evolution of digital technologies. However, even though their agility, the commercialisation of digital solutions is not exempt of challenges. The purpose of this study is to explore how ecosystems can be leveraged as a strategy for successful scaling, identifying the underlying configuration of activities deployed by small innovative firms in traditional industries.

Design/Methodology/Approach: A qualitative multiple-case study of 5 small innovative firms operating in the manufacturing, mining, and processing industries is used to investigate the scaling of digital solutions. The study builds on 10 exploratory semi-structured interviews with 7 key informants.

Findings: Partnering, standardisation, and alignment are identified as the configuration of activities underlying the ecosystem strategy for the scaling of digital solutions in traditional industries.

Originality/Value: We focus on an underexplored area in the literature, the scaling of digital solutions. This study extends current knowledge in the commercialisation and expansion of digital solutions, moving beyond initial market penetration and into market growth. In addition, by focusing on small innovative firms' perspective, this study brings forward an undermined actor in the literature uncovering their importance for the digital transformation of traditional industries.

KEYWORDS: digitalization, scale-up, SME, ecosystem

1. INTRODUCTION

The evolution of technologies is opening new avenues to operate and compete in the market. Small innovative firms hold a privileged position to leverage the benefits of the digital transformation (Bustinza et al., 2018). Their agility and innovativeness open growth avenues through new relationships and sources of revenue. Indeed, small firms are aiming to become a driving force in the transformation through the scaling of the latest wave of digital solutions in traditional industries (Kolagar et al., 2021). Despite the disruptive potential of new technologies and its applications (Bughin, 2017), moving beyond initial market penetration and into the scaling of digital solutions is not exempt of challenges.

In this context, joining forces with other industry actors in an ecosystem, such as established large corporations or infrastructure providers, emerges as an effective path for smaller firms (Kolagar et al., 2021). The Swedish firm Mobilaris AB represents an example of how to penetrate and scale situational software solutions in the mining industry, rapidly gaining customer reputation and legitimacy, leading to its full acquisition by established equipment manufacturer Epiroc AB (2021). However, little is known regarding how firms can leverage ecosystems to scale digital solutions, leaving many questions still unanswered.

First, there is a lack of understanding regarding how to exploit the opportunities that ecosystems provide to enhance the scalability of digital solutions in traditional industries. Studies examining ecosystems tend to focus on digital solution co-development and provision (Dalenogare et al., 2023; Skylar et al., 2019), limiting our ability to assess its effectiveness in the scaling phase of the journey. Second, firms need to select the best way to configure activities and allocate resources to enable scalability (Piaskowska et al., 2021). This task is even more complex for small innovative firms, whose size and capacity can constrain the choice of alternative configurations. This highlights the importance of understanding how firms deploy specific activities in their ecosystems to enhance the scaling of digital solutions.

The purpose of this study is to explore how ecosystems can be leveraged as a strategy for successful scaling, identifying the underlying configuration of activities deployed by small innovative firms in traditional industries. In doing so, we focus on an underexplored area in the literature, the expansion of digital solution commercialisation beyond initial market penetration.

2. THEORETICAL BACKGROUND

2.1 Scaling Digital Solutions in Traditional Industries

This study belongs to the literature stream examining the commercialisation and expansion of digital solutions (Kolagar et al., 2021; Linde et al., 2023). In particular, we focus on scaling as the phase beyond initial market penetration and into market growth. Prior research has provided us with an understanding of the outcomes and drivers to pursue the scaling of digital solutions (Kohtamäki et al., 2020; Coreynen et al., 2020). However, little is known about how firms successfully scale in traditional industries, where innovative solutions are faced with higher levels of uncertainty and lower legitimacy.

The intangible nature of solutions together with the lack of prior experience of traditional industry customers with new technologies represents a barrier to the commercialisation of new digital solutions (Linde et al., 2023). The need for understanding of scaling is even more relevant for smaller firms, where the liability of newness and smallness increases the complexity to succeed in such endeavour (Gimenez-Fernandez et al., 2020). For instance, the implementation of digital solutions tends to take place in the wider scope of large industry projects putting their size and limited resources under further scrutiny.

Some studies have established a connection between scaling and ecosystems in the context of digital solutions (Kolagar et al., 2021; Sjödin et al., 2021), providing a starting point for the exploration of scaling in traditional industries. While we can agree that ecosystems provide an opportunity for firms to accelerate the capture of value from digital solutions, further research is needed to understand how firms exploit the potential of ecosystems to scale. We build on the configurational aspect of scaling to expand our understanding (Piaskowska et al., 2021), and uncover the underlying activities deployed to leverage the ecosystem.

3. METHOD

An exploratory multiple case study of 5 small innovative firms pursuing the scaling of particular digital solutions in traditional industries (i.e., manufacturing, mining, processing) is developed. The aim is to identify the underlying activity configurations deployed to leverage ecosystems for successful scaling in the firms' real-life and unaltered context (Yin, 2014).

Table 1. Key informants and interviews

Firm	Digital Solution	Traditional Industry	Informant(s) and number of interviews
Firm A	Warning and deviation software system	Mining Industry	Chief operating officer (2)
Firm B	Automation equipment and integration solutions	Manufacturing Industry	Chief technology officer (1)
Firm C	Data management and visualization solutions	Mining Industry	CEO & Co-founder (1) Chief operating officer (2)
Firm D	Information handling and interoperability solutions	Process Industry	CEO & Co-founder (3) Business Development (3)
Firm E	Mass customization software	Manufacturing industry	CEO & Founder (2)

Semi-structured interviews with key informants (i.e., CEO and top management) were carried out and secondary data was used for triangulation of insights. Table 1 provides a summary of case firms and informants. Data analysis followed an interpretive and iterative process identifying within and cross-case patterns. Several coding strategies were used to refine and combine information regarding activity configurations and its implications for successful scaling. Validity was enhanced through the presentation of insights to informants demonstrating the trustworthiness and foundations of the findings.

4. FINDINGS

The ecosystem strategy comprises three main set of activities, namely partnering, standardisation and alignment. This configuration of activities explains how small innovative firms leverage ecosystems to scale in traditional industries by growing the customer base, configuring the digital solution, and expanding the ecosystem.

4.1 Partnering Activities Accelerate Growth of Customer Base

Partnering activities refer to actions aimed at specific actors in the ecosystem that the firms deploy to **accelerate the growth of their customer** base in traditional industries. Partnering activities pointed to the relevance of industry ambassadors, global consultancies, and established suppliers to scale digital solutions.

Leveraging on industry ambassadors (i.e., well-known and reputed customer-facing actors) enable small firms to gain global legitimacy and brand awareness through referrals and digital solution positioning. For instance, the CEO & Founder of Firm E explained how their commercialisation process have shifted to inbound traffic after being featured as part of a global systems provider modules:

"We get requests from partners because [customers] find us together with other systems. [...] partnering up with others' modules has been the success factor for us [...] we actually swapped the whole process. Before last year we were the one driving sales usually. Last year, the majority of the customers came to us. Like we had only inbound bound traffic instead of we doing the calls, visiting, trying to grow, and that meant that during last year we doubled the number of [customers]."

Becoming a sub-supplier of established customer-facing organisations was identified to accelerate sales in traditional industries. This partnering activity was particularly beneficial with large customers reticent to work with innovative firms.

Lastly, **cascading customer training and education** through **global consultancies** was seen to ensure an effective implementation of the digital solution in traditional industries. The CEO & Founder of Firm E highlighted the importance of teaching consultancies about the digital solution to mitigate customers' lack of readiness and scale implementation in the industry:

"And then we have the implementation partners, which are all the consultants who work with change in the industry. [...] those we try to teach because they can go out and teach [...] they will scale that into the industry [...] So we tried to solve this teaching problem by teaching the right people and they can go do it."

4.2 Standardisation Activities Support Configuration of Digital Solution

Standardisation activities refer to actions aimed at simplifying the **digital solution** integration, development, and visualisation in the ecosystem that the firms deploy to support its **configuration** in traditional industries.

A **lack of user interface** allows **brand agnostic and seamless integration** of the digital solution with partners in the ecosystem. The Chief operating officer from Firm A explained their choice to not have an interface as their goal is for other companies to integrate products and services with their software becoming part of wider industry systems and solutions:

"So the software is available globally, but other companies will use our software to solve customer problems [...] There's no user interface there. It's only a configuration interface when you set up the software [...] we want partners and other organizations to take this in their hands [...] so other companies can develop products based on this. [...] you can create a lot of solutions based on that."

Relying on **open-source software** allows flexible **development of extensions and functionalities**. While some things are packaged behind the solution, open-source allows to continuously change and add value-adding features over time motivating its tailored configuration by both partners and customers in the ecosystem.

Optimising the software set-up allows **visualisation** of return-on-investment reducing the uncertainty associated with the innovativeness of the digital solution. The CEO & Founder of Firm E explained their journey towards standardised practices as a way to scale. For instance, set-up optimisation reduces the digital gap with traditional industry customers through real-time demos:

"We are doing less and less customization. Because that's one of our ways to scale. It's to make sure that whatever we do is standard [...] And we actually have optimized this, [...] we often have a demo with us to the first meeting. [...] We can be very concrete like, it's not abstract, what you're buying will look like this, then you just add the details. [...] We worked really hard to shorten this uncertainty gap to take the step into the digital world."

4.3 Alignment Activities Enable Ecosystem Expansion

Alignment activities refer to actions aimed at fostering joint competitiveness that firms deploy to **enable ecosystem expansion** over time.

Communicating role boundaries promotes collective growth over individual wins reducing opportunistic behaviours in the ecosystem. For instance, the CEO & Founder of Firm E described how they intentionally left out some functionalities to avoid competing with partners in the ecosystem:

"We've been very clear what we're not doing. Then the other systems don't feel threatened that we are competing with them. Because it's so easy to just keep adding functionalities [...] But then we would start messing with [partners] [...] And something that's really strange because we could sell more of course, but that keeps us focused and it helps building the ecosystem."

Bouncing customers between partners streamlines processes increasing leads in the ecosystem. Being aware of the skills available in the ecosystem enables small firms to focus on their strengths while providing leads to the right partner to take over specific processes.

Pursuing modularity increases back-end and front-end integration opportunities in the ecosystem. The Chief operating officer from Firm A highlighted the need to adopt modular solutions in favour of scalability:

"So maybe the industrial customer, they will never know we exist because we can be the module of a bigger system. [...] I think more companies need to think about that someone can be in the background [...] That's not a problem [...] it's more scalable."

5. CONCLUSIONS

5.1 Theoretical Contributions

Overall, this study advances the literature on digital servitization, contributing to the dialogue on the relevance of ecosystems for the scaling of digital solutions in traditional industries (Sjödin et al., 2021). First, this study complements existent knowledge through the perspective of small innovative firms, answering the call for further research to address different digital solution providers (Linde et al., 2023). While the literature highlights the opportunities for revenue growth emerging through digitalization (Bustinza et al., 2018; Kohtamäki et al., 2020), smaller firms' paths are usually cut short and even driven out of market by more resourceful and well positioned firms. Findings provide a micro-level understanding of activities that such firms can deploy to overcome the liabilities and successfully endure the task of expanding digital solutions in traditional industries.

Second, this study supports the efforts of scholars who have explored the role of ecosystems at different phases in the commercialisation journey (Dalenogare et al., 2023; Skylar et al., 2019), complementing such contributions by focusing on the scaling of digital solutions. We set apart from prior studied ecosystem strategies (Kolagar et al., 2021) to look closely into the underlying configuration of activities deployed to successfully scale. For instance, while customization of solutions is shown to increase value for the customer (Sjödin et al., 2020), we contend that standardisation

activities may become the appropriate scaling path for smaller firms to leverage the potential of ecosystems.

5.2 Managerial Implications

From a managerial perspective, this study's findings provide novel and important implications for practitioners. Practical contributions support managers of small firms to better assess and execute the scaling of their digital solutions. Prioritizing specific activities over others can impact the scaling of digital solutions, and small firms need to be aware of the different trade-offs to effectively configure and deploy the best strategy accordingly. Managers could benefit from our findings to make better-informed decisions regarding the orchestration and allocation of resources in ecosystems to successfully scale digital solutions in traditional industries.

5.3 Limitations and Future Research

This research is not exempt of limitations. Even though the selection of cases is representative of the scaling of digital solutions, findings are limited to the traditional industry where the firms operate. A similar study may be done in this area including small innovative firms from additional industries/markets to complement our findings. In addition, we focused on the ecosystem and its relevance for scaling, but not all small innovative firms may require the same level of external support. Future research could investigate alternative configurations to scaling where small firms leverage their internal resources to expand this study's perspective. Lastly, ecosystems are in continuous evolution and our research only comprises a snapshot of the small firms scaling journey. A longitudinal study could expand our findings exploring the impact of changing actors and ecosystem learnings on the underlying configuration of activities.

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DIGITALISATION – THE INVESTMENT CHALLENGE

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ABSTRACT

Purpose: Although the importance of digitalisation as a critical source of innovation and competitiveness among manufacturers is widely accepted, the manufacturing industry struggles to make the necessary investments to capture these opportunities. This lack of investment threatens the future competitiveness of manufacturing and puts at risk the environmental and employment opportunities that are associated with digitalisation. It is critical to develop a detailed understanding of the digital investment challenges manufacturers are facing to support manufacturers with their digitalisation journey.

Design/Methodology/Approach: This paper outlines the findings of a study that systematically reviews the academic and grey literature to establish what is known on the diverse organisational, technical and process challenges manufacturers are facing with their investment into digitalisation and the good practices that are available to address them.

Findings: The investigation identifies a wide range of core challenges that affect the manufacturers' effective investment into digitalisation; the range of theories and theoretical perspectives that current research apply to guide investigations into effective digital investment decisions

Originality/Value: It also evaluates the current theoretical contributions and gaps in the existing literature to develop a research agenda to help researchers target and accelerate their future investigations on the digitalisation of the manufacturing industry.

KEYWORDS: Digitalisation, investment, business case

1. INTRODUCTION

The success of servitization is dependent on the digitalisation of manufacturing. Digitalisation helps manufacturers to create the insights that are critical for the development of service value propositions and management of the risks of their delivery (Schroeder et al. 2020). Nevertheless, in its current stage the manufacturing industry lags in its digital investments (MakeUK 2020). 94% of UK manufacturers believe their industry lacks digital investment, and 90% consider underinvestment into digitalisation to be the industry's biggest productivity blocker (The Manufacturer 2022).

Although the gap in investment into digitalisation among manufacturers is widely recognised, there is less clarity on its underlying root-causes. As individual studies point to different organisational or technical root-causes (e.g. Kalaitzi and Tsolakis 2022; Rose and Jones 2020), it becomes increasingly clear that the gap is the result of multiple factors. The ability of researchers to understand and support manufacturers with their critical digitalisation journey is an important precondition for large-scale servitization.

To contribute to the development of such a comprehensive understanding, the present investigation set out to i) review and consolidate the current insights on the digitalisation investment challenges of manufacturers and ii) develop a research agenda that stimulates and guides research on it. To account for the diverse range of factors that may impact the investment process the investigation draws on socio-technical (STS) theory (Bostrom and Heinen 1977) as a structuring and sense-making framework. Further, to ensure that the investigation captures the wide range of challenges of digital investments the investigation covers both the academic and grey literature and extends beyond the English language domain by including the Chinese and German language literature.

The investigation identifies a wide range of core challenges that affect the manufacturers' effective investment into digitalisation; the range of theories and theoretical perspectives that current research apply to guide investigations into effective digital investment decisions; and a research agenda to theoretically ground future studies, which supports manufacturers with their investments into their digitalisation journey.

2. CONCEPTUAL DEVELOPMENT

A range of digitalisation definitions have emerged, some of which are overlapping with related concepts (i.e. digital transformation, digitisation). Following Gassmann et al (2014) the present study defines digitalisation as the "ability to turn existing products or services into digital variants, and thus offer advantages over tangible product". The definition identifies digital technology as a prerequisite for digitalisation but focuses on the creation of new business opportunities and roles in the value chain as the focal implications (Parviainen et al. 2017). Digitalisation, in particular, can affect a company's internal efficiency (improved way of working), external opportunities (new business opportunities in existing business domain) and ability for disruptive change (complete change of business roles) (Björkdahl 2020). Its disruptive nature refers to the fundamental changes in the economic value generation within and between firms digitalisation can create (Teubner and Stockinger 2020).

While digitalisation affects all industries, its impact on the manufacturing industry is of particular interest. As manufacturers traditionally focus on physical products, creating value through the use of digital technologies represents a paradigm shift (Lasi et al. 2014). It requires them to effectively exploit new technologies such as machine learning, digital twin, internet of things by changing product designs, customer value propositions and competitive positioning. Importantly, by not participating in digitalisation manufacturers not only risk losing profit-generating opportunities but even their competitive strength (Björkdahl 2020). Digitalisation opens up competition from firms with more asset-light business models leading Björkdahl (2020) to identify a climate of 'Schumpeterian competition' for manufacturers, where threats come from both incumbent firms and firms outside their own industry.

Although the importance of digitalisation for manufacturers has been widely recognised studies confirm their reluctance to make the investments necessary to capture the opportunities (MakeUK 2020; The Manufacturer 2022). To better understand this reluctance the present study investigates *the range of challenges that affect the manufacturer's ability to make effective business cases for investments into digitalisation*.

Studies investigating technology challenges often discuss these in isolation which makes it difficult to understand their interactions, which is required to overcome them (Berghout & Tan, 2013; Chaysin et al., 2016). To address this difficulty the present study draws on a socio-technical systems (STS) theory. STS theory explicitly moves research away from a technology focus and embraces the non-linear, iterative, and context-laden nature of technology implementations (McLeod and Doolin 2012). It conceptualizes technology as part of a complex, socio-technical ensemble, embedded in organisational culture and processes (Orlikowski and Iacono 2001) and has been used in prior digitalisation studies (e.g. Imran et al. 2021; Sony and Naik 2020). While different STS conceptualisations exist, the present study particularly draws on Clegg et al's (2017) STS framework as it provides a particularly wide range of categories to structure the investigation, comprising both socio elements – people, culture, and goals – and technical elements – technology, infrastructure, and processes.

3. METHOD

The study employs a systematic literature review (SLR) method (Denyer and Tranfield 2009) develop the STS perspective on *the range of challenges that affect the manufacturer's ability to make effective*

business cases for investments into digitalisation. The SLR method is recognised for its integration of rigor and comprehensiveness in reviewing literature and is regularly used to investigate literature in related areas (e.g. Matt et al. 2022; Suppatvech, Godsell, and Day 2019). To ensure the appropriate breadth of insights to develop an STS perspective the scope of the present study includes i) academic and business publications, ii) English, Chinese and German-language outputs (to account for the fact that significant advances in digital manufacturing have been made outside the English language domain).

3.1 Academic literature

First, the research team identified the most suitable academic database, EBSCOHost, in the English language domain. Second, the research team developed, refined, and validated the search terms. The initial search and screening of articles enabled us to decide the final search terms as:

- ‘manufactur*’ (to include manufacture, manufacturer, manufacturers and manufacturing)
- AND “invest” (to include investment. In quotation marks to avoid capturing “investigate”, which was an issue noted in this search)
- AND ‘digital*’ OR ‘technolog *’ (as it became apparent from this search that many recent articles implicitly discuss digital when discussing manufacturing technology investments)

To create the Chinese academic catalogue, the research team identified the most appropriate outlets by using the Chinese Social Sciences Citation Index (CSSCI). Applying the same keywords in Chinese in Baidu Academic 百度学术 (one of the largest academic search engines in China) identified 146 articles. One of the team members, as a native speaker in Chinese, screened the articles by applying the same exclusion criteria, which created a final catalogue of 27 Chinese academic papers.

To create the German academic catalogue, the research team sought to identify the most appropriate outlets by using the German Business Scholar Citation Index (Schrader n.d.). The review of the journal list showed that Index largely focused on the same English language journals that were represented and already captured in the Chartered Association of Business Schools (CABS) Academic Journal Guide (AJG) (CABS 2021).

3.2 Business literature

Unlike the academic literature which is catalogued in recognized databases, the business (“grey”) literature lacks a central repository and format. Also, the outlets are not formally ranked as it is the done by the Chartered Association of Business Schools (CABS) Academic Journal Guide (AJG). This lack of central repository and formal ranking is widely recognized as a critical challenge for integrating grey literature into literature review (Adams, Smart, and Huff 2017; Soldani, Tamburri, and Van Den Heuvel 2018). Instead of being able to follow a formal process the consideration of the grey literature in a literature review requires the researchers to apply judgement to apply outlet control and source expertise (Adams, Smart, and Huff 2017).

The team started with searching and identifying the English language grey literature by using the Google web-search, with the use and combinations of keywords, scope limitations, consideration of the outlets and contribution. The keywords included ‘manufacturer’, ‘digital’, ‘investment’, ‘business case’ and ‘financing’. To limit the findings to substantial publications the search was limited to PDF documents and limited to hits that are not older than five years. The search for the English language grey literature led to an initial corpus of 32 publications. The search for the Chinese language grey literature led to an initial corpus of 15 publications of which a final number of 8 publications used in the full analysis. The search for the German language publications led to an initial corpus of 23 publications of which a final number of 9 publications were used in the full analysis.

Following the process of searching and identifying academic and grey literature across three centuries, a final catalogue consists of 99 articles (Table 1).

Table 1. Summary of the academic and grey literature articles

	English	Chinese	German	Sub-total
Academic	37	27	0	64
Grey	18	8	9	35
Sub-total	55	35	9	TOTAL 99

4. THEMES

4.1 Challenges for digital investment

The review examined a wide range of academic and grey literature to identify the factors that are put forward to explain manufacturers' lack of digital investment and the challenges manufacturers face in making effective business cases for digital investment. The in-depth analysis of the diverse challenges that affect digital investment of manufacturers showed that these challenges can be mapped against Clegg et al's STS framework (2017). The framework provides a structure to group the challenges into process/procedure, people, technology, infrastructure/network, goals and culture themes. We explain each of the themes in the following section. A detailed outcome of the literature review with links to the sources is provided here: <https://interact-hub.org/2022/12/12/digital-investment-for-manufacturers-a-literature-review-of-challenges-and-good-practices/>.

Processes/procedures

The process/procedure-category focuses on the challenges related to the actions or steps taken to make digital investment decisions. A core challenge underlying the investment decisions were related to the **selection of measurements** that would guide the investment decision, in particular related to the two aspects of development or choice of measure as well as the application of the measures. While the traditional measures such as return on investments and profitability can hardly be applied to justify the digital implications, systematic digital investment measures have not been identified yet. Further, digital investments are often part of an architecture, which requires a staged **investment process** that builds up the digital architecture and fully unfolds the digital implications.

People

The people-category focuses on the challenges related to the individuals involved in making digital investment decisions. Digital investment is naturally associated with decision-making, in which manufactures find it challenging to establish an **effective decision-making structure**. The challenge starts at the management level as managers fail to recognise the digital opportunities or are incompetent to lead the digitalisation journey. A dominant challenge that lays across the different levels of individuals involved in the digital investment is the **lack of digital skills**.

Technology

The technology-category focuses on the challenges related to the required software and hardware that forms part of the digital investment. Specific challenges identified that fall into this category include the **cost of technology**. Not only face manufactures direct costs including search, purchase, and implementation costs, in which the budget may not be available, but in addition, the cost-challenge is associated with the underlying economy of scale that drives the unit cost. Further, the intrinsic **attributes of digital technology** make it difficult to attract digital investment.

Infrastructure/network

The infrastructure/network -category focuses on the external parties and their resources that forms part of the digital investment process. Digital value creation is not an isolated job. Hence, the network aspects create implications and challenges for the digital investment. Specific challenges identified that fall into this category include the potential shift of manufacturing production away from large-

scale plants to a **network of distributed, smaller scale localised and customisable manufacturing facilities**. Manufacturers who are not familiar with the notion of collaborative manufacturing may find it challenging to work together in the form of synergetic whole with blurred boundaries. Another challenge relates to the **manufacturer's networking capability**. Acquiring, processing, analysing, and capitalising information about market-change through working with suppliers, customers, and partners is important for manufacturers to identify digital opportunities. Investing in digital requires manufacturers to **interact with customers in new ways**.

Goals

The goals-category focuses on the focal direction that drives the digital investment process. The **lack of agreement on digital goals** is a major stumbling block for justifying the business case of digital investment. Decision-makers and managers struggle with defining and agreeing on the goals and scope of the digital change. There are challenges around the **quality of the actual digitalisation goal**. Digital investment requires holistic thinking that consists of several levels like digital strategy, digital business model innovations, and digital technology implementation. Manufacturers put emphasis on the technological goals but ignore the strategic and operational levels that should align with the digital investment. Other challenges are related to **the ambition in the goals**.

Culture

The culture-category focuses on the behaviours, institutions, and norms found in that drives the digital investment process. The lack of top-level **buy-in** as an important barrier to digital investment because when top management teams are less skilled and more conservative about digital investments, this may limit the adoption of digital technologies. At the higher level, leaders are required to have the ability to formulate, communicate, and establish the values, visions, and culture to successfully manage change. The **low tolerance for uncertainty and risk** is a major challenge to making digital investments. It is particularly difficult for manufacturers who traditionally have limited R&D activities to understand and undertake digital projects with high risks. Another challenge that is typical in manufacturers that have limited digital experience is the **lack of trust in digital technologies**. There is an anxiety about the issues of trusting "black box" digital technologies like algorithms. Building the understanding of digital technologies entails a substantial cultural transition.

4.2 Theories & perspectives used

In addition to the core themes illustrating the range of challenges and good practices of digital investment, the review also examined the theoretical perspectives used to drive the investigations (see summary table 8)

Organisational theories

A number of theoretical perspectives that discuss or illustrate the digital investment challenges focus on the social context and its impact on the digital investment.

Resource based view (incl. knowledge-based view). The resource-based view provides a static perspective on the focal resources that enable a firm to achieve a sustainable competitive advantage. The knowledge-based view of the firm identifies the knowledge resource as the most critical among the resources. The resource-based view has been used in several reviewed studies to highlight the importance of the availability of the firm's internal resources in making the most of their digital investments and the need to develop additional resources to compete in the digitalisation process (Felsberger et al. 2022).

Dynamic capability theory. Dynamic capability theory provides a process perspective to illustrate how critical resources are developed and renewed (Wilden, Devinney, and Dowling 2016). Consequently, research draws on dynamic capability theory to understand how manufacturers can effectively align their resource base in order to match the market requirements and hereby draw value from the digital

investments for themselves (Felsberger et al. 2022) and business partners (Gong, Kung, and Zeng 2018).

Organisational boundary theory and value co-creation. Organisational boundary theory provides an essential theoretical lens to investigate the strategic repositioning of manufacturers in the value network. The repositioning is complex and dynamic because the focal firm needs to move the boundaries based on the moves of other firms like partners and competitors. It is an interplay between the manufacture's identity, power, capability, and dependency (Huikkola et al. 2020). Sjödin et al. (2020) proposed an agile co-creation model that provides insights into the phases, activities, and organisational principles that manufacturers can draw on partners' and customers' resources for successful cooperation.

Knowledge search strategy. Knowledge search strategy explains how manufacturers can source external knowledge from actors like technology vendors, universities, research centres, suppliers, and customers, which accelerates their adoption of digital technologies (Ricci, Battaglia, and Neirotti 2021). Such broad and in-depth knowledge search may trigger a phase of digital opportunity recognition, through which manufacturers understand, assess, and deploy digital technologies (Ricci, Battaglia, and Neirotti 2021).

Contingency theory. Contingency research focuses on context (contingencies that are exogenous to the organisation), response (organizational actions taken in response to contingencies), and performance (effectiveness between contingencies and responses), which can be used to explain manufacturer's organisational change due to the digitalisation (Bokrantz et al. 2020).

Portfolio theory. A portfolio theoretical perspective prioritises investments in order to maximize the value and risk trade-offs, and thus, optimises the organisational overall return of investment. The application of the portfolio theoretical approach to digital investment highlights the need to move away from considering projects and their funding individually and instead select and manage these optimum set of diverse projects that deliver maximum business value and strategic alignment. The resources highlight the need to centralize investment decision-making to achieve this portfolio approach (Colas et al. 2014). The portfolio approach also requires the dynamic management of project resources (Vedantam and Iyer 2021).

Real options theory. Real options theory puts an emphasis on providing decision makers with systematic and structured flexibility to adapt decisions in response to subsequent developments. The application of options theory to digitalisation recognizes the uncertainty that these investments imply (Lo et al. 2020). In a simplified model some digital investments can be viewed as consisting of first-stage and second-stage investments. However, the value of the second-stage investment is not known exactly at the time of first-stage investment.

Economic theories

Also economic theories have been applied in the studies that highlight the digital investment's monetary value and the pricing mechanisms behind digital technologies.

Transaction cost theory. Transaction cost theory explores the choices that can achieve economic efficiency by minimizing the costs of exchange. In the digitalisation context, for example, manufacturer's decision of developing digital technologies in-house or purchasing digital technologies externally requires the decision-maker making a choice to use a firm structure or source from market by comparing the internal production cost with external coordination costs (Gong, Cheng, and Nault 2021).

Game theory and pricing models. Game theory is useful to study the interactions between technology vendors/IT infrastructure platforms and manufacturers. The digital investment decision of manufactures is affected by the pricing models of the platforms that provide digital infrastructure (Sun and Ji 2022). Moreover, technology vendors can use different pricing strategies to motivate the adoption of digital technologies (Tang, Wang, and Xu 2022).

Technology theory

Technology theory put an emphasis on the specific nature of the technology resource that is being considered and investigated.

Technical debt. Technical debt conceptualises the accumulation of the technology work that has previously not been carried out which now constrains the future technological trajectory (Panchal and Iyer 2020). In the digitalisation context, technical debt describes the missed opportunities and their future costs as a consequence of a lack of investment. It stretches across lack of standardisation that prevents future high-value integration of data sources and applications.

TOE model. The TOE model considers technological, organisational, and environmental dimensions that simultaneously affect innovation adoption at the firm level. Digital investment is concerned with the technological factors, but more importantly, can be influenced by the organisational and environmental context (Kalaitzi and Tsolakis 2022). Thus, the TOE model is valuable in capturing the multi-dimensional characteristics of the digital investment decisions (Li, Chen, and Miao 2022).

5. CONCLUSION

Drawing on the challenges identified in the literature, this literature review provides the basis for the development of a research agenda. The development of the research agenda aims to ensure that the diverse perspectives in making digital investment decisions and their interconnections are captured. It also aims to ensure that future research effectively responds to the urgent needs of the manufacturing industry in engaging in digital transformation.

The table below groups the future studies according to the five themes, i.e. process/procedure, people, technology, infrastructure/network, goals, and culture. In each of the themes, we propose focal research questions that address the challenges identified from the literature review and make suggestions of the suitable theoretical perspectives that can provide the grounding for addressing the research questions and directing theoretical contributions.

Table. Future research opportunities

Digital investment challenge	Focal research questions	Proposed guiding theories and perspectives
Process/procedure challenges		
Challenges related to existing measurement (The KPI's used by the manufacturers do not appropriately capture the contributions of digital technology)	Which KPIs are most effective in directing investment decisions into digitalisation?	Performance measurement system design (e.g. Neely, Gregory, and Platts 1995), Viable Systems Approach (e.g. Choong 2014)
	What scope should be considered for the development of the KPIs directing the investment decisions into digitalisation?	Stakeholder Theory (e.g. Barro 2009)
	How do manufacturer attributes (e.g. size, digitalisation maturity, industry) affect the KPI adoption and effectiveness?	Contingency theory (e.g. Taylor and Taylor 2014)

	How should the KPIs change in the course of the manufacturer's digitalisation trajectory?	Life-cycle approach (e.g. Nudurupati et al. 2011)
Challenges related to the investment processes	How should the manufacturer plan the investment in digitalisation?	Portfolio theory (e.g. Drake and Byrd 2006), Real option theory (e.g. Kim and Sanders 2002)
	How should the manufacturer integrate flexibility in its planning process?	Real option theory (e.g. Yeo and Qiu 2003)
Challenges related to organisational structure	Which structures should manufacturers use to facilitate digital investment decision making?	Governance theory (e.g. Tiwana and Kim 2015)
Challenges related to people		
Lack of decision-making structure	How to structure an effective decision-making process?	Empowering leadership theory (e.g. Sharma and Kirkman 2015)
Lack of digital skills of managers and employees	How to effectively use pilots to disseminate learning about digitalisation across the manufacturer	Organisational learning; the learning organisation (e.g. Odor 2018)
Challenge related to resistance	How to overcome resistance to digital innovation and exploitation across the hierarchies	Theory of interpersonal influence and leadership (e.g. Yukl, Falbe, and Youn 1993)
Challenges related to technology		
Challenges related to cost of digital technology	How to evaluate the cost of not investing in digitalisation?	Opportunity cost theory (e.g. Renkema and Berghout 1997)
Challenges related to attributes of digital technology	How can manufacturers understand and prepare for future technological change?	Foresight theory (e.g. Piirainen and Gonzalez 2015)
Challenges related to the understanding of digital technology	How to frame the different and potentially diverging opportunities (exploration vs exploitation) that digitalisation offers manufacturers?	Ambidexterity theory (e.g. Turner, Swart, and Maylor 2013)
Challenges related to the management of digital technology	How to make a decision on whether to outsource or not digital technology	Transaction cost theory, resource based view (e.g. Watjatrakul 2005)
Infrastructure/Network		
Challenge related to manufacturer network	How to ensure shared investment commitment among network partners?	Resource dependency theory (e.g. Schroeder et al. 2020)
Challenge related to manufacturer networking capability	How should manufacturers exploring new relationships providing critical expertise	Dynamic capability theory (e.g. Mu et al. 2017)
Challenge related to customer	How to ensure commitment from customer to justify investment into digital?	Agency theory (e.g. Hypko, Tilebein, and Gleich 2010)
Goals		
Challenge related to goal development	How to create a shared vision for digitalisation across the business ecosystem?	Resource-based theory (visioning & orchestration capability) (e.g. Teplov et al. n.d.)
Challenge related to goal quality and ambition	How to overcome inertia and lack of ambition in visioning a digital pathway?	Theory of organisational frame of reference (e.g. Shrivastava and Schneider 1984)
Culture		

Challenge related to buy-in	How to facilitate a wider engagement with the digitalisation journey?	Psychological ownership theory (e.g. Pierce, O'driscoll, and Coghlan 2004)
Challenge related to uncertainty and risk tolerance	How to create a culture that values experimentation?	Knowledge-based theory of the firm (knowledge friendly organisational culture) (e.g. Liu, Tsui, and Kianto 2021)

The research set out to i) create an understanding of the investment challenges manufacturers are facing with their investment into digitalisation, ii) develop a scientific foundation to facilitate academic research on the topics and iii) develop a research agenda to guide future investigation to address the core challenges. The socio-technical systems framework was used as an investigative lens to analyse the diverse range of challenges among manufacturers and to give an indication on how multifaceted the approaches need to be to overcome these challenges.

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INNOVATIVE ASSET FINANCE FOR ADVANCED SERVICES

Chris Raddats, Tim Baines

ABSTRACT

Purpose: To investigate multi-actor approaches to developing innovative asset finance for advanced services.

Design/Methodology/Approach: Multiple case studies with nine companies that are involved in asset finance (manufacturers, finance providers, specialist intermediaries).

Findings: Financial providers can potentially enable both customers and manufacturers to remove assets from their balance sheets as part of advanced service provision. However, complexities around financial regulations and contract risks mean that captive finance providers are particularly valuable to enable advanced services.

Originality/Value: Traditional sources of asset finance for advanced services are limited and innovative approaches are required, such as using digital technologies to monitor contract performance. Solutions are likely to involve multiple actors, including non-captive finance providers and specialist intermediaries.

KEYWORDS: Advanced services, asset finance, captive, servitization.

1. INTRODUCTION

Manufacturers develop advanced services to create competitive advantage, with payment based on performance or outcomes (Schaefer et al. 2021). Advanced services necessitate a variety of changes to manufacturers' business models (Baines et al. 2020), including the 'revenue model' (Kindström and Kowalkowski 2014). As part of the revenue model, advanced services can be distinguished from other services in that payment is based on performance or availability, and regular service subscription payments replace the payment for a product/service solution (Grove et al. 2018). While the revenue model deals principally with how value is captured, it is closely linked to asset financing; that is, how assets are funded and by whom. Traditional approaches to asset financing, such as the outright purchase by customers, seem inappropriate for advanced services given that payment is based on a service subscription rather than the outright sale of capital equipment (Helms 2016). Equally, the provision of advanced services is likely to be restricted if manufacturers have to finance the assets given there is a limit on how much capital they have access to and are prepared to utilise for advanced services. Thus, asset finance provision is a likely inhibitor of the large-scale provision of advanced services.

To address the challenge of asset finance for advanced services, innovative methods of financing are required (Kamp and Gil de San Vicente 2019), from both captive and independent providers. For example, Rolls Royce's *captive* finance division (Rolls Royce & Partners Finance) offers customers operating leases that can incorporate its 'TotalCare' maintenance services on their engines. Thus, captive asset finance providers focus on their parent company's products and may be reluctant to finance non-proprietary assets because of greater contract risks through having less knowledge about the likely faults of other OEMS' products (Hou and Neely 2018). Rolling stock leasing companies (ROSCOs) are *independent finance providers*, which operate in the UK rail industry (e.g., Angel Trains). ROSCOs acquire rolling stock assets from train manufacturers and lease them to train operating companies (TOCs), contracting through-life maintenance to the manufacturers (Diaz and Trentesaux 2018). Independent finance providers may be reluctant to finance assets that underpin advanced services, as they lack technical knowledge about the assets or indeed the operational processes to which they are aligned (Kamp, 2020). Therefore, further research on the role of captive and

independent providers of asset finance is required to understand how they can facilitate advanced services.

The development of innovative asset financing is likely to necessitate a multi-actor perspective (Kortmann & Piller 2016); that is, considering the perspectives of manufacturers, finance providers, customers, and other actors. Indeed, the need to consider the perspectives of different actors in servitization research has been noted (Raddats et al. 2019), and for asset finance, a multi-actor perspective for asset finance provision seems appropriate given that few manufacturers have captive providers. Thus, this study aims to investigate multi-actor approaches to developing innovative asset finance for advanced services. To address the gaps in the literature as set out above, the research questions (RQS) are 1) how can innovative asset finance facilitate the provision of advanced services? 2) how can innovative asset finance approaches by captives and finance providers be distinguished?

2. LITERATURE REVIEW

Access to finance is a key issue to propagate advanced services since assets are financed upfront, yet revenues are generated over some time through service subscriptions (Perona et al. 2017). In this regard, the role of a manufacturer's management accounting function has been noted as an important facilitator of change to offering advanced services (Laine et al. 2012). Moreover, the financial aptitude of the manufacturer undertaking the change is important in terms of accessing the required external financial resources (Kamp 2020). Advanced services involve both changes to the basis for payment and ownership of physical assets, with the manufacturer owning the asset (rather than the customer) and charging the customer based on usage or performance (Spring and Araujo, 2009). Thus, advanced services replace conventional fixed-price or cost-plus contracts with a subscription model, which includes both fixed and cost-sharing/performance elements (Kim et al. 2007; de Oliveira et al. 2018; Selviaridis and Wynstra 2015).

Despite attention in the literature on the different financial aspects of advanced services such as manufacturers' willingness to incur financial risk (Karatzas et al. 2022), there is limited research on asset financing. What research there is assumes that the supplier retains ownership of the asset, often using a captive finance provider (Spring and Araujo, 2009). Thus, some larger manufacturers have set up finance subsidiaries, such as GE Capital and Siemens Financial Services, which can fund assets for advanced services (Kamp, 2020). However, captive finance is not available generally for most small and medium-sized manufacturers, so whatever innovative solutions captive finance providers can deliver are likely to be only available to a small group of larger manufacturers. Some research has, therefore, investigated externally-provided finance whereby the asset is procured from the manufacturer by an independent finance provider (Kamp and de San Vicente 2021). Collaborating with a finance provider in this way may help a manufacturer to speed up market entry since internal sources of finance are less required (Gebauer et al. 2017). Thus, developing innovative solutions around asset finance requires manufacturers to work with new partners, with an enhanced role for the finance department to engage suitable providers (Toxopeus et al. 2018).

Traditional independent providers of finance (e.g., banks) may lack sufficient knowledge about earnings from advanced services and may prefer to lend to a manufacturer that has assets on its balance sheet (Kamp 2020). What is, therefore, required are finance providers which have a more granular understanding of the value of a manufacturer's products and customers' operational processes as part of advanced services (Kamp and Gil de San Vicente 2019). In reality, finance providers may be less keen to lend for advanced services since they need a degree of certainty of a manufacturer's ability to generate revenue from them over a large customer base to optimise future cash flows (Toxopeus et al. 2018). Thus, assessing the operational performance of an advanced service requires investment in appropriate measurement and reporting systems. If these are too onerous to develop and operate then it may dissuade manufacturers and their customers from contracting on this basis (Selviaridis and Wynstra 2015). In this regard, Internet of Things (IoT) technologies, machine learning, and blockchain-based 'smart contracts' could provide an improved set of usage metrics to measure advanced service performance (Heinis et al. 2018; López-Pintado et al. 2019).

3. METHOD

A qualitative multiple-case study approach was adopted to collect data for this study (Beverland and Lindgreen, 2010). The sample comprised nine companies (four manufacturers, three finance providers, and two specialist intermediaries, which provide platforms and risk management methodologies to help facilitate innovative asset finance. All the interviewees had expertise in asset financing for advanced services and in total, we interviewed 11 managers. Table 1 shows the anonymised companies and respondents in the study.

Table 1: Respondents in the study

Actor	Company	Interviewee
Manufacturer	M1	Head of Channels Chief Financial Officer
Manufacturer	M2	Finance Business Partner Service Business Development Manager
Manufacturer	M3	Global Vice President - Service Solutions
Manufacturer	M4	Managing Director
Finance Provider	FP1	Chief Executive
Finance Provider	FP2	Managing Director
Finance Provider	FP3	Head of Finance & Legal
Specialist Intermediary	SI1	Chief Operating Officer
Specialist Intermediary	SI2	Chief Executive

Interviews were used to collect data, in addition to company documentation such as websites, brochures, and news articles. Interviews were conducted using a semi-structured guide and lasted between 45–60 minutes each. They were audio-recorded, transcribed, and then shared with participants and any clarifications in the conversations were sought. The data from the interviews and other sources were thematically analysed and are presented in section 4 aligned to the study's RQs.

4. FINDINGS

4.1. How can innovative asset finance facilitate the provision of advanced services?

4.1.1. Changing to an Advanced Service Business Model

The manufacturer interviewees noted that in many cases advanced services were not currently a major proportion of their companies' order books. For example, M1 noted that "leasing is the only real financing type arrangement that we currently offer today with customers. We do offer various service contracts but they're not really in the advanced services outcome type of area". Underlying this position is M1's caution about the risk around outcome-based guarantees, and how liabilities could be capped.

The study shows that finance providers can potentially enable both customers and manufacturers to remove assets from their balance sheets by buying the assets and taking on some of the operational risks (M3). However, finance providers' lending does not normally encompass operational risk (but credit risk) and they may lack the processes and systems to manage such a business model. For example, a manager noted, "it struck me that there was enough risk around just financing a piece of equipment.... it became a whole other level when you started to talk about outcomes" (M1). Thus, traditional finance providers, such as banks, are reluctant to get involved in advanced services (pay-per-use) contracts and look for other ways to generate the same benefits without taking risks (M2). Equally, from a manufacturer's perspective, there is a question about whether having a finance partner might reduce its agility when shaping customer contracts. A manager noted "different customers will reach different bargains with us for what share of risk we take. Would a financier

reduce that agility, in other words, would they put us in a 'straight jacket' so that we could only ever take this level of liability?" (M1).

The role of specialist intermediaries was highlighted by the manager from SI1, who noted that manufacturers need to change their balance sheets over time from a product sale model to a servitization model. To help them do this it is necessary to garner data from about 100 service contracts to do some evaluation. Using this data, SI1 can design a viable business model. The need for business modelling was also taken up by the manager from M3 who asked "how do we model a comparison between a traditional business model with a cash sale to a customer, or a traditional lease, and the prices that it would have, versus the new business model which is the pay-per-use, Capex into Opex variable payment"? Thus, developing a transparent and viable business model for the finance provider, manufacturer, and customer seems critical.

4.1.2. Expanding the Scope of Operations

Asset finance providers can help manufacturers to facilitate the provision of advanced services at scale, be this the number or size of contracts and/or the geographic scope where they are offered. As a manager from M1 noted, "because we have customers everywhere, we could end up potentially with assets sat in a vast variety of countries, so therefore there are questions for financiers around whether they are happy to support those geographic credit risks in different territories". It may be that finance providers are not willing to take these risks and as the manager from M4 noted, "the service model will be operated by the service company in that local country. The majority of that profit will be made in that country, not in this country, and of course, we lose out by having to share the profit with the in-country partners". This manager also noted that access to finance was a limiting factor to growth, "there's a window of opportunity where we have to advance very rapidly or else, inevitable we will get copied and we will lose that opportunity. And we are hamstrung by a lack of access to capital" (M4).

The manager from FP1 emphasised the importance of the advanced service contract, not just the asset to finance. In this respect, the manufacturer has created a new revenue stream based on this contract, which has been monetised by selling future receivables (payments). This, then, enables the manufacturer to retain more capital to be able to expand the number of such contracts in operation. Thus, asset financing can make a manufacturer's service business more scalable.

4.1.3. Fixed Versus Variable Payments

Revenue models for asset finance generally comprise both fixed and variable payments. While there may be a minimum (fixed) payment, it is this variable element that is challenging to finance since the finance provider is dependent on the manufacturer maintaining performance outcomes. As the managers from FP1 noted, "as a financier, I look at the variable usage contract and I'm not interested in it because I am a lender of money and, therefore, want to know what is my collateral and what is my source of repayment". Therefore, independent finance providers may not be qualified to take a view on the outcome from an advanced service contract; that is, whether the variable element is achievable. So, all they will finance is the minimum (fixed) contract payment. Thus, the performance risk of a contract (the variable part) is borne by the manufacturer but the credit risk from the contract (the fixed part) may be borne by an independent finance provider (FP3).

Manufacturers may be able to evidence contract performance outcomes by having historic usage and payment data for existing advanced service contracts. This information can help to 'prove' the future value of the contracts (FP1). Moreover, by pooling risks from multiple contracts, finance providers could (in theory) smooth the peaks and troughs of variable payments. Nevertheless, if a manufacturer has to indemnify the finance provider and warrant equipment performance, then the sale of the equipment cannot be recognised under international accounting standards (IFRS15) until the end of the contract (FP1). So, finance providers would not generally wish to assess the highs and lows of the variable payment and if they did, these would have to be predictable (FP3).

4.1.4. Using Digital Technologies

Remote monitoring of equipment usage using IoT technologies can help to substantiate the revenue stream from a portfolio of advanced service contracts (M4). The manager from SI1 noted that they were able to develop a tool that could build an audited data trail into the financing process, which includes usage-based reports that are sent to the finance provider to evidence product usage. This manager also noted the advantages of advanced services over lease contracts despite their greater complexity; for example, better alignment with customer business models. To this end, SI1 has developed a simulation engine with various pricing and usage-based models. He noted, “we give manufacturers the opportunity to implement their balance sheet and P&L information. Then, we will compare the recurring revenue impact and the P&L impact based on these recurring revenue models over the next years, so how many assets would they have to deploy to generate 20% of recurring revenue”? The more data SI1 receives about existing product usage, the better the simulation will be.

The manager from FP3 noted the flexibility that a Cloud-based advanced service could provide, “so, we’ll license you to access the Cloud for 100 people but if in January only 20 people access it then you pay for the 20....and if you need to increase it to 120, we increase it to 120. If you make 10% of your workforce redundant, we’ll reduce it to 90, and you just pay as you use it”. This flexibility has real benefits for the customer in that they only pay for what they need. In another example, the manager from M2 noted that if the finance provider owns the equipment, then they would also own the data from it. However, it is possible that the finance provider will not use the data and might try to sell it back to the manufacturer. Alternatively, this could create an opportunity for an intermediary to ‘buy’ the data to create insight into product operations that could be useful for both the manufacturer and finance provider.

4.2. How can innovative asset finance approaches by captives and finance providers be distinguished?

Although there are different approaches between captive and independent finance providers, it is noteworthy that some of the challenges are the same. As a manager from M1 noted, “the questions would be the same whether it’s an internal or an external provider. They might want to look at the cash flow that is coming from these offerings. Is it a business with a reasonable number of customers which over a period of time has been producing steady and regular income, for which to pay back the money that you’ve been lent”? Thus, the approaches set out below do not set out a dichotomy of finance provision between captive and independent providers but focus on relative differences.

4.2.1. Approaches by Captive Finance Providers

Captive finance providers are particularly valuable to enable advanced services as they have a more insightful understanding of risk profiles associated with manufacturers’ assets (FP2). The manager from FP2 noted, “it’s easy with [manufacturer] because we have access to design and engineering and product evaluations”. Moreover, FP2 has ready access to the telematics data from the manufacturer’s machines. Interestingly, FP2 also finances other non-competing products that its customers wish to acquire through lease purchases.

Returning to the issue of the variable element of the advanced service contract, a captive provider may be prepared to finance that part of an advanced service contract, unlike an independent provider. However, there are relatively few manufacturers with captives making this a relatively limited option. Moreover, the captive finance provider interviewed for this study (FP2) noted that asset finance is overwhelmingly used for lease purchases rather than advanced services.

Another advantage of the captive finance provider is that finance can be secured internally at low interest rates (M1). Moreover, if the captive finance provider operates at a large-scale, then it may also be prepared to take risks that the manufacturer could not take alone. That said, there would still be limits on how much money is made available for advanced service contracts. The manager from M1 noted, “our parent company would be willing to finance us in some way whether it’s to lend us some money or through whatever route for a bigger push into advanced services, but the question is to what scale? If we went to them and said that we’re going to move 5% of our business into advanced services they would probably say fine off you go. If we said 50%, it’s a much bigger question”.

4.2.2. *Approaches by Independent Finance Providers*

While captive finance providers and traditional independent finance providers (e.g., banks) may be restricted in the type of financing they provide, there could be a market opportunity for alternative independent providers. These organisations may not be a party to the same regulatory environment that banks operate in, which effectively mitigates them from taking unknown risks (FP1). Equally, each funder has different goals, perspectives, and market orientations, or as the manager from SI1 notes, “pay-per-use appetite, as well as pay-per-use models that they would be willing to fund”. For example, SI1 noted flexibility around the residual value of equipment that was part of an advanced service contract, “if we apply a flexible lifetime model, based on its actual usage, it could be that the model is finished after five years and the residual value that you have been guaranteed (25%) is actually 40%”.

The approach that the independent finance provider takes is important to the manufacturer. The manager from M3 noted, “the model we are trying to understand is how the (independent financial providers) of the world can keep the asset in their balance sheet and invoice through pay-per-use to us. We then integrate that element into our bigger scope of supply, but we don’t have it in our balance sheet either and we sell it to the customer”. In this scenario, the manufacturer invoices the customer for the usage and neither the customer nor the manufacturer owns the asset.

5. THEORETICAL AND PRACTICAL CONTRIBUTIONS

The study aims to investigate multi-actor approaches to developing innovative asset finance (Kortmann & Piller 2016). In terms of theoretical contributions, the study reveals that asset finance is an important aspect of advanced service provision, which has been largely overlooked in business model research (Baines et al. 2020; Kindström and Kowalkowski 2014). It is, however, an important aspect of how manufacturers can initiate and expand advanced service provision given that neither manufacturers nor their customers may want the assets that underpin advanced services on their balance sheets (Helms 2016). Our research identified a particular issue around asset finance, namely that traditional lenders, such as banks, would not want to take on the operational risks (the variable element) from an advanced service contract, whereby payment is dependent on product availability, usage, or performance (Kamp, 2020). They may, however, be prepared to fund the minimum payment for such a contract (the fixed element) for which they assess the credit risk of the manufacturer, its customers, and the viability of the advanced contract. Our study supports the utility of using remote monitoring and IoT technologies to provide all parties (manufacturers, customers, finance providers) with a stronger sense of product operations (Heinis et al. 2018), although we found that it may be specialist intermediaries which are best placed to provide these capabilities.

Our study provided support for the different benefits of captive versus independent finance providers. Captive providers have deep knowledge of the manufacturer’s products and the operational processes for which these products are used (Kamp 2000). Indeed, their mission is to support manufacturers and their customers and so the risks they take and the interest rates they charge may be preferential over those available from the commercial market. However, while captive providers may be well-placed to support advanced services, there was little evidence of them doing so from our study, and one captive finance provider (FP2) noted that they mainly support lease purchases. Turning to independent finance providers, these actors are likely to be the ones that could kick-start the take-up of advanced services if suitable business models can be identified, which help mitigate the risks of operational performance (the variable element). However, it is currently unclear whether such business models exist although it is likely that specialist intermediaries, who can collect and manage data to help all parties understand product usage and risk, will play a role. While solutions to asset finance are elusive, if they can be found, they could have major implications for the viability and expansion of advanced services.

In terms of managerial implication, our study shows that an innovative multi-actor approach is likely to be one which can drive the uptake of advanced services. Captive finance providers may be the best approach for larger manufacturers if they them within their organisations. It may be that their

current focus is lease sales but by using the deep technical knowledge of the products and their operational performance, it may be possible to start to finance advanced services. It may be that independent asset financed providers and specialist intermediaries offer the best chance for the majority of manufacturers to develop innovative solutions to asset finance and managers could seek to initiate discussions with them about this matter.

In terms of limitations and future research, this study is one of the first to consider asset finance for advanced services, and the data collected is rather speculative at times given there are not many solutions available in the market. Future research would be strengthened by collecting data from providers of innovative finance which are already working with manufacturers and possibly specialist intermediaries to develop solutions. Furthermore, the asset finance business model for advanced services is still rather nebulous and further research with other manufacturers and finance providers would help to clarify how it might work.

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EQUIPMENT USERS' EXPERIENCES OF A MANUFACTURER'S SMART SERVICES

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ABSTRACT

Purpose: The use of a manufacturers' equipment and industrial services is dependent on the users' readiness and capabilities. In a business-to-business context, different users may have different experiences with intelligent product features and related smart services, and the experiences need to be understood, when a manufacturer develops and delivers its industrial services. The goal of this study is to identify user experience patterns concerning intelligent product features and related smart services for industrial equipment. The focus is on the early phases of adopting the intelligent product features and related smart services.

Design/Methodology/Approach: A qualitative case study was implemented with two customers of a machine manufacturer. Data were collected through interviews, and user experiences were analysed concerning intelligent features, services, and the service supplier.

Findings: The cross-case analysis reveals that all users do not experience benefits from intelligent features and related smart services. Four different user experience patterns are reported: feature-centric, competence-centric, development-oriented, and decision-oriented.

Originality/Value: The study adopts a users' perspective to industrial services, thereby offering a more nuanced idea of customer experiences and potentially explaining why digital servitization proceeds slowly within customer firms.

KEYWORDS: Smart services, Equipment users, Customer experience, User experience, Digital servitization, Intelligent technology

1. INTRODUCTION

Manufacturing firms offer industrial services with an intent to create value for and with the customers and to gain business benefits for themselves. Research on industrial services and digital servitization tends to concentrate on the manufacturer's (i.e., supplier's) perspective to smart services and their enablers (Klein et al., 2018). While also the importance of customer-centricity has been acknowledged (Kamalaldin et al., 2020), the customer's role is treated primarily as something that the manufacturer has to consider (Abrell et al., 2016), instead of treating customers as the actual research focus. Business customers tend to include multiple different individuals in service procurement and use, and there is a need to understand the users' experience, when the manufacturer develops and delivers its services. Therefore, there is a need to distinguish between customer and user views. Customer represents the view of the organisation and especially its decision-making function responsible for buying the equipment in question, whereas users are the individuals who lead the equipment-related processes and operate the equipment in practice (Abrell et al., 2016; Mora & Johnston, 2016). This study concentrates on equipment users' experiences in connection with intelligent technologies and related industrial services.

User experience is among the key dimensions of managing digital product and service innovations (Nylén & Holmström, 2015), and it has become a top objective for managers to create a strong customer experience (Lemon and Verhoef, 2016). Abrell et al. (2016) point out the necessity for identifying the individual users as representatives of the customers and distinguishing them from the buyers, to understand the customer's needs and experiences toward digital innovations. As the importance of customer experience dimensions varies between different functional units (Witell et al., 2020), the actual users' experience cannot be understood by studying the customer firm or buyers only. Manufacturers will need information on the users' experiences in developing and delivering industrial services, but they may struggle to discover their latent needs.

This study is motivated by the need to understand equipment user's experiences in adopting intelligent product features and related smart services. Smart services are activities that the supplier carries out on customer's behalf by collecting and analysing data facilitated by intelligent technical systems (Klein et al., 2018). Equipment connected with information and communication technologies include intelligent features such as automated functionalities, safety measures, sensing environmental factors, and measuring production outputs and they, in turn, may enable various smart services. This emphasises the importance of user experiences as many of the service benefits stem from process improvements or changes from which only the users have first-hand knowledge. Understanding the intelligent features and related smart services and their possibilities necessitates deep, embedded, and tacit knowledge of the customer's processes and work practices.

The goal in this study is to identify user experience patterns concerning intelligent product features and related smart services for industrial equipment. The main research question is: How do equipment users experience the intelligent features and smart services associated with an equipment manufacturer's technologies? We intend to offer new information to guide industrial smart service development so that it acknowledges users' patterns of equipment use. The focus is on industrial business-to-business settings, and business-to-consumer contexts are purposely excluded. Moreover, the study focuses on early experiences of customer firms adopting intelligent product features and smart services, as opposed to more established experiences.

2. THEORETICAL BACKGROUND

2.1 User Experience as Part of Customer Experience

Customer experience has grown to be an important topic both for practice and research (Becker & Jaakkola, 2020). It is often viewed from a marketing perspective, as customer's responses to a supplier's stimuli (Becker & Jaakkola, 2020). Experiences are individual by nature, but they are influenced by personal expectations as well as corporate goals and requirements, and they are shared with others through interaction (Mora & Johnston, 2016). Experiences can also be viewed from the supplier's perspective (Mora & Johnston, 2016), often in terms of how a supplier can manage the customer experience. For example, some studies explore how the manufacturer can leverage information about the customers and their experiences in its operations (Abrell et al., 2016). The majority of customer experience studies takes place in business-to-consumer contexts (Witell et al., 2020) and research is still fragmented (Becker & Jaakkola, 2020). Few studies concentrate on customer experience in a business-to-business context (Lecoeuvre et al., 2021; Roy et al., 2019) and smart services in particular (Gonçalves et al., 2020). In business-to-business contexts, customer experience is formed differently as the offerings are often more complex and multiple individuals are involved with services in different roles (Witell et al., 2020). There is a need for more research on different types of customers (Gonçalves et al., 2020).

User experience is a particular form of customer experience that focuses on the perceptions of the person that uses a product, system, or service in practice. In industrial settings users are those individuals that operate the equipment or lead the related processes (such as production or in-house maintenance) and may be the first-hand recipients of the manufacturer's products and services. Users' perspective is necessary to understand as they may oppose a procurement done by a separate purchasing unit and even seek to bypass the arrangement (Witell et al., 2020) which would result in suboptimal benefits. Users also possess the embedded, tacit knowledge of the actual use context and the usability of the products and services (Abrell et al., 2016), and the contextual variables affect how people respond to stimuli (Becker & Jaakkola, 2020). In addition to the features of efficient use and easy learning, there is a need to understand the rich user experience in terms of usability, aesthetics and engagement (Nylén & Holmström, 2015).

Some studies have investigated user experience in industrial settings, and they express the necessity to clarify the user's position and perspective. Abrell et al. (2016) emphasise that delineating users from customers is particularly important when the role of customer/user knowledge is applied in digital innovation. Accordingly, understanding the users' latent needs and work context can help to envision future needs and usability criteria, whereas customers are often unable to express long-term

expectations for technology development as they are not familiar with the specific use practices (Abrell et al., 2016). People in different positions and functional units may emphasise different components of the customer experience, and there may be even multiple simultaneous customer journeys going on within one customer company during a purchase (Witell et al., 2020; Zolkiewski et al., 2017). Due to the involvement of different people, user experiences are not formed in isolation, but users and suppliers are a part of a complex network that influences and constrains user experiences (Liinasuo et al., 2016). Also, part of the user experiences are found to be mediated and based on other users' experiences (Liinasuo et al., 2016).

The emergence and formulation of user experience occurs through various touchpoints (Witell et al., 2020) or journeys (Lemon & Verhoef, 2016) where users and suppliers interact. This implies that user experience is not static – it is iterative, dynamic, and evolving (Lemon & Verhoef, 2016; Witell et al., 2020; Zolkiewski et al., 2017). It varies across the organisational levels and functions, and it is relational: in business-to-business settings, users may interact differently with the suppliers' personnel and also its partners, when the supplier attempts to serve the customer's needs (Witell et al., 2020). Some of the touchpoints can be controlled by the supplier, whereas others cannot (Lemon & Verhoef, 2016; Witell et al., 2020). As the user experience accumulates through the touchpoints, customer may assess it not only through formal aspects of supplier attributes, functional benefits, and key performance indicators, but also through situation-specific reactions, responses, and help or lack thereof. This accumulated user experience may, then, influence the business relationship over the long term (Witell et al., 2020).

2.2 Users' Experiences of Intelligent Product Features and Smart Industrial Services

Smart services are provided through embedding intelligence (i.e., awareness and connectivity) into the products (Allmendinger & Lombreglia, 2005). Some examples of intelligent features in industrial equipment include status information and diagnostics, control and automation, profiling and behaviour tracking, replenishment and commerce, and location mapping (Allmendinger & Lombreglia, 2005). Smart services can be categorised based on the supplier's and users' activity levels into interactive service, self-service, provider-active service, and machine-to-machine service (Wunderlich et al., 2012). Some studies use the concept smart product-service systems in reference to the embedded digital technologies in products that enable digital services (Zheng et al., 2019; Zhou et al., 2022). Smart services are not only defined by their technological features, but also by their multi-dimensional and interconnected nature, which requires collaborative efforts between manufacturing firms and their networks, including customers (Momeni et al., 2023) and users.

In order to benefit from smart services, users first need to acknowledge and use the intelligent features. For example, Verdugo Cedeño et al. (2018) studied Internet-of-Things technologies in farming, where users tracked operation data, equipment failure, component condition, work progress, and resource consumption. The suppliers needed to understand these user needs when developing smart services. Only through the use of the intelligent features, smart services can enable customers to improve the efficiency of operations, optimisation, and digitally-enabled functionalities (Klein et al., 2018). While smart services are assumed to improve user experience by making the user journey predictable and optimisable, the firms face challenges in reaching a superior user experience (Zhou et al., 2022). Smart services bring new features and possibilities, but customers are not necessarily willing or able to use them (Vaittinen & Martinsuo, 2019) and, thereby, may fail to benefit from the value of such services (Kamp et al., 2023). Customers may experience various barriers, such as a fear of losing control over information, unwillingness to outsource, and the supplier becoming a competitor with customers, and such barriers may hinder the progress of smart services (Klein et al., 2018).

Some research has considered user attitudes, behaviours, and new technology acceptance, when users begin to gain their first-hand experiences from the intelligent features and related services. Technology acceptance literature often focuses on the innovation features, in terms of usefulness and ease of use as key influencers of technology use. The interactive nature of smart industrial services draws attention to the users' attitudes and behaviours as responses to smart services, including the perception of control, trustworthiness, social presence, and collaboration (Wunderlich et al., 2012). A

recent study on the adoption of augmented reality for industrial services identified users as a key influential category where their age, digital skills, experience, and technology acceptance level were associated with the adoption of technology (Aquino et al., 2023). One study concentrated on customers' service readiness and highlighted the interdependency between different personnel groups and levels in the customer organisation, and between the customer organisation and the supplier (Vaittinen & Martinsuo, 2019). Suppliers need to understand the different user groups' service readiness, to develop and offer suitable service solutions to them (Vaittinen & Martinsuo, 2019). User experience of smart services is mainly studied from the perspective of service design in a business-to-consumer context. Several factors are relevant in designing smart services and smart product-service systems, including interaction, expectation, enjoyment, user context, personas, and user activity journeys (Zhou et al., 2022).

3. RESEARCH METHOD

We used a qualitative embedded-case research design to study two customer firms (C1 and C2) of MechCo (pseudonym), a large international manufacturer of mobile equipment and traditional and digital services. MechCo's new equipment has intelligent features that enable various smart services, but customers may have older generations of equipment in use. Both C1 and C2 have recently acquired modern-generation equipment, selected for their unique needs and used in specific contexts. Background information on the firms is summarised in Table 1.

We carried out 28 interviews (Table 1) with production and maintenance related persons on themes concerning the equipment use, experiences of intelligent features, and experiences of and expectations toward services and cooperation with the manufacturer.

Table 1: Background information on the firms and research data

	MechCo	C1: Customer 1	C2: Customer 2
Type of business	Complex systems (mobile equipment for industrial customers) and related services	Foodstuff (business-to-business)	Logistics involving large cargo (business-to-business)
Turnover	>2 BEUR	>10 MEUR	>100 MEUR
Personnel	>10.000	<100	>500
Nr of interviews (interviewees)	(2)	15 (14)	13 (13)
Interviewees' job profiles	Background information and contacts to customers from two directors involved in service business development	Production manager Production operators (11) Maintenance technicians (2)	Operative manager Unit manager Maintenance supervisor Operators (6) Foremen (2) Maintenance technician Production planner

In the analysis, we first mapped the use experiences separately for the intelligent features, smart services, and service supplier. We also considered the context of service use (features of the customer site), to understand its potential implications on user experiences. We created a cross-tabulation of the user experiences at C1 and C2, to compare their experiences. In the second analysis step, we clustered the user experiences according to their dominant pattern into feature-centric, competence-centric, development-oriented and decision-oriented user experience.

4. FINDINGS

4.1 Users' Experiences of Intelligent Features, Services, and the Service Provider

The two customers differ in their conditions of using the equipment and their intelligent features, and also their user experience patterns, as summarised in Table 2. We analysed the users' experiences of the intelligent features, services, and the equipment and service supplier.

Table 2: Cross-case comparison of use context and user experiences

	C1 experiences	C2 experiences
Use context	- Inside; light loads - Single location, lightly complex floorplan - No direct customer contact - One piece of equipment, with multiple users, in two work shifts - Hygiene requirement in core production - Fairly low use frequency for the use of the equipment - Users vary in the length of experience with using the equipment (many have just a short experience)	- Outside (susceptible to weather conditions); heavy loads - Multiple locations, dynamic context - Direct customer contact - Multiple pieces of equipment at the site, each with a single user in two shifts, user location rotates among equipment - Extreme safety requirements and risks at the site - High intensity for the use of the equipment (but varying) - Interviewed users were very experienced in equipment use
Experiences of intelligent features	- Low to medium use - Usability perceived as good - User induction necessary - Strengths: safety, ergonomics, efficiency, ease of use - Challenges: requires location-specific programming (not always done during equipment installation); automated features slightly slower than manual; variety in the use of the features, depending on operator	- Low use - Both old and modern equipment are in use, and old equipment do not have intelligent features - Intelligent features are not considered as relevant to work; operators prefer the sensation of control that they have without using the intelligent features - Strengths: good for equipment lifecycle, safety - Challenges: Experienced users do not perceive the need to use intelligent features; Loss of control for operators
Experiences of services and supplier	- Managers are aware of the supplier and services; equipment users are not. - Basic services function well and are appreciated (pre-sales consulting and information provision, installation, maintenance, technical problem solving). - Smart services would become useful, if volumes were higher. E.g., speeding up maintenance cycles, monitoring of production-related data.	- Managers are aware of the supplier and services; operators connect with them in basic spare parts and acute corrective maintenance tasks. - Basic services and ongoing cooperation with the service provider function well and are appreciated (pre-sales consulting and information provision, installation, maintenance, technical problem solving). - The slow spare part delivery due to the availability of parts (from third parties) is sometimes a problem. - Smart services would be interesting for managers, particularly from the perspective of business tracking. - Training and induction for intelligent features needed also later than during equipment purchase.

The findings portray intelligent features from the users' perspective as mechanisms to promote efficiency, better safety at the site, and increased user ergonomics. Whereas some operators in C1 used the intelligent features actively, all operators in C2 preferred manual use, even if some of them had experimented with the intelligent features during and after their equipment training. General services concerned basic trainings, installations, and maintenance, but also some smart services were offered by the supplier for accumulating real-time process knowledge, awareness of operator's competences, and performance in equipment use. Interviewees in both customer firms expressed that they were not very interested in smart services, even if they were partly already available.

There is a clear difference between the experiences of operators working with the equipment and managers involved in planning and purchasing the equipment and leading the operators' work. In C1, only the managers had visibility toward the services and equipment supplier, whereas operators did not speak much about services and the supplier at all, even when prompted. In C2, also operators were

in touch with the services (when requesting acute maintenance and spare parts), whereas managers spoke about them primarily from the perspective of the contract and the negotiation process.

Users identified additional expectations toward service supplier's basic services and intelligent technology features, but not so toward smart services. While the experiences and expectations concerning the intelligent features and smart services were largely similar between the two customers, especially the expectations toward basic services and supplier's operations differed significantly between their operating contexts, due to the unique features of the customer site (inside vs. outside and indirect vs. direct customer contact). C2 interviewees explicated the urgency of some service needs, due to the direct customer involvement and significant cost effects of any delays in operations.

4.2 Four Types of User Experience Patterns

The interviewees pointed out various safety-enhancing, efficiency-enhancing, and efficiency-reducing properties of the intelligent features and smart services, and the need to integrate them with existing systems. We clustered the interviewees into four user experience patterns, depending on their dominating type of user experience. While many interviewees did not experience smart services as necessary or even interesting, the smart service features appeared as partly relevant for the customer firms' business.

Feature-centric user experience. The majority of operators especially in C1 explicated such user experiences that dealt merely with the intelligent features of the equipment. The operators did not acknowledge services or the service supplier separately, since they were not in direct contact with them. In that way, their user experience and connection to potential smart services stemmed only from the use or knowledge of the intelligent features. It depended on the operator's personal preferences and competences whether they in fact used the features or not.

Competence-centric user experience. The majority of operators in C2 and some operators and maintenance people in C1 preferred the manual use of the equipment (that is, not using the intelligent features at all). They appreciated the possibility to maintain their control over the equipment, despite knowing about the intelligent features. They also had some first-hand connection with the services and service provider. They were very experienced operators who understand the significance of their own competences in the demanding and varying conditions of equipment use.

Development-oriented user experience. Some individual operators and some maintenance technicians in both firms had had a chance to participate in the procurement of the equipment (in C2, the newer equipment). Consequently, they had a broader experience of the intelligent features and at least some connection with the (possible) services and service provider. During the procurement process they had gained some knowledge of what is possible with the smart features and services. Especially in C1, they saw potential in experimenting with the next technologies and possibly also adjusting the usage environment so that they could benefit more from the intelligent features. In C2, the interviewees actively expressed improvement possibilities to the equipment's basic features but were reluctant to use the intelligent features and smart services.

Decision-oriented user experience. Many of the interviewed managers and some maintenance technicians had participated in the procurement of the equipment and its decision making. They oversaw the production or maintenance and were also responsible for the business performance. They had first-hand experiences of the equipment service supplier, they engaged in repetitive or continuous cooperation, and some of them also ordered the services (especially in C1). The managers and technicians did not talk about the intelligent features of the equipment much, since they were not involved in operating the equipment, except from the perspective of comparing old and new equipment and their properties, and mechanisms to access real-time information about the performance of operations.

5. DISCUSSION

This study explored user experiences in two industrial customer firms of an equipment manufacturer and sought responses to the question of how equipment users experience the intelligent features and smart services associated with an equipment manufacturer's

technologies. A central observation regarding user experiences relates to the users' readiness to use the intelligent features that are linked with the potential use of smart services. Our findings on the low to medium use of intelligent features indicates that the users' readiness for smart services may depend on the users' technology readiness (also Klein et al., 2018). This offers additional evidence to previous studies on service readiness and adoption (Vaittinen & Martinsuo, 2019; Wunderlich et al., 2012; Zhou et al., 2022) and reveals potential reasons for the limited progress of manufacturers' digital servitization. The empirical evidence with the two customers suggests three potential reasons underlying the low extent of intelligent feature use. Firstly, users perceived that manual operation allowed them to maintain greater control and that they felt more comfortable using familiar methods (supporting Wunderlich et al., 2012). Secondly, users may not see the immediate value or benefits of smart services, especially if they do not experience any significant problems with their equipment. This may lead to a lack of motivation to adopt new services or features and offers user-level evidence to support the firm-level study of Vaittinen & Martinsuo (2019). Thirdly there may be weak awareness or understanding of the potential benefits of smart services, as well as a lack of training or support for users in how to effectively use them. This may lead to users feeling uncertain or hesitant about adopting the new technology.

As a core finding, we revealed different patterns of user experience, differentiating the companies and users. The clustering into four user experience patterns — feature-centric, competence-centric, development-oriented, and decision-oriented — offers empirical evidence of how people in different positions and functions experience different aspects of intelligent features and related services differently (offering evidence to Witell et al., 2020; Zolkiewski et al., 2017). The patterns reflect differences in the operational context and user preferences, potentially following from the user's level of experience, the complexity of the tasks, and the perceived value of the features. Also, differences emerged in the visibility towards suppliers and the services, potentially following from such factors as organisational structure, communication channels, and the level of involvement of different stakeholders. Overall, the differences highlight the importance of considering the specific context and user needs in that context (following Abrell et al., 2016).

The patterns of user experience show how even people with exactly the same job profile in a firm can have clearly different user experiences. Thereby, our findings offer evidence about potentially diverging touchpoints with the supplier and diverging customer journeys (in line with Abrell et al., 2016; Witell et al., 2020; Zolkiewski et al., 2017). This highlights the equipment supplier's (i.e., service provider's) need to understand that some users do not have any touchpoints with them and, thereby, it may become almost impossible to control or even affect the customer experience comprehensively. Current literature highlights manufacturers' will and need to try to create positive customer experiences (Witell et al., 2020; Zolkiewski et al., 2017), which in light of our results requires new ways to connect with different user groups and serving their needs regarding the use of intelligent product features and smart services. If siloed customer experiences and lack of touchpoint control are among key challenges in industrial customer experience management (Witell et al., 2020), manufacturers need to treat their industrial customers in holistic ways, recognising the specific needs of their unique user groups.

6. CONCLUSIONS

The study contributes with the new categorisation of user experience patterns – feature-centric, competence-centric, development-oriented, and decision-oriented – concerning intelligent product features and smart services in an early phase of digital servitization, from the perspective of users in their unique operating environments. The findings complement the manufacturer-centric digital servitization research by emphasising the customer's viewpoint and diverse user experiences. In particular, the study revealed that smart service suppliers cannot take for granted that users experience the benefits of intelligent product features and smart services in a similar way as managers or buyers responsible for their procurement, or that the features would be regarded as beneficial by

the users. This may impact and explain the rather slow adoption of smart services among industrial customer firms.

The validity of the study has some limitations due to the choice of firms and their phase of adopting intelligent technologies and smart services. The choice of the firms was limited through the access offered by the focal manufacturer and its clientele. We were extremely satisfied with gaining access to quite different firms and industries, but obviously the choices do not enable broader generalisations. The use of intelligent features and related smart services was in its early phases in these firms and, thereby, the data are limited to such a context and do not offer evidence on more established smart service use. Also, equipment users' experiences are limited to the immediate context of their own work and processes in which they are involved. To get a more comprehensive picture of the effects of smart services in the customer organisation as a whole, the user perspective could be balanced with the experiences of decision-makers such as directors and professional buyers.

More research on user experiences in industrial smart service settings is called for. Industrial services tend to be overlooked in customer and user experience studies, but when smart services are gradually becoming more prominent, research on their user experiences becomes possible. To continue from this research, the identified user experience patterns could be further developed and fine-tuned by adding further customer firms and individual users. Follow-up studies could replicate the research setting in similar and different contexts, thereby enabling the testing and elaboration of the initial findings. As the present study covered users in firms that were only taking their first steps in harnessing intelligent product features and related smart services, further studies could include customer firms that have more established experiences of smart services over longer period of time and among a larger group of users. Theoretically, user engagement could offer a novel analysis perspective in such contexts where smart services are widely adopted among users.

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ORGANISATIONAL METAMORPHOSIS THROUGH BALANCING ON A TIGHTROPE: IDENTIFYING TENSIONS OF AND BUILDING BALANCING ROUTINES FOR IDENTITY CHANGE

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ABSTRACT

Purpose: This article attempts to 1) identify tensions a manufacturing company faces when moving from a product provider towards a smart solution provider and 2) explicate how to build organizational routines to manage those tensions effectively.

Design/Methodology/Approach: The study utilizes an extended, in-depth, longitudinal single case study method to capture a process in which the selected case firm is transforming its product-based business logic towards smart solution-based business logic. The explorative case study approach combined with qualitative enquiry provides a thick description on the key tensions and balancing routines.

Findings: The study identifies different type of cognitive and behavioural tensions that are further classified into five dimensions: 1) short-term vs. long-term target setting, 2) tailored vs. standardized product-service systems, 3) product vs. customer mindset, 4) integrated vs. separated organizing, 5) exploitation vs. exploration in innovation. Associated balancing routines regarding managing tensions are identified.

Originality/Value: This study analyses further balancing routines and coping practices a firm develops to address tensions stemming from firm's identity change. These routines and practices are helpful to understand better how to navigate these complexities in practice.

KEYWORDS: Dynamic capability; routines; organizational identity; digital servitisation; smart solutions; organizational metamorphosis

1. INTRODUCTION

Manufacturing companies are increasingly engaged in services and software to generate a competitive edge and differentiate from other manufacturers in the B2B markets (Cusumano et al., 2015). This strategic change, however, is far from easy initiative as this change affects firm's identity (Huikkola et al., 2022a), power position (Porter & Heppelmann, 2014), business model components (Sjodin et al., 2019), capabilities (Ulaga & Reinartz, 2011), activities (Rabetino et al., 2015), routines (Immelt, 2017) and even decision-making styles (Huikkola et al., 2022b). Strategic change thus creates tensions (Kohtamäki et al., 2019; Visnjic et al., 2022) and rigidities (Lenka et al., 2018) within a firm. These tensions can be paradoxical by their nature (both-and approach) or contain trade-off elements such as dilemmas (either-or approach) (Visnjic et al., 2022). Furthermore, tensions can be considered wicked problems (almost impossible to solve because of their complexity) or dilemmas (dilemma can be solved but often requires counterintuitive business decisions and managerial practices; see Christensen et al., 2018).

To manage tensions regarding the strategic change, they need to be identified and categorized. Typical tensions identified in the management literature are related to belonging, learning, organising, and performing (Smith & Lewis, 2011). In the servitisation studies (e.g., Kohtamäki et al., 2020), these tensions have been categorized as follows: 1) effectiveness in the solution customisation vs. efficiency in production, 2) building a service and client orientation vs. maintaining an engineering and product mindset, 3) integrating products and services under one roof vs. separating services and products structurally, and 4) exploring innovation in solutions vs. exploiting product innovations. Based on existing servitisation studies regarding tension management, there exists different management

practices and routines to manage them in practice. Kohtamäki et al., 2020 discuss developing coping practices that help manufacturers to balance these paradoxes whereas Visnjic et al., (2022) identify different sequences and evolution of tensions and how manufacturer develops and establishes new routines to avoid their escalation. Lenka et al., (2018) discuss microfoundations and how individual actions can help manufacturers to overcome organizational resistance.

Despite these studies about tension management in service transition context, more is needed to know how managers manage these tensions in practice and what types of routines and practices they employ to successfully pursue such a strategic change. This article thus contributes to the extant servitisation literature of organisational tensions by shedding light on the managerial routines and practices that help to manage (inevitable) tensions stemming from strategic change from products to smart solutions.

2. THEORETICAL BACKGROUND

2.1 Digital servitisation and transition to smart solutions

Strategic transition from selling products to developing, selling, and providing smart services and solutions has been coined *digital servitisation* (Kohtamäki et al., 2021; Paschou et al., 2020; Sklyar et al., 2019; Tronvoll et al., 2020). This strategic transition has been studied from many perspectives in the existing servitisation literature. Theoretical grounds include capability (Spring & Araujo, 2013; Ulaga & Reinartz, 2011) and dynamic capability theory (Coreynen et al., 2017; Kindström et al., 2013), which has been considered the most dominant theoretical paradigm in the field (Raddats et al., 2019). Other theories applied to study this business phenomenon include power and industrial organisation perspective (Porter & Heppelmann, 2014), organizational identity theory (Huikkola et al., 2022), transaction-cost theory (Salonen & Jaakkola, 2015) and game-theory (Wagstaff et al., 2021). When product firms move towards selling more advanced services (Baines & Lightfoot, 2013) such as outcome-based contracts (Korkeamäki et al., 2021) or autonomous solutions (Makkonen et al., 2022), complexity of both offerings and the changes in the external environment increase. This increased complexity creates tensions within an organisation because the firm's business logic, identity and capabilities become more service and customer-oriented (Visnjic et al., 2022). Simultaneously, the firm must maintain its product-oriented business logic because products typically account for a remarkable share of its sales and are the basis for the (advanced) services sold for the clients (Kohtamäki et al., 2020). This ambidexterity needs alignment of both products and services/solutions (Bustinza et al., 2020; Schaarschmidt et al., 2018).

2.2 Organisational tensions

Organisations face productive tensions (Bingham & McDonald, 2022) and even conflicts (Tidström, 2014) when pursuing strategic change. These tensions emerge for instance from the misalignment of capabilities, mindsets and activities between the units (Töytäri et al., 2018), separate business logics (Kowalkowski & Ulaga, 2017), conflicts of interests (Kohtamäki et al., 2020) and different rhythms between the units (Huikkola et al., 2022b). Tensions (umbrella term) can be paradoxes, indicating that organisations face contradictions that lead to situations in which options are mutually exclusive and thus, difficult or impossible to make choices between them. Hence, paradoxes require accepting both-and approach rather than either-or solution. This either-or perspective is associated with dilemmas. Dilemmas are situations in which managers can evaluate both advantages and disadvantages of different options and then make a (justified) decision which one to choose from (Smith & Lewis, 2011). Many times dilemmas can be counterintuitive, meaning that practices to solve dilemmas are not rational and thus, they do not seem to follow common sense (Christensen et al., 2018). As an example, established and innovative firms should react to disruptive innovation in a manner that is not based on their existing competences, values and routines.

2.3 Dynamic capabilities and organisational routines

The dynamic capability approach addresses how firms renew themselves by developing and employing routines to sense new opportunities (Kindström et al., 2013), seize those opportunities

(Eisenhardt & Sull, 2001), and transform their capabilities to fit into rapidly changing environments (Teece, 2007). Firms revamp their routines to obtain, create, develop, and acquire new resources (Feldman & Pentland, 2003) and forget the old way of doing things (Huikkola et al., 2022). Organisational routines refer to repetitive patterns of actions to transform firm's assets. Routines are thus specific, repeated practices and checklists used to develop and execute strategic processes (Bingham & Eisenhardt, 2011). This routine perspective of dynamic capabilities suggests that firms learn through trial and error (Bingham & Eisenhardt, 2011). These mistakes made in the past lead to creating and establishing new routines that help firms to modify their assets and eventually, renew the organisation strategically.

3. METHODOLOGY

3.1 Research strategy and case selection

We adopt an in-depth, single-case study research strategy due to its capacity to support capturing the complex phenomenon of tension management (Eisenhardt, 2021). We chose an incumbent solution provider because the focal company has recently expressed its willingness to become a smart solution provider. This means that their vision in the future is to provide more advanced services such as outcome-based contracts and autonomous solutions to its clients globally.

We selected this company because it is one of the leading solution providers in its sector, the firm has been able to monetise its services for a relatively long time already, and it offers smart solutions for its clients in global markets. At the moment, the focal company must develop smart solutions to address both external and internal changes and pressures (e.g., profitability requirements from the stock markets). Thus, the company provides a good and appropriate case of a future smart solution provider and its challenges along the way. Furthermore, some of the research team members have more than ten years of experience collaborating with the case company on service business development initiatives. This long-term collaboration has enabled us to understand certain strategic themes, such as key challenges and their root causes.

3.2 Data collection and analysis

As stated earlier, researchers have collaborated with a studied firm for a long time. These collaborations include mutual research projects (e.g., about service and solution business development), joint research work (e.g., common research publications) and training (e.g., strategy-related issues, firm's involvement in the university courses). We have also conducted 20 interviews with firm's executives and managers to understand better the key challenges and tensions regarding the strategic transition towards smart solutions. We collected extensive secondary data from public sources such as websites, annual reports, press releases, firm histories, executive speeches (e.g., capital market days, public presentations), and internal strategy documents (e.g., playbooks, strategy documents). Hence, various sources of data were combined to triangulate the data (Yin, 1994) and increase the study's validity and reliability (Storbacka, 2011).

We analysed the data through a thematic pattern-matching method. We first analysed the focal company's general process towards services and smart solutions. Second, we analysed general challenges and tensions regarding that transition. Lastly, we coded management practices and routines employed to manage those challenges and tensions in practice. These codes were compacted into first-order themes describing interviewees' original use of language (Corley & Gioia, 2004). The second-order themes focused on analyzing these first-order themes, whereas the aggregate dimension represents the most abstract thematical dimension.

4. FINDINGS

4.1 Tensions emerging from the strategic change

We identified altogether five distinct tensions that emerged from firm's transition towards smart solutions. The first tension is short-term vs. long-term tension of target setting. As the case firm is a public listed manufacturer, profit pressures are evident and force company to behave in a manner

that serves short-term benefits. However, firm must be able to consider also long-term advantages and build a roadmap for the future. At the focal company, core technology roadmap for the company took as long as 20-30 year perspective. However, most projects were related to much shorter term objectives.

The second identified tension was related to tailoring vs. standardisation of doing. Tailoring is considered as a good service for the client. However, tailoring may be costly and inefficient as tailoring is not scalable and creates variation. Standardisation, on the other hand, attempts to reduce both variation and unit costs but may cause customer dissatisfaction, especially if the client has got used to tailored projects. Modularisation is one way to tackle these challenges and manage the tension stemming from efficiency-seeking standardisation and customer-satisfaction seeking tailoring.

The third tension is between product versus service mindset and identity. When product mindset is taking a push perspective (as Steve Jobs has said that customers don't know what they want), service mindset emphasises pull perspective that considers client as a key informant to develop solution offerings. As the focal company possesses a long tradition in manufacturing, selling and delivering products, this engineering mindset is dominant within a company. However, the studied company has been struggling with lack of service and customer orientation and started to emphasise the need to listen to clients' needs, job-to-be-dones, pains and gains better.

The fourth identified tension is related to organising tensions, namely whether to integrate products and services or keep them separated. When integration attempts to highlight synergy benefits between products and services, it often leads to power centralisation, especially for the unit that has traditionally gained power in history (in this case, the product unit). It may also lead to inefficiencies because of integration challenges. Structural separation, on the other hand, leads to efficiency benefits but hinders integration between products and services as both of the units are profit-and-loss responsible units on their own.

The last identified tension related to ambidexterity is taking advantage of existing assets (exploitation) versus exploring new opportunities. Established companies are typically in danger of falling into exploitation trap, indicating that they keep doing "right things for too long time". Start-up companies, on the other hand, may be in danger of falling into exploration trap, meaning that a firm is too keen on seeking too many ideas and is failing to exploit any of them successfully. To align both exploitative and explorative activities, managers can benchmark "ambidextrous organisations" and build practices that help to integrate these activities whether structurally (organisational-level integration) or contextually (individual-level integration).

4.2 Building integrative routines to manage tensions

We found three different integrative routines that help managers to manage tensions between products and services/solution businesses, namely 1) knowledge-sharing routines, 2) cross-functional collaboration routines and 3) decision-making routines. These organisational routines help a manufacturer to balance tensions stemming from contrary business logics of products, services, and software. These businesses also follow different cycles. These routines enable a firm to mitigate inertia regarding strategic change. However, executing these routines effectively is anything but easy.

Knowledge-sharing routines refer to ways to share information and knowledge within a company. In a studied case firm, ICT-systems played a remarkable role in sharing for instance customer information. This codified customer information and knowledge were useful not only for different business units (products, services, software) but also for the members within the same unit. To harness openness, the case firm created a playbook to encourage knowledge-sharing not only within a company but also across the boundaries. This playbook attempted to create new routines within a firm by encouraging people to share information. Encouraging examples to initiate change were the following extracts: *"Share your insights, skills and networks. What you know or can do just might be what is needed"* or *"Share your learnings and best practices with both the team and the wider audience"*. These extracts manifest a firm's willingness to establish new routines to share knowledge and information both within and between organisations.

Cross-functional collaboration routines accord with practices that force or encourage individuals in different business units to collaborate and coordinate activities. Working together helps units to intertwine these different business logics and become more familiar with each other. The studied case firm wanted to increase mutual cooperation because the complexity of both environment and provided smart solutions requested this approach as the following quotes manifest: *“We are dealing with such complex problems that we need multidisciplinary teams to solve them. The sooner we start solving together, the better”* and *“Make sure you all agree on the goal you’re aiming for. Aim for win-win-win situations: mutual good, growth and benefit.”* The danger of cross-functional collaboration and coordination is that these collaborations will resemble committees that lack real decision-making power and thus, real impact on business.

Decision-making routines are those situations in which decisions are made mutually. In the case company, decisions boards were established for instance, in situations regarding new solution development. Even though these decisions followed the regular funnel model, it was important that decisions in each phase had certain decision-making structures and rules. In the exploration phase, the case firm had to evaluate if the idea had merit, was it lucrative enough and did it have a strategic fit with existing businesses. After this exploration phase, the decision board needed to consider if the idea had real demand in the key customer segment, if the idea had enough monetary potential and if the firm possessed the capabilities to run this idea further. Making decisions more routinised was seen mandatory to establish a better system that was more consistent, systematic and efficient.

5. DISCUSSION

5.1 Theoretical contributions

The present study contributes to the existing literature on tensions in servitisation in two ways. First, the study advances the extant servitisation research of tensions (e.g., Kohtamäki et al., 2020; Korkeamäki et al., 2022; Visnjic et al., 2022) by identifying five distinct tensions regarding 1) time (short vs. long perspective), 2) efficiency (tailoring vs. standardising), 3) identity (product vs. service identity), 4) organising (integrated vs. separated) and 5) acting/doing (exploitation vs. exploration). These tensions become evident when a manufacturing company pursues a strategic change. These tensions can be framed whether as dilemmas (either-or) or paradoxes (both-and). In this case, managers treated these tensions as paradoxes as they tried to balance between them and utilized paradoxical framing (Vallaster et al., 2019) when addressing these emerging issues.

As a second theoretical contribution, the present study contributes to the discussion of tension management routines and practices (Kohtamäki et al., 2020; Visnjic et al., 2022) by identifying three integrative routines that help a manufacturer to better align products, services and software together. These integrative routines are knowledge-sharing routines, cross-functional collaboration routines, and decision-making routines. This study thus advances our understanding how manufacturers who attempt to sell smart solutions need to share knowledge and information not only within a firm but also across its boundaries. As the complexity in both environment and provided solutions increases, top management team needs to establish tools, practices and routines that facilitate knowledge and information sharing both within and between organisations. Utilisation of different ICT tools and platforms such as Slack or Jakamo is one way to facilitate knowledge and information sharing and codify the information (e.g., customer-related information, technology knowhow, process information). Cross-functional collaboration routines (see Porter & Heppelmann, 2014) attempt to increase mutual understanding of different businesses (products, services, software) and facilitate coordination of activities between them. Based on interviews, firms should devote enough resources to cross-functional development activities even though in the short-term perspective, they may not be so urgent. However, in the long run, investing in cross-functional work may increase mutual understanding and help firm to sense new opportunities, learn from each other, decrease information asymmetries between the units and understand different perspectives and requirements better. Mutual decision-making routines (see Cui et al., 2019; Huikkola et al., 2022b) have been established to make decision-making more transparent, increase mutual commitment, improve consistency, and make organisation more agile in responding to changes taking place in the environment.

5.2 Managerial contributions

Managers in manufacturing companies today are facing many tensions and they feel that they need to correspond to contradictory demands. Especially middle managers face different tensions occasionally. This study helps managers to understand that these tensions are almost inevitable and they can be identified and thus, managed. However, some tensions (dilemmas) can be solved whereas most of the tensions (paradoxes) cannot be solved. However, they can still be managed by establishing new integrative routines. The present study identifies key tensions firms face when pursuing strategic change from products to smart solutions. Furthermore, this study identifies key organisational routines and practices to manage those tensions. Managers can benchmark practices and routines identified in this study. In practice, managers can advance development of modularity within their organisations, establish new organisation structures (e.g., smart solution focused unit) to develop, sell and deliver smart solutions. To bridge products, services and software, integrative routines should be developed. Managers can pay special attention to create structures that facilitate knowledge sharing within an organisation (e.g., establishment of new ICT systems) and create incentives to use those systems. Also cross-functional collaboration should be encouraged to gain long-run benefits. Managers should avoid that this collaboration would resemble committees but ensure that real development occurs in those collaborations. One potential practice to increase cross-functional collaboration is job rotation between the units. This job rotation could include not only managers but also white collar professionals. Talent management should be considered in all of the units, meaning that services would not be seen as something dirty as is often the case in manufacturing companies. Also software people should be able to pursue opportunities in higher hierarchical layers.

5.3 Limitations and future research avenues

The chosen research method sets limitations for generalizability of the results. As this is a qualitative in-depth single case study, the results do not contain statements of the type or relative share or importance of tensions in managerial practice but form a general basis for understanding such tensions and opportunities for building balancing routines. Thus, other empirical studies applying comparative and multiple case method would be useful for building understanding on the contextual contingencies regarding industry and company characteristics and their connection with tensions and opportunities for balancing routines in practice. Future research could aim to produce individual level accounts on how managers identify tensions and what kind of emotions they feel when facing and managing them (Vuori & Huy, 2022). Future studies could also study microfoundations and psychological foundations of individual managers regarding these productive tensions – what kind of mental models and heuristics managers develop based on lessons learned from similar paradoxical framings.

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BEYOND SERVITIZATION: EXPLORING CONCEPTUAL PROLIFERATION IN THE INDUSTRIAL SERVICE LITERATURE

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KEYWORDS: service infusion; servitization; industrial services; digital.

1. INTRODUCTION

Interdisciplinary research is important for dealing with wicked problems or grand challenges. The key to solving wicked problems (and a successful integrated business), is a shared language. Despite the rhetoric, this remains a huge challenge to academics and practitioners alike. In a post-industrialized service world this problem is systemic.

2. THEORETICAL BACKGROUND

Industrial service literature is a multi-characterised domain (Li et al., 2020). Servitization whereby (manufacturing) firms improve their value proposition by adding services to their value proposition (Baines et al., 2017) is such a domain. Maintaining cognizance of the entire field is increasingly challenging. The level of consistency of conceptualisation is impacted by servitization research emerging from four areas: *operations*, *marketing*, *service*, and *general management* (Raddats et al. 2019). We need to further understanding of how definitions of servitization, service infusion and associated concepts fit together. In 1988 Vandermerwe and Rada (1988, p.314) suggested that servitization was: “managers looking at their customers’ needs as a whole, moving from the old and outdated focus on goods or services to integrated... with services in the lead role.” More recent definitions account for the increasingly key role of interconnected digital technologies and the role that digital transformation can play in business model change designed to evolve business processes, improve efficiency gains, and co-create greater value with customers (Favoretto et al., 2022). For example, in a manufacturing context Kamal et al., (2020:9)’s definition is that “*Servitization is the strategic shift of an organisation’s capabilities, human and financial resources and processes in order to offer end-to-end integrated services utilising innovative technologies that deliver added value to products*”.

However, recent developments point to the significant role in value co-creation that digital technologies can perform, at a more holistic level, e.g.:

1. recognition that service capabilities can be developed by actors outside of manufacturing organisations (Paiola et al., 2013; Story et al., 2017; Marcon et al., 2022)
2. the value of servitization for service organizations and ecosystems (Burton et al., 2022; Raddats et al., 2019; Story et al., 2017)
3. servitization for sustainability (Kamal et al., 2020; Doni et al., 2019)

Thus, our aim is to encourage dialogue that harmonizes industrial services terminology. We seek to answer the Research Question: Is there scope for a wider, more encompassing definition of industrialization of services, taking account of perspectives and activities of multiple actors within ecosystems, looking beyond adding value to (physical) products?

Such a definition would need to recognize co-creation of value in industrial services as a phenomenon occurring within *and* beyond focal firm boundaries.

In terms of digital servitization, a growing volume of research identifies how manufacturers have moved their focus from products to advanced, and increasingly smart solutions, as they pursue competitive advantage and associated higher returns and growth (Lightfoot et al., 2013; Matthysens & Vandenbempt, 2008; Rabetino et al., 2015; Kohtamäki, et al., 2021). Digital servitization or digitalization refer to the deployment of smart devices for “the transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic” (Kowalkowski,

Gebauer, Kamp, & Parry, 2017, p. 8; Skylar et al 2019). This technological change brings opportunities to new technological savvy actors to orchestrate ecosystems of actors to create new smart service solutions.

Despite these developments, the definition of 'servitization' (and thus in turn digitalization servitization), tends to suggest a perspective, locus of control and focus on value creating activity centred on the actions of a focal firm creating a servitized value offer (Raddats et al., 2019). Such a myopic view of value creation aligns with a goods-dominant view that is at odds with multiple research streams on B2B value creation, services marketing, and service systems, which recognize that value is co-created, is contextual and is determined by the customer perception:

- From the 1990's IMP researchers wrote about the network approach, asserting that: "actor behavior or dyadic business relationships cannot be fully understood without taking into account the actors' positions and history in a wider network of relationships" Möller and Halinen (2018, p.19).
- Vargo and Lusch (2008) in their work on service-dominant logic (SDL) suggested that goods could be seen to 'render' services (Grönroos, 2006) and that firms could propose and co-create value through the exchange of service for service with other actors.
- The Nordic School also offers a service logic for marketing, (which similarly to SDL rejects the concept of value-in-exchange inherent in goods-dominant thinking), in which exploring the service marketing phenomena in *context* (rather than goods-centric models) with goods seen as resources playing a role within the service process, better explains value co-creation outcomes (Grönroos, 2006)
- Research on service science and the study of service systems builds on SDL (Maglio and Spohrer, 2008) and the notion of value being 'derived and determined in use' in *context* rather than exchange (Vargo, Maglio and Akaka, 2008, p.145).
- Subsequent research on measuring outcomes (Zolkiewski et al., 2017) and the B2B customer experience (Witell et al, 2019) underlines the need to understand value assessment from the customer perspective.

Therefore, the notion of evolving actor roles and their impact on industrialization of service is ripe for exploration. An area of research that parallels and is often seen by academics as interchangeable with 'servitization', is the work on service infusion (often attributed to researchers in the Marketing domain) or service transformation. According to Wittell (2021) service infusion relates to increased services as part of a firm's offering. Therefore, we posit that service infusion may be a more flexible and encompassing concept, which might be stretched to include wider groups of actors, because it relates to business model change but not focal organisation specific change.

We explore literature considering infusion or increasing relevance of services (Brax, 2005) and compare this with the servitization literature. We consider studies that use 'servitization' and 'service infusion' interchangeably and those that maintain that they represent different phenomena (Raddats et al., 2019; Kowalkowski et al., 2017).

3. RESEARCH METHODOLOGY

Via a keyword search for 'service infusion' within Google Scholar (Figure 1) we identified 38 documents related to 'service infusion'. We used Google Scholar for this exploratory work because it is "broader and more encompassing than others" (Alexander, 2020, p.12). We sorted the results 'by relevance' as indicated by Google and stopped searching where we reached a page of publications that did not contain any relevant paper. We downloaded all relevant papers. To sense check included publications we applied researcher knowledge and searched abstracts and full papers to establish if the publication discussed 'service infusion'. Ten papers that focused on digital technology infusion and which mentioned service only in passing, were dropped from the sample. Within the remaining papers we considered whether the prime focus was (i) 'service infusion' or (ii) 'servitization', (iii) both, defined separately or (iv) an overlapping interchangeable combination.

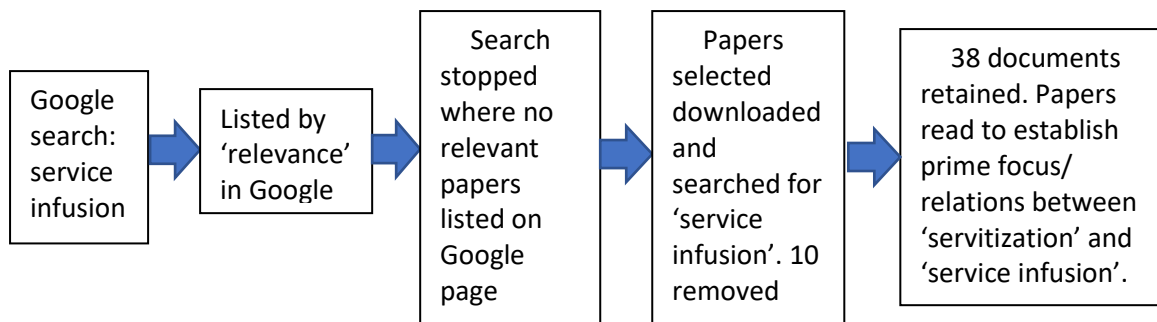


Figure 1: Research Methodology

4. FINDINGS (INITIAL)

Whilst remaining low as a proportion of the industrial service literature, the number of publications including discussion of 'service infusion' has been growing steadily (Figure 2).

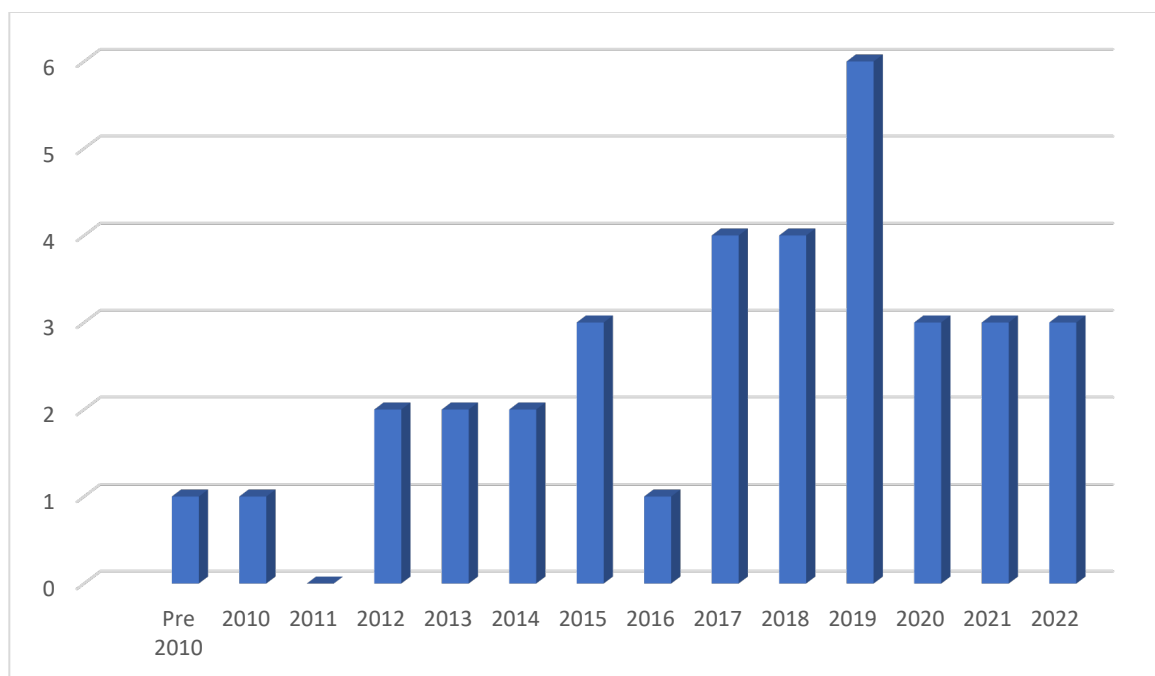


Figure 2: Number of 'service infusion' publications identified by year of publication.

Ten papers did not distinguish between service infusion/servitization. Others focused on: servitization (eight), both topics distinctly (six), service infusion (14).

Where a distinction was made by authors, service infusion was characterised by alterations to business models placing greater importance on customer-centred services within the offer bundle. This becomes servitization if it also involves attendant organisational transformation (Forkmann et al., 2017; Kowalkowski et al., 2017; Witell (2021). *"Service infusion is therefore understood as a process affecting the business model dimensions of transaction content, structure, and governance."* (Forkmann et al., 2017 p1), whilst servitization occurs where an organization changes its form in response to and in order to effect, efficient organizational business model change. Table 1 provides a summary of service infusion related phenomena in the literature, relating to a range of actors at multiple levels. We will present an expanded version of Table 1 at the SSC2023 conference.

Table 1: Key Findings

Scope of Orchestration	Actor	Original Core 'Product'	Service Infusion (Business model change)	Associated Servitization by focal firm (Business model <i>and</i> logic change)
Service Infusion by manufacturer	Focal manufacturer	Physical good	Yes	Yes
Digital service infusion by manufacturer and ecosystem	Focal manufacturer	Physical good	<i>Yes- but insufficient. Servitization is required.</i>	Yes
Service Infusion by Service provider	Focal service provider	Independent Professional Service	Yes	Yes
Service Infusion by ecosystem	Intermediaries	Facilitating Professional Service	Yes	No
Service Infusion in the network environment at industry or market level	Independent service providers	Competing Professional Services	Yes	No
		Competing physical good		No

5. THEORETICAL AND PRACTICAL CONTRIBUTIONS

We have identified eighteen papers recognizing that ‘Servitization’ and ‘Service infusion’ are distinct concepts, describing differing phenomena.

Servitization involves both a change in a focal firm’s business model *and* a change in its strategic logic, involving a shift from product to service/customer centrality. Such a focal firm may be a manufacturer, or they may be a service provider.

Service Infusion also involves business model change, whereby service offerings become of greater importance (Johansson, Raddats, Witell, 2019), but it lacks the requirement for change in strategic logic. It can take place within a focal firm, encompassing multiple levels and actors. However, we contend, that where it differs significantly from servitization and offers a broader definition of the evolution of industrial service activity, is that it can also occur outside of, focal firms. Thus, external service infusion activity, within the focal firm’s ecosystem or the wider industry network, can impact focal firms and their ecosystem of related actors. This distinction is important because much work on servitization and service infusion fails to identify the difference and applies a focal firm specific descriptor (servitization) to the wider concepts of service infusion occurring between multiple actors. In part this may be a symptom of the focus on qualitative dyadic case-based studies, which are a convenient and often necessary route to access rich data that is difficult to capture. It reflects the challenge of collecting data to make sense of entire dynamic ecosystems. Key work highlighting differences between these concepts tends to be published in the area of marketing (e.g., Kowalkowski et al., 2017; Witell, et al., 2021) or multidisciplinary work providing an overview of the domain (Kohtamäki et al., 2021), but it remains limited and often still applies a single combined definition. We call for cross-disciplinary implementation of a distinction between servitization and service infusion in order to encourage recognition of the impact that ecosystem or network level service infusion may have on the servitization decisions of focal firms.

We therefore propose an extended definition of service infusion developed from that offered by Kowalkowski et al., 2017, p.7:

Service infusion can be defined as the process whereby the relative importance of service offerings, (i) to a business unit, or (ii) to a firm, or (iii) to a firm’s ecosystem or (iv) within the wider network, increases so augmenting the firm’s service business orientation and/or increasing the significance of service business for other ecosystem actors and/or the industry.

5.1 Limitations

Limitations of this work are inherent in the method of data collection. For speed, we undertook a Google Scholar search; with more time a more comprehensive approach could involve a structured literature review using different search systems (Gusenbauer and Haddaway, 2020; Tranfield et al., 2003). A subsequent Google Scholar search check for a broader range of terms in combination: ‘service infusion PSS hybrid servitization’ identified three additional papers which were not included in this study in which google failed to identify ‘service infusion’ despite its presence in the papers.

5.2 Future Research

A structured literature review drawing upon a wider range of databases might offer greater accuracy and could be extended to encompass associated concepts, e.g., hybrid solutions, product-service solutions, service transformation, in order to map and compare terms used to describe industrial service evolution. Future cross-disciplinary research needs to focus on developing empirical data analysis at the ecosystem level before then deep diving to consider the perspectives of multiple actors. Researchers also need to specify and distinguish their own understanding of key terms relating to the industrialisation of service to ensure improved understanding, accuracy, and co-operation across the domain.

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MOVING TOWARDS “EVERYTHING-AS-A-SERVICE” IN MANUFACTURING: A FRAMEWORK

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ABSTRACT

Purpose: Manufacturers are interested in the adoption of the Everything-as-a-service (XaaS) model in order to gain a new competitive advantage and generate service revenues on a continuous basis. At the environmental level, the XaaS model can also contribute to greater sustainability, since retention of ownership by providers achieves better resource use. Despite this increasing interest, the application of the XaaS model in manufacturing is still limited. This paper addresses this gap by developing a framework that can be used to identify the key elements that characterize the XaaS models in manufacturing companies.

Design/Methodology/Approach: The proposed framework has been developed based on the literature dealing with XaaS and PSS Business Models, which allowed us to identify the relevant dimensions for the adoption of the XaaS paradigm.

Findings: This paper identifies a set of 8 dimensions and 32 variables that need to be designed to successfully implement a XaaS and thus guide strategic decisions.

Originality/Value: This research, contributes to the systematization of knowledge on this topic, which is gaining increasing attention from research and management. Moreover, the proposed framework can help companies in taking into account all the relevant aspects that need to be considered for implementing the XaaS paradigm in manufacturing.

KEYWORDS: Everything-as-a-service, Servitization, Pay-per-x, Sustainability

1. INTRODUCTION

In the last decades, companies have realized that services and service-oriented business models (Adrodegari & Saccani 2017) may generate significant profits and less imitable competitive advantages (Kindstrom 2010). In addition, also in manufacturing sectors, customers are today increasingly demanding a shift to more flexible business models instead of one-off payments (Pezzotta et al. 2021). Manufacturing companies, therefore, are increasingly moving from product-centric offerings to services and solutions, in what has been defined as servitization (Vandermerve e Rada 1988): this transformation can be seen as an opportunity for gaining revenues and a new competitive advantage, and a source of revenue, profit, customer retention, and long-term competitive advantage (Gebauer et al. 2017). The service-oriented business models, in which the use or result of a product is sold instead of the product itself, are therefore gaining attention and are nowadays often referred to, especially in the management community, as the “Everything-as-a-service” (XaaS) paradigm (Duan et al. 2015). Various declinations of this term have emerged also in manufacturing, such as “Equipment-as-a-Service”, “Product-as-a-Service”, and “Manufacturing-as-a-Service”. In this context, the term “as-a-service” is used to define business models in which new digital technologies are the enabling factor for making products-services accessible on demand (Classen et al. 2023). The need for a more flexible business model to face competition, increased customer focus on preserving cash and reducing capital spending as well as new opportunities offered by AI and automation processes are therefore driving also manufacturing companies to take this path.

However, this transition is challenging and requires, in line with the servitization literature, fundamental changes in the structure, culture, and competencies of the company. As a consequence, a limited application of servitized-business models associated with the XaaS paradigm (i.e. access or use-oriented) in manufacturing has been observed today (Relayr 2022), also due to the fact that this

transformation seems to be still poorly understood in practice. As well the literature on this topic appears fragmented and has not defined the elements that can characterize this transformation.

This paper aims to develop a framework that identifies and characterizes the key elements that need to be designed to successfully implement the XaaS paradigm in manufacturing.

This article is structured as follows: Section 2 provides the research background; Section 3 presents the main evidence of the literature analysis while Section 4 describes how this literature has been used to design the new XaaS framework. The final section proposes conclusions, limitations, and further developments of this work.

2. BACKGROUND

2.1 The Everything-as-a-Service paradigm

The concept of XaaS has its origin in the information technology domain, with the Cloud Computing paradigm, a term introduced in 2007 to indicate an IT delivery model based on virtualization where resources, consisting of infrastructures, applications, and data, are provided as an on-demand service via the Internet (Duan 2015, Durao et al. 2014). Various declinations of the concept have emerged generally named based on the sales object and the application sector (e.g. Software-as-a-Service (Goyal 2013), Communication-as-a-Service (Garai 2015), Network-as-a-Service (Costa 2012), Maintenance-as-a-Service (Zoll 2018), Heat-as-a-Service (Britton et al. 2021), Mobility-as-a-Service (Jittrapirom et al. 2017)).

Even with some differences, all concepts are used to define business models in which digital technologies are the enabling factor to make on-demand products-services accessible through subscription-based or pay-per-x models (Classen et al. 2023). The concept of XaaS is in fact closely linked to the revenue generation mechanism. Two macro-categories are thus distinguished: the Subscription category, which requires the payment of an agreed sum at a certain periodicity, and which is the immediate next step from the one-off sale of an asset, and the Pay-per-x category, where revenue streams are based on the actual use of the good by the customer (Pay-per-use), the performance of the machine (Pay-per-performance), or the output actually produced (Pay-per-outcome) (Gebauer et al. 2017; Uski et al. 2022).

In all these categories, the producers typically maintain product ownership and lifecycle responsibility (Gebauer et al. 2017). These entail an incentive to adopt levers that are typical of the circular economy paradigm (Bressanelli et al. 2018). In fact, XaaS models help to maximize resource productivity and lifetime value, using less material, and decreasing waste and operational costs (Vahle et al. 2022, Gebauer et al. 2017). Moreover, at the end of the utilization cycle, retained ownership also enables the remanufacturing and recycling of valuable raw materials (Kjaer et al. 2019). An example of the potential impact of XaaS models on environmental sustainability can be found in the Cars-as-a-Service (CaaS), in which a company provides vehicles to its customers based on actual need and pays according to usage, could complete the transformation to sustainable passenger transportation, contributing to the reduction of CO2 emissions (Roblek et al. 2021).

2.2 XaaS in manufacturing: Equipment-as-a-Service

One of the most widely used declinations of the XaaS paradigm in manufacturing is the “Equipment-as-a-service” (EaaS), where the manufacturer is responsible for all activities required for the proper functioning of the equipment (Gebauer et al. 2017) and performs therefore all required services over the product life-cycle (e.g. taking care of spare parts, consumables, technician time and recalibration of settings, ...). The shift from one-off sales of capital goods to recurring revenue streams based on equipment usage or output has been a common practice in certain industries for more than a decade. One prime example is the well-known “power-by-the-hour” model by Rolls-Royce (Begadia & Vitasek 2012) which demonstrates that these models can improve financial economics and competitiveness by offering companies a way to compete on value parameters other than production costs only. Today, manufacturers adopting the XaaS paradigm can have a greater opportunity to innovate (Bhattacharya & Bhattacharya 2022). Offering XaaS models in fact, enhances customer relationships toward partnerships, competing with traditional models in terms of customer experience and loyalty due to

the long-term nature of the relationship (Moraes & Cunha 2022). Indeed, such duration facilitates collaboration and the co-creation of common values. In XaaS business models, additional value is created through integrated services that ensure product performance or meet advanced customer needs (Moro et al. 2022a). Further, XaaS model users benefit from financial advantages. In fact, XaaS business models shift business activities and budgets from a CAPEX (capital expenditures) to OPEX (operating expenditures) basis, moving from high one-time expenditures to recurring. Today, digitally enabled technologies such as sensors and IoT connectivity can further improve the adoption of this model, enabling more efficient operations through performance data (e.g. flexible billing/utilization, data transparency). Moreover, digital platforms are increasingly being adopted in the industry and this is enabling the adoption of XaaS models in manufacturing (Singh et al. 2021). XaaS models emerge in companies of various sizes on the basis of different motivations. Companies in younger, technology-driven market segments often implement XaaS models to proactively push products to market. Some SMEs seem to consider XaaS models mainly to create recurring value based on technological advantages (e.g. connectivity throughout the supply chain), reflecting the practices of the Software-as-a-Service sphere, while companies in more mature or historical sectors often seem to offer such models as a defensive move.

Despite this potential, EaaS is still in its infancy. Accordingly to the “Equipment as a service adoption in the U.S. manufacturing industry” study by Relayr 2022 today less than 35% of surveyed companies are currently offering products or services in “as-a-service” mode.

3. CONCEPTUAL DEVELOPMENT

Building on the analyzed body of literature, we developed the model described in the following table. We use common dimensions of the analyzed framework as a basis for the model. In addition, each dimension was operationalized with variables derived from the literature that represent the relevant aspects for the adoption of the XaaS paradigm in companies.

Dimension	Relevant aspects for XaaS	Key References
Value proposition	• Offer object • Customization • Communication • Ownership	Moro et al. 2022a; Adrodegari & Saccani 2020; Adrodegari et al. 2017; Kindstrom 2010
Customers	• Customer segments • Customer relationship • Customer involvement	Chakrabarti et al. 2022; Moro et al. 2022a; Kimita et al. 2022; West et al. 2022; Adrodegari & Saccani 2020; Adrodegari et al. 2017; Kindstrom & Kowalowski 2014, Wikstrom et al. 2009;
Ecosystem	• Presence of strategic partners • Alliances definition • Systemic integration	West et al. 2022; Kindstrom & Kowalowski 2014.
Organization structure and culture	• Commitment • Roles and responsibilities • Presence of a digital team • Aftersales and distribution network	Schroderus et al. 2023; Moro et al. 2022a; Kimita et al. 2022; West et al. 2022; Adrodegari & Saccani 2020; Wikstrom et al. 2009.
Economic and Finance	• Revenue stream and mechanism • Cost structure • Risk detection and mitigation • Contract management • KPI	Moro et al. 2022a; West et al. 2022; Adrodegari and Saccani 2020.

Sustainability	• End-of-life and reverse logistics strategies • Product-life extension strategy • Use and service intensity	Moro et al. 2022a; Kolling et al. 2022
Resources	• ICT and monitoring technologies • Installed base product usage and process data • Data security • Field service technologies	Schroderus et al. 2023; Moro et al. 2022a; Bulut et al. 2021; Adrodegari & Saccani 2020; Adrodegari et al. 2017; Kindstrom & Kowalowski 2014.
Capabilities	• Data collection and data analysis capabilities • Design Capabilities • Risk assessment capability • Human capability	Schroderus et al. 2023; Moro et al. 2022a; Kimita et al. 2022; Adrodegari & Saccani 2020; Kindstrom & Kowalowski 2014.

Table 1 - XaaS Dimensions

3.1 Value proposition

In the XaaS domain, the offering can be related to Product/machinery/system (i.e., the supply of machinery, production systems, and equipment), Service (services for installation, support, and maintenance, as well as components and spare parts), or Software (software for optimizing business operations/processes, data storage, and analysis). Offering communication is a key variable in this dimension, as value propositions must communicate favourable value changes adopting the XaaS models for the customer, such as reducing problems and emerging benefits (Moro et al. 2022a). Also, the aspect of customization, namely the provision of superior or unique value through the design, modification, and selection of services (Nordin et al. 2011) is an important component of the XaaS value proposition. In the XaaS model, in fact, there is a need for balancing customization needs against the possibility of satisfying multiple customers with a single offering (standardization). In XaaS models, a good compromise is modularity, which combines the advantages of standardization (lower costs) with those of customization (personalization). Value proposition includes also the aspect of product ownership (Adrodegari et al., 2017), which is the foundation of the XaaS paradigm, where the ownership of the product remains of the provider.

3.2 Customers

Chakrabarti et al. 2022 highlight the aspect of customer centricity and the ability to understand the unspoken requirement of the client as an important lever to support the implementation of a new paradigm, such as the XaaS. Understanding customer needs is in fact critical to define service-oriented value propositions (Adrodegari & Saccani 2020). In this dimension, we have analyzed the presence of different target customers (customer segments), since defining which customers are likely to be interested in such an advanced and complex offering is a critical element for these business models. In fact, different targets may have different needs (e.g. Capex-Opex, performance guarantee, reduction of initial investment, ...), often also influenced by the sector in which they operate and the business size of the customers themselves. The relational aspect, namely how the company establishes direct contact with the consumer is also important, in that the XaaS model needs trust and communication, for example in the provision by the company of its data. Furthermore, of particular interest is the variable of customer involvement, which relates to the capability of engaging customers in the development of the XaaS offering by soliciting customer inputs (Jin et al. 2014).

3.3 Ecosystem

The first investigation variable of our framework is the presence of strategic partners for the delivery of the XaaS offering, which is a critical variable because the use of a servitization strategy

involving extensive use of technology, such as the XaaS model, requires a coordinated effort among all actors (Sklyar et al. 2019). Moreover, the presence of a strategic partner at the financial level is essential to be able to assume the financial risk, resulting from the lack of product sales. Also the contractual, legal, and revenue distribution aspect among ecosystem actors (alliances definition) is an important variable because it is necessary to define the task to be performed by each partner, and how the value obtained from the offering will be distributed. Also, the positioning and role of the company, standardization of processes, control, and performance monitoring (systemic integration) must be established, so as to define the organization within the ecosystem. In fact, the value proposition depends on the actor's participation, regardless of whether or not they have direct links to the customer (Adner 2017).

3.4 Organization structure and culture

As culture is often reflected in the organizational structure of the company, we include these aspects in the same dimension, following the approach proposed by Wikstrom et al. 2009 and West et al. 2022. Within this perspective culture deals with collaboration, sharing knowledge, and attitude toward accepting the new XaaS model in the organization (Schroderus et al 2023). This translates into a business organization that will have a widespread commitment at the level of top management and a centrality of service division throughout the organization and especially in product development, marketing, and sales department (Moraes & Cunha 2022). The presence of a specialized unit focused on XaaS is an essential element for designing and selling the new XaaS offering, as well as the establishment of a team for technology-level after-sales support and data collection/analysis (Presence of a digital team). In fact, it is not only important to collect the data, but also to understand the useful information both for the customer, which can be shared as an additional service, and for the company itself in order to comprehend the status and operation of the product, allowing the implementation of the pay-per-x revenue model (Chakrabarti et al. 2022). The organization at the aftersales and distribution network level will also need to be functional for a XaaS-type offering, with an established service delivery and field service structure and capabilities and dedicated roles and resources for end-of-use and reverse logistics management.

3.5 Economic and Finance

Ranked as one of the seven barriers to be managed for the transition to service delivery in manufacturing (West et al 2022), the economic aspect is aggregated with value capture in the model proposed by Moro et al. 2022a. we decided to adopt the same strategy, as one of the defining characteristics of XaaS is the revenue model (revenue stream and mechanism), which combines the economic aspect with actual value generation for the customer, who can thus pay a monthly fee (subscription) or based on actual usage, availability, or performance (pay-per-use, pay-per-availability, and pay-per-performance). The revenue model is one of the key aspects of this dimension since elements such as the need to develop procedures and models to manage legal and contractual aspects (Chavez et al. 2023) as well as the need to measure aspects defined precisely in the contract (Kpi), such as the profit and the return on investment (Moro et al. 2022b), are linked to this variable. Another key element is risk management (Chakrabarti et al. 2022). In particular, companies need to identify and mitigate the risk associated with the operational, financial, and behavioral aspects (Schroderus et al. 2023). For this reason in our framework, we put attention to risk management. In this case, the variables investigated are the presence of risk mitigation and controversy management tools, from the perspective of partnership, contracting, measurement, and data collection as well as the proper targeting of the offer, and the presence of a measurement system that signals risks (risk detection).

3.6 Sustainability

As the manufacturer retains ownership of assets, XaaS models offer the possibility to reduce resource consumption and deal with through-life and end-of-life issues (Pigosso & McAloone 2016). From the company perspective, this is strictly connected to the reverse logistic and remanufacturer

concept (Paricio et al. 2019, Kazakova & Lee 2022). In fact, the XaaS paradigm can include at the expiration of the contract the return of the good, which can then be reconditioned and reused for other contracts, even with shorter expiration dates (Pigosso & McAloone 2016). In addition, remanufacturing combined with the XaaS paradigm allows for increased customer acceptance of remanufactured products, as the customer is only interested in the functioning of the good (Kazakova & Lee 2022). The product-life extension strategy, especially in the design phase, is also an important part of the XaaS paradigm because due to the firm's ownership of the product and performance-based profit, firms are advantaged design products of higher durability. These features could translate into lower production and natural resource consumption (Kanatlı & Karaer 2022). Moreover, we analyze the development of use-intensive/service-intensive products in order to maximize products' utility for more customers. In fact, in this way as-a-service model converges consumer demand on a few products rather than meeting each one with a separate product (Kanatlı & Karaer 2022, Despeisse 2022).

3.7 Resources

In the XaaS model, particular importance is given to the use of technologies and especially cloud computing (ICT and monitoring technologies) used for monitoring products/systems and real-time data collection, as well as instrumentation for reorganizing, processing and interpreting data, necessary for as-a-service (Installed base product usage and process data) (Chakrabarti et al. 2022). These technologies must, however, satisfy customer privacy and security (data security) requirements and be as integrated as possible with existing management systems (Schroderus et al. 2023). Technologies for field service development (field service Technologies) also play an important role in the XaaS model, allowing services to be delivered quickly and easily (Bulut et al. 2021).

3.8 Capabilities

Capabilities are basically what the firm can do (Kindstrom & Kowalowski 2014), but the concepts' boundaries are not often clear as the term "capabilities" is mentioned in different ways in extant literature (Chirumalla et al. 2023). Kimita et al 2022 classify them into seven categories to demonstrate how this dimension crosses over to the dimensions previously identified, as well as Moraes & Cunha 2022. In our model too, the capabilities dimension is transversal to the others identified above. Especially, we analyze data collection and data analysis capabilities, risk assessment capabilities, and human capabilities, fundamental to the adoption of the XaaS paradigm. In fact, Sjödin et al. (2016). highlight that the combination of data processing and interpretation capability, risk assessment and mitigation capability, and hybrid offering sales capabilities can have an enhancing effect on outcome-based product-service offerings. Special emphasis is given to data collection and data analysis capabilities, such as the advanced ability to use smart and connected physical products, which are considered relevant to the provision of advanced product-service offerings (Cimini et al. 2021). Risk assessment and mitigation capabilities are very important, as described above, as the XaaS model involves retaining ownership of the asset and the risks are all borne by the company. Moreover, design capabilities, to encourage the practices described in the sustainability dimension, and human capabilities, such as the competencies to deal with customers, must be present in the company (Kimita et al. 2022).

4.CONCLUSION

The XaaS paradigm is attracting increasing interest in companies, particularly in the manufacturing sector. Indeed, there are numerous benefits related to the adoption of the as-a-service model, from an economic, customer relationship, and environmental point of view. Nevertheless, little attention has been given to identifying the main characteristics that companies must have to implement such a model. This paper, therefore, seeks to provide a guideline for manufacturing companies through a framework based on 8 key dimensions and key variables. However, the framework was developed at the theoretical level; future research developments, therefore, involve its practical application

through an empirical application through case studies with companies belonging to the manufacturing sector.

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BREAKING DOWN THE BLACK BOX OF INDUSTRY PLATFORM PROCESSES: A SYSTEMATIC LITERATURE REVIEW AND RESEARCH AGENDA

Khaled Abed Alghani & Marko Kohtamäki

ABSTRACT

Purpose: Despite the increasing prevalence of industry platforms, we still lack a comprehensive understanding of the processes that platform owners should undertake. Our knowledge of how these platforms are created, how they attract and integrate various actors, how they design governance mechanisms, how they manage internal and external issues, and how they evolve remains fragmented across different literatures. Moreover, our understanding of the antecedents and outcomes of these processes is limited.

Design/Methodology/Approach: A systematic literature review of 442 articles from top-tier journals focused on industry platforms.

Findings: This study makes three significant contributions: (1) identifying the key processes that platform owners pursue in the context of industry platforms, (2) identifying the antecedents and outcomes of these processes, and (3) presenting a comprehensive research agenda to guide future research on industry platforms.

Originality/Value: Although previous literature reviews on this topic and other related ones have contributed valuable insights to the literature and we have leveraged them to enhance our understanding of industry platforms, none of these studies have comprehensively examined the processes involved in a platform owner's journey, including their antecedents and outcomes. Therefore, this study is the first to address this gap in the literature by comprehensively examining the black box of industry platform processes that platform owners undergo.

KEYWORDS: industry platforms, two-sided markets, digital platforms, multi-sided platforms, network effects, micro-processes

1. INTRODUCTION

The examination of the credit card industry and the associated antitrust cases were the driving force behind the subsequent research on the topic of two-sided markets, which was initiated by the economics literature (de Reuver et al., 2018). In two-sided markets, value is generated through the coordination of various market actors (Gawer, 2014), with pricing as a key mechanism to achieve such coordination (Caillaud & Jullien, 2001; Caillaud & Jullien, 2003; Rochet & Tirole, 2003; Parker & Van Alstyne, 2005; Armstrong, 2006; Rochet & Tirole, 2006; Eisenmann et al., 2006; Rysman, 2009). By integrating insights from both the economics and engineering literature (Baldwin & Woodard, 2009), which conceptualize platforms as intentionally designed technological architectures that foster innovation, Gawer (2014) bridged the two perspectives and, along with Cusumano, coined the term "industry platforms" (Gawer & Cusumano, 2014a). Industry platforms are defined as "products, services, or technologies developed by one or more firms, and which serve as foundations upon which a larger number of firms can build further complementary innovations and potentially generate network effects" (Gawer & Cusumano, 2014: 420), where network effects are the most prominent feature that sets industry platforms apart from supply-chain or product platforms. Furthermore, in response to Tilson et al. (2010), Yoo et al. (2010), and Tiwana et al. (2010) regarding the scant attention given by Information Systems (IS) scholars to the subject of platforms, several scholars have since addressed the topic, including, Ghazawneh & Henfridsson (2013), Huber et al. (2017), and Foerderer et al. (2018). As the platform architecture consists of a stable core, a variable periphery, and interfaces, with control over the interfaces equating to control over the platform interfaces (Baldwin & Woodard,

2009), the IS literature has primarily focused on governance mechanisms which are concerned with behavioural complexities (Constantinides et al., 2018).

The fragmented structure of the industry platforms literature, as discussed earlier, led to each literature focusing on distinct aspects of industry platforms. While this approach allowed us to gain valuable insights into different processes related to industry platforms, it also meant that these processes were examined in isolation. For instance, the economics literature has provided valuable insights into platform competition and the use of pricing as a means to integrate various market actors and as a coordination mechanism (Caillaud & Jullien, 2001; Caillaud & Jullien, 2003; Rochet & Tirole, 2003; Parker & Van Alstyne, 2005; Armstrong, 2006; Rochet & Tirole, 2006; Eisenmann et al., 2006; Rysman, 2009); and the information systems literature, building on the engineering viewpoint of platform architecture (Baldwin & Woodard, 2009), has provided significant insights into platform governance (Tilson et al., 2010; Yoo et al., 2010; Tiwana et al., 2010; Ghazawneh & Henfridsson, 2013; Wareham et al., 2014; Eaton et al., 2015; Huber et al., 2017). Although various literatures have offered valuable insights into different processes related to industry platforms, these processes are like puzzle pieces of a larger puzzle. As a result, we still do not fully understand all the processes that platform owners go through. Additionally, certain processes remain understudied in the literature, such as how platforms emerge (Gawer & Cusumano, 2014; Gawer, 2014; Tan et al., 2015; de Reuver et al., 2018; Shi et al., 2021) and how they evolve (Gawer, 2021). Besides, the different literatures have not only neglected certain processes but have also limited the scope of the topics they have discussed. For example, regarding the integration of different market actors, the economics literature has predominantly focused on pricing mechanisms (Rochet & Tirole, 2003; Parker & Van Alstyne, 2005; Armstrong, 2006; Rochet & Tirole, 2006; Eisenmann et al., 2006; Rysman, 2009), creating an impression that these are the only means of attracting different actors to the platform. However, recent literature has revealed that non-pricing mechanisms (Eisenmann & Hagiu, 2007; Sridhar et al., 2011; Hagiu & Spulber, 2013; Fang et al., 2021) can also play a significant role in attracting different actors to the platform and in coordinating their behavior and interactions. Furthermore, in designing governance mechanisms, the literature has exclusively emphasized hard governance mechanisms (Ghazawneh & Henfridsson, 2013; Parker & Van Alstyne, 2018; Foerderer et al., 2018; Young Kang & Suarez, 2022) to the extent that the existence of soft governance mechanisms has been overlooked (Foerderer et al., 2021). However, recent literature has highlighted the significant role that soft governance mechanisms play in coordinating the various actors on the platform, e.g., awards (Foerderer et al., 2021). Additionally, while the literature has primarily addressed competition-related managerial issues, such as, multi-homing (Eisenmann et al., 2006) (Doganoglu & Wright, 2006) (Armstrong & Wright, 2007) (Doganoglu & Wright, 2010) (Belleflamme & Peitz, 2019) (Bakos & Halaburda, 2020) (Wiegand et al., 2022), winner-take-all (Eisenmann et al., 2006) (Cennamo & Santalo, 2013), and envelopment (Eisenmann et al., 2006), there are other non-competition related challenges that also require attention and management, e.g., hiring (Ge et al., 2020).

In order to bridge this gap, this study aims to perform a comprehensive and systematic literature review that encompasses various works pertaining to platforms associated with network effects, that is, two-sided markets (Caillaud & Jullien, 2001; Caillaud & Jullien, 2003; Rochet & Tirole, 2003; Parker & Van Alstyne, 2005; Armstrong, 2006), two-sided networks (Parker & Van Alstyne, 2005), multi-sided platforms (Hagiu & Wright, 2015), industry platforms (Gawer & Cusumano, 2014a), digital platforms (de Reuver et al., 2018), and innovation platforms (Zahra & Nambisan, 2011), allowing for an in-depth exploration of the distinct processes that platform owners undergo. Our study is based on a comprehensive systematic literature review of 447 articles that were published in top-tier journals, specifically focusing on industry platforms while disregarding studies that examine internal, company, product, and supply-chain platforms. Besides, although previous literature reviews on this topic and other related ones, including, (Roson, 2005), (D. P. McIntyre & Subramaniam, 2009), (D. P. McIntyre & Srinivasan, 2017), (de Reuver et al., 2018), (Constantinides et al., 2018), (Rietveld & Schilling, 2020), (Kapoor et al., 2021), and (Trabucchi & Buganza, 2022b), have contributed valuable insights to the literature and we have leveraged them to enhance our understanding of industry platforms, none of these studies have comprehensively examined the processes involved in a platform owner's journey,

including their antecedents and outcomes. Consequently, this study contributes to the literature on industry platforms by: (1) identifying the key processes pursued by platform owners in the context of industry platforms, (2) identifying the antecedents and outcomes associated with these processes, and (3) presenting a comprehensive research agenda to direct future research efforts on industry platforms.

2. METHODOLOGY

This systematic literature review adheres to Tranfield et al.'s (2003) widely recognized guidelines, which involve defining search terms, identifying relevant journals, and establishing criteria for the selection of pertinent articles. We narrowed our focus to academic journals that spanned a range of disciplines, including, accounting, economics, econometrics and statistics, entrepreneurship and small business management, finance, general management, ethics, gender, & social responsibility, human resource management and employment studies, information management, innovation, marketing, operations and technology management, operations research and management science, organization studies, and strategy. Furthermore, we utilized Elsevier's Scopus, which is widely regarded as the premier tool for conducting literature searches (Falagas et al., 2008), to identify and search for our selected keywords.

Our objective was to select articles containing one of the following keywords in their title, keywords, or abstract (Newbert, 2007): "tech* platform*" OR "external platform*" OR "industry platform*" OR "transaction platform*" OR "innovation platform*" OR "hybrid platform*" OR "digital platform*" OR "software platform*" OR "software based platform*" OR "software-based platform*" OR "internet platform*" OR "two sided market*" OR "two-sided market*" OR "twosided market*" OR "two sided platform*" OR "two-sided platform*" OR "twosided platform*" OR "multi sided market*" OR "multi-sided market*" OR "multisided market*" OR "multi sided platform*" OR "multi-sided platform*" OR "multisided platform*" OR "platform logic" OR "platform competition" OR "platform evolution" OR "platform governance" OR "platform leader*" OR "platform ecosystem*" OR "platform based ecosystem*" OR "platform-based ecosystem*" OR "platform-based organization*". However, to focus only on industry platforms, and because an industry platform is set apart from an internal platform or a supply chain platform by its ability to generate network effects (Gawer & Cusumano, 2014b), we included a second search string where we required that the selected articles should include "network e*", which refers to network effect, network effects, network externality, or network externalities, in their full text. Initially, our search yielded 448 articles, out of which 27 had to be excluded since they did not pertain to industry platforms and instead focused on internal or supply-chain platforms. Subsequently, upon reviewing the reference lists of the selected articles, we identified an additional 26 articles that satisfied our inclusion criteria, bringing the final count to 447 articles.

3. INDUSTRY PLATFORM PROCESSES

Based on the systematic review that we have conducted, we were able to identify five different processes that a platform owner undergoes: (1) creation process, (2) integration process, (3) design process, (4) management process, and (5) evolution process. Besides, it is important to note that in this paper, we will be relying on Cusumano et al.'s (2019) classification of industry platforms. They distinguish between two primary types of industry platforms: transaction platforms, which enable exchanges or transactions between different parties, such as the Apple AppStore, and innovation platforms, which facilitate complementary innovations by serving as a technological foundation, such as Apple iOS. Additionally, hybrid platforms, such as Apple, share functions of both the transaction and innovation platforms (Cusumano et al., 2019).

3.1 Micro-processes of industry platform creation

The topic of platform emergence, or the process of creating industry platforms (Gawer & Cusumano, 2008), has been under-researched in academic literature (Shi et al., 2021; Gawer, 2014; Tan et al., 2015; de Reuver et al., 2018). Recently, Teece et al. (2022) proposed a classification system for platforms based on their origins and value proposition in the value chain. This classification includes incumbent-born platforms, created by incumbent firms targeting existing customers, platform-born

adjacent, created by incumbent companies targeting new customers in different markets, and born-platform startups, created by entrepreneurs offering innovative products and services using new technology to target new customers (Teece et al., 2022). Given this classification and based on our review, we further categorize the process of industry platform creation into incumbent-born platforms and born-platforms.

On one hand, incumbent-born platforms are those platforms that originate from incumbent firms (Teece et al., 2022). Gawer & Cusumano (2008) argue that any firm, regardless of its size, can create a platform by addressing specific business and technological challenges. To achieve this, a firm must consider two strategic options: (1) Coring, which refers to creating a new platform in a previously non-existent market, and (2) Tipping, which refers to gaining market momentum to win platform competition. Besides, Gawer (2014) posits that a firm can transition from an internal platform to a supply-chain platform and eventually to an industry platform by increasing platform openness. However, Thomas et al. (2014) suggest that the evolution of an internal platform to a supply-chain and then to an industry platform is influenced not only by platform openness but also by various leverage logics. They note that a platform can concurrently undergo changes in leverage logic and platform openness. Consequently, they identify three distinct logics of leverage: production, innovation, and transaction (Thomas et al., 2014). Additionally, after analysing the US and European broadcast industry through multiple longitudinal case studies, Pagani (2013) argues that incremental innovations can convert vertically integrated networks into loosely coupled networks, while cross-boundary industry disruptive innovations can transform loosely coupled networks into two-sided markets. Moreover, Hagiu et al. (2020) investigates the strategies a multi-product company can adopt to transition from a multi-product company to a successful industry platform by hosting rival firms. Also, Wichmann et al. (2022) recognized the challenges that brands face when constructing flagship platforms, which are a specific type of industry platforms owned by brands, and developed a comprehensive guide to assist brands in the process of establishing an industry platform.

On the other hand, born-platforms are those platforms that are created by start-up firms (Teece et al., 2022). The majority of the literature have focused on incumbent-born platforms, however there have been limited studies on born-platforms. Through a five-years longitudinal case study of Friendz (Trabucchi & Buganza, 2022a), an Italian two-sided platform, Trabucchi & Buganza (2022) examined the impact of the different actors on the entrepreneurial decisions of platform providers which led to the emergence of the platform. The study outlines a four-step progression that shows how entrepreneurs can start by using an existing platform to launch a new business, then move on to creating their own two-sided platform. The findings of the research emphasize how the different actors of the platform can influence the platform provider's entrepreneurial choices, in terms of value proposition design and the creation of a new industry platform. Also, Cennamo et al. (2022) examined Patient Innovation (Cennamo et al., 2022), which is a prominent platform in Europe that provides user-generated innovative solutions in the healthcare industry, where they argue that applying the generic strategies that are adopted for other industry platforms might be challenging due to the unique characteristics of the healthcare industry. Consequently, in addition to the orchestration activities, Cennamo et al. (2022) identify three roles that a platform owner should play in order to diffuse patient innovation: community organizer, market matchmaker, and innovation manager.

3.2 Micro-processes of industry platform integration

Whether the platform is created by an incumbent firm or a start-up, attracting and integrating the different actors of the market onto the platform is one of the key challenges for the platform owner (Eisenmann et al., 2006). The primary focus of the earlier literature has been centered exclusively on pricing strategies for the purpose of attracting and integrating the different actors on board (Caillaud & Jullien, 2001; Caillaud & Jullien, 2003; Rochet & Tirole, 2003; Parker & Van Alstyne, 2005; Armstrong, 2006; Rochet & Tirole, 2006; Eisenmann et al., 2006; Rysman, 2009). Nevertheless, several authors have contended that pricing strategies are not the sole means of integration, and have examined non-pricing strategies as well (Eisenmann & Hagiu, 2007; Hagiu & Spulber, 2013). Therefore, the industry platform integration process can be categorized into two distinct strategies, namely pricing and non-pricing.

In the context of industry platforms, pricing strategies involve setting the right prices for the different actors in order to incentivize their participation (Eisenmann et al., 2006). The emergence of the industry platform literature can be traced back to the early 2000s when authors began directing their attention toward pricing strategies as a means of enticing the participation of diverse actors (Caillaud & Jullien, 2001; Caillaud & Jullien, 2003; Rochet & Tirole, 2003; Parker & Van Alstyne, 2005; Armstrong, 2006; Rochet & Tirole, 2006; Eisenmann et al., 2006; Rysman, 2009). Caillaud & Jullien (2001) argue that a platform owner can employ cross-subsidization by subsidizing one market segment in order to attract it and enhance their appeal to the other market segment. In a similar vein, Rochet & Tirole (2003) posit that a two-sided market ought to be capable of cross-subsidizing the distinct market actors effectively. Nevertheless, Rochet & Tirole (2003) argue that not only is the value of the price charged to the different market segments consequential, but also the manner in which the price is decomposed; consequently, “A market is two-sided if the platform can affect the volume of transactions by charging more to one side of the market and reducing the price paid by the other side by an equal amount; in other words, the price structure matters, and platforms must design it so as to bring both sides on board” (Rochet & Tirole, 2006: 664). Therefore, the structure of the price is significant (Armstrong, 2006; Rochet & Tirole, 2006; Kaiser & Wright, 2006) and firms should be able to set the right price (Eisenmann et al., 2006).

Although there has been a significant emphasis on pricing strategies, a number of authors have demonstrated that various non-pricing strategies can be employed to effectively engage the different actors of the market. Eisenmann & Hagiu (2007) contend that conventional methods of attracting the various actors of the market, namely pricing strategies, can be both expensive and hazardous. As a result, they have proposed a cost-effective phased strategy for the integration process, the “vendor to two-sided platform” approach, that involves the platform owner acting as a vendor to integrate the first side of the market and then subsequently drawing in the other actors in later phases. Also, Sridhar et al. (2011) underscored the significance of the marketing investments made by platform owners in driving demand among the diverse parties involved; and Hagiu & Spulber (2013) argue that, under specific conditions, first-party content can serve as an integration mechanism to attract sellers. Lately, Fang et al. (2021) investigated the impact of temporary gatherings, which are organized by platform owners, in inducing third-party complementors to join a software platform; Dou & Wu (2021) examined piggybacking, which is defined as “the ability of a platform to connect with an existing user base from a different platform and stage the creation of value units to recruit those users to participate” (Dou & Wu, 2021: 821), as a non-pricing strategy to attract the different actors on board; and Adam et al. (2022) contend that a moderate degree of signalling input control possesses the potential to exert a considerable influence over the expectations of third-party complementors, which, in turn, can affect their decision to join a platform.

3.3 Micro-processes of industry platform design

Baldwin & Woodard (2009) assert that the platform's architecture comprises distinct components, namely, (1) a stable core characterized by a low degree of variety, and (2) a variable periphery with a high degree of variety, while (3) the interfaces are the “specifications and design rules that describe how the platform and modules interact and exchange information” (Tiwana et al., 2010b). Consequently, platform architecture is more concerned with the structural complexity of platforms, whereas governance is more concerned with their behavioural complexities (Constantinides et al., 2018), and exerting control over the interfaces equates to having control over the platform (Baldwin & Woodard, 2009). Based on our review and given the classification of Foerderer et al. (2021), we have further categorized the process of industry platform ecosystem design into hard and soft governance mechanisms.

Hard governance mechanisms influence complementors' behaviour through resource provision and control exertion (Foerderer et al., 2021). Achieving a balance between controlling the behaviour of complementors and maintaining the desired level of generativity poses a significant tension when designing an appropriate governance mechanism (Tilson et al., 2010; Wareham et al., 2014; Eaton et al., 2015). The early literature has contended that boundary resources can facilitate the arm's length relationships between platform owners and third-party complementors (Ghazawneh & Henfridsson,

2013; Eaton et al., 2015; Fink et al., 2020). Boundary resources, e.g., application programming interfaces (Ghazawneh & Henfridsson, 2013), software libraries (Fink et al., 2020), or standardized development tools (Miric et al., 2022), are defined as “the software tools and regulations that serve as the interface for the arm's-length relationship between the platform owner and the application developer” (Ghazawneh & Henfridsson, 2013: 175). Besides, Foerderer et al. (2019) highlight the importance of knowledge boundary resources in accessing and extending the platform's functionality. Additionally, control is perceived as a hard governance mechanism that enables platforms to exercise the option of either opening or closing their platforms (Parker & Van Alstyne, 2018); the entry of a platform into complementary markets is recognized as a hard governance mechanism that enables the coordination of complementors (Foerderer et al., 2018; Young Kang & Suarez, 2022); and agreements and rules, selective promotion, joint problem solving, and socialization are distinct governance mechanisms that enable the platform owner to manage complementary innovation (Jingyao et al., 2022). Moreover, despite being more commonly discussed in the context of innovation platforms, the importance of governance is equally significant in the realm of transaction platforms. For instance, in the context of social media platforms, Reuber & Fischer (2022) examined distinct types of governance mechanisms, namely, those regulating user behaviour, and those concerning user identification and status; and in the context of E-commerce content platforms, Lin et al. (2022) examined the impact of controlling the output through monetary rewards and punishments. Besides, in addition to the previously mentioned tension, Huber et al. (2017) introduced the dyadic governance tension, which considers the trade-off between co-created value and governance costs, as an additional tension that should be considered when designing the appropriate governance mechanism. Consequently, they argue that the governance process is “a process of considerable variation and change in practicing ecosystem-wide rules and values” (Huber et al., 2017: 580).

While most of the literature has focused on hard governance mechanisms, soft governance mechanisms, which influence complementors' behaviour through non-monetary and non-control means (Foerderer et al., 2021), have received less attention in research. To fill this gap, Foerderer et al. (2021) proposed the use of awards as a soft governance mechanism that can effectively influence the behaviour of complementors. Also, soft governance mechanisms were examined in the context of transaction platforms. For instance, in the context of social media platforms, Reuber & Fischer (2022) examined distinct governance mechanisms, namely, those structuring user relationships, e.g., likes or endorsements, and those directing user attention, e.g., hashtags. Additionally, Chan et al. (2022), introduced the concept of strategic design of ratings and reviews and Hukal et al. (2020) introduced the utilization of signalling, opportunity and endorsement signals, as a mechanism for governing the actions of complementors.

3.4 Micro-processes of industry platform management

Managing a platform is a complex task that cannot be accomplished by simply applying strategies that have worked in traditional contexts, as relying on such strategies is often insufficient to ensure success (Eisenmann et al., 2006). Pricing, which was previously discussed as part of the platform integration process, is only one aspect of platform management and is closely intertwined with attracting different actors to the platform (Eisenmann et al., 2006; Hagiu, 2014). In addition to pricing, Eisenmann et al. (2006) argue that platform owners need to manage competition-related challenges; however, the recent literature suggests that non-competition-related challenges also require attention from the platform owner. As a result, the process of managing industry platforms is categorized based on competition-related challenges and non-competition-related challenges.

Challenges related to competition encompass various aspects such as pricing, winner-takes-all scenarios, multi-homing, and envelopment (Eisenmann et al., 2006), among others. Platform owners should cope with the winner-take-all competition, that is, the platform owner should be aware of whether the market can be served by a single platform or not, and whether it should share the platform or try to maintain proprietary rights (Eisenmann et al., 2006). The winner-take-all topic was discussed by several scholars, including Doganoglu & Wright (2006), Armstrong & Wright (2007), Doganoglu & Wright (2010), Cennamo & Santalo (2013), Belleflamme & Peitz (2019), and Wiegand et al. (2022), among others; however, some authors have challenged the winner-take-all hypothesis in

the context of industry platforms, including, Anderson et al. (2014) and Huotari et al. (2017). Besides, one of the conditions that make the winner-takes-all situation arise is the height of the multihoming costs (Eisenmann et al., 2006). Unlike the early literature which examined multihoming in the absence of exclusive contracts (Rochet & Tirole, 2003; Caillaud & Jullien, 2003; Armstrong, 2006; Doganoglu & Wright, 2006), Armstrong & Wright (2007) argue that introducing exclusive contracts play a major role in preventing multihoming on the seller's side of the market. Nevertheless, the effectiveness of exclusive contracts in preventing multihoming was challenged later on by Doganoglu & Wright (2010). Additionally, platform owners should avoid envelopment, where other companies leverage overlapping user bases to enter a different market (Eisenmann et al., 2006). Nevertheless, winner-take-all, envelopment, and multihoming (Belleflamme & Peitz, 2019; Park et al., 2021; Wiegand et al., 2022) are not the only challenges that should be managed by the platform owner. Platform owners face a range of challenges, including responding to market entries (Cozzolino et al., 2021), executing effective market entry strategies (Eisenmann et al., 2011; Barile et al., 2022; Ozalp et al., 2022), managing disruptive innovation (Ansari et al., 2016), dealing with cyberattacks (Sen et al., 2020), and developing internationalization strategies (Stallkamp & Schotter, 2021). Besides, the relationship between different platforms is not always competitive and can involve collaborations (Zhu et al., 2021) or synergies (Wu et al., 2022).

Alternatively, non-competition-related challenges refer to issues that a platform owner must address, but which are not directly linked to competition, including, digital piracy, hiring, and data strategies, just to mention a few. Miric & Jeppesen (2020) posit that the unauthorized duplication and distribution of digital products, that is, digital piracy, poses a significant strategic challenge due to the potential loss of income and the perceived negative impact on innovation; Ge et al. (2020) examined the impact of hiring skilled workers, from firms with high platform human capital, on the financial performance of a recipient software platform; Bhargava et al. (2020) highlighted the dearth of research on data strategy in platform contexts, wherein the specific strategy employed to handle data collection, storage, sharing, access, and monetization varies based on the type of platform and its business context; Broekhuizen et al. (2021) suggested a non-actor based approach for making openness decisions, where the platform owner decides which product categories and channels to open up; and Garud et al. (2022) analyzed how firms can attain cognitive and socio-political legitimacy by utilizing both market and non-market strategies, specifically by leveraging liminal movement.

3.5 Micro-processes of industry platform evolution

Numerous studies have identified platform architecture and governance as critical factors that drive platform evolution (Modol & Eaton, 2021). Thomas et al. (2022) argue that the early governance decisions of a platform play a crucial role in shaping the platform's evolution and its associated ecosystems. While the platform owner bears the primary responsibility for designing and altering the architecture of digital ecosystems, the evolution of platforms goes beyond this (Helfat & Raubitschek, 2018). For instance, platforms must continuously innovate and adapt their business models to the changing competitive landscape (Helfat & Raubitschek, 2018) to remain competitive as markets and technologies continue to evolve (Gawer & Cusumano, 2014a). Consequently, the process of platform evolution can be classified into two distinct categories, architecture-related evolution and function-related evolution.

Architecture-related evolution is driven by changes in platform architecture, governance, and control mechanisms. Architectural control is seen as significant by scholars as it enables platform owners to shape the platform's evolution and direction. Baldwin & Woodard (2009) argue that having control over the interfaces of a platform is tantamount to having control over the platform itself and its evolution. Tiwana et al. (2010) argue that platform evolution is not only influenced by its architecture, but also by the coevolution of governance, environmental dynamics, and architecture. Additionally, Gawer & Cusumano (2014) argue that platform owners use architectural control to maintain or increase competition among third-party complementors and thereby drive the platform's evolution towards a leadership position. Besides, after developing the boundary resources model, Ghazawneh & Henfridsson (2013) utilized the boundary resources model to analyze the evolution of Apple's iPhone platform and identified four distinct stages of evolution: (1) self-resourcing: when

third-party developers create new resources to overcome limitations caused by excessive platform governance, (2) regulated securing: when platform owners control their platform through administrative legislation instead of technical restrictions, (3) diversity resourcing: when platform owners diversify their platform through third-party development to transform their enterprise and stimulate new application areas, and (4) sovereignty securing: when a platform owner takes actions to control the evolution of the platform. Besides, in the initial phases of platform evolution, platform owners tend to adopt broad governance mechanisms and maintain an arm's length relationship with third-party complementors; however, as the platform matures, platform owners tend to move beyond these broad rules and establish partnerships with appealing complementors (Huber et al., 2017).

On the other hand, function-related evolution is related to the evolution driven by changes in platform's functionality and value propositions. Zhao & Chen (2019) argue that the process of evolution from a two-sided platform to a multi-sided one is primarily fueled by business model innovation and imitation. Nevertheless, sustaining a leadership position necessitates ongoing innovation and redesign of the business model, which, in turn, calls for the development of three dynamic capabilities: innovative capabilities, environmental scanning and sensing capabilities, and integrative capabilities for ecosystem orchestration (Helfat & Raubitschek, 2018). Besides, Tan et al. (2015) proposed four development strategies: encapsulating, delegating, meshing, and empowering. While they acknowledged the relevance of the coring and tipping strategies, which were introduced by Gawer & Cusumano (2008) and previously discussed in the platform creation process, they argue that these strategies are only relevant during the nascent stage of platform development. Consequently, encapsulating and delegating strategies are relevant in the formative stage, while meshing and empowering strategies are relevant in the mature stage of platform development (Tan et al., 2015). Likewise, Au et al. (2020) argue that there are unique strategies and outcomes associated with each evolutionary stage. However, they classified the evolution of peer-to-peer lending platforms into three distinct stages, with each stage focusing on the development of a specific actor, such as partners, lenders, and borrowers.

4. FUTURE RESEARCH AGENDA

Based on the systematic literature review, we classified the studies into five key processes: creation, integration, design, management, and evolution. Our analysis has shown that a significant portion of the literature concentrates on specific micro-processes, while others have not received adequate attention. Despite the extensive efforts invested in researching industry platforms, this field is still evolving. As a result, a comprehensive understanding of the subject is yet to be achieved, with certain aspects still underexplored or in their early stages of development. As previously mentioned, the industry platforms literature has been influenced by the two-sided markets literature (Caillaud & Jullien, 2001; Caillaud & Jullien, 2003; Rochet & Tirole, 2003; Parker & Van Alstyne, 2005; Armstrong, 2006; Rochet & Tirole, 2006; Eisenmann et al., 2006; Rysman, 2009), which has long examined pricing matters. Consequently, pricing has been a primary focus of research regarding industry platforms, as it is a critical tool to attract market participants and compete with rivals (Eisenmann et al., 2006). Nonetheless, our comprehension of non-pricing methods for attracting various actors is still inadequate, despite the considerable efforts devoted to this area of study, including, (Eisenmann & Hagiu, 2007), (Amelio & Jullien, 2012), (Sridhar et al., 2011), (Hagiu & Spulber, 2013), (Fang et al., 2021), (Dou & Wu, 2021), and (Adam et al., 2022). Thus, it is evident that the initial literature focused mainly on the integration and management processes, with a particular emphasis on pricing. However, this approach led to a relative neglect of the issue of how these platforms are created (D. McIntyre et al., 2021). Thus, the creation of industry platforms remains an area that requires further investigation. We have yet to fully understand the creation of both incumbent-born and born-platforms, as well as their antecedents and determinants. Furthermore, the majority of the literature has focused on attracting various actors to the platform. However, the issue of how many sides a platform should have and how the platform owner can make such a decision, including the antecedents and determinants involved, remains relatively understudied.

Additionally, since Tilson et al. (2010), Yoo et al. (2010), and Tiwana et al. (2010) shed light on the lack of attention given by Information Systems (IS) scholars to platforms, numerous studies have addressed this subject. However, the majority of these studies have primarily focused on governance mechanisms in innovation platforms (Ghazawneh & Henfridsson, 2013; Eaton et al., 2015; Fink et al., 2020), neglecting the importance of governance in transaction platforms, with the exception of (Hukal et al., 2020), (Reuber & Fischer, 2022), (Lin et al., 2022), and (Chan et al., 2022), just to mention a few. Hence, further exploration is required to gain a better understanding of governance in the realm of transaction platforms. Furthermore, most studies on the design process have primarily emphasized hard governance mechanisms (Ghazawneh & Henfridsson, 2013; Parker & Van Alstyne, 2018; Foerderer et al., 2019), with little consideration given to soft governance mechanisms until the recent study by Foerderer et al. (2021). As a result, our understanding of soft governance mechanisms remains limited. Moreover, most studies on the management process have primarily concentrated on competition-related issues (Eisenmann et al., 2006; Armstrong & Wright, 2007; Doganoglu & Wright, 2010; Cennamo & Santalo, 2013; Belleflamme & Peitz, 2019; Wiegand et al., 2022), specifically price competition with other competitors (Rochet & Tirole, 2003; Parker & Van Alstyne, 2005; Armstrong, 2006; Rysman, 2009). However, there are also non-competition related issues that platforms must manage. Therefore, there is a need to explore non-competition related managerial issues, such as human resource management (Ge et al., 2020) and data management (Bhargava et al., 2020).

Also, just like the creation process, the evolution of industry platforms is often overlooked. Most studies attribute the evolution of these platforms to their architectural structure (Gawer & Cusumano, 2014; Tiwana et al., 2010; Ghazawneh & Henfridsson, 2013; Thomas et al., 2014). However, some authors have explored other aspects of platform evolution beyond its architecture, including, (Gawer & Cusumano, 2014a), (Muzellec et al., 2015), and (Zhao & Chen, 2019). Therefore, we currently have limited understanding of how industry platforms evolve and transform over time, given that the antecedents and outcomes of the evolution process are still uncertain. Therefore, to bridge this knowledge gap, it is crucial to conduct research not only on the creation of industry platforms but also on their evolution. Besides, the five processes we discussed are not necessarily sequential, and platform owners should address them concurrently due to the dynamic nature of platforms. Consequently, there is a need to examine the interplay among processes, micro-processes, and the relationship between them.

While the majority of work on industry platforms is conducted through conceptual and stylized analytic models (Sriram et al., 2015), there is a pressing need for more empirical research, particularly longitudinal studies, to deepen our understanding of the creation and evolution processes. While studies focusing on a snapshot of time have provided valuable insights into various platform processes, relying solely on such studies may limit our comprehension of other critical processes. Besides, most studies on industry platforms have focused on B2C and C2C contexts, leaving a significant gap in our understanding of B2B industry platforms, with the exception of (Loux et al., 2020), (Jovanovic et al., 2021), and (Shree et al., 2021), just to mention a few. This lack of research has resulted in limited knowledge about B2B industry platforms and the processes involved. Thus, conducting a systematic literature review on industry platforms in a B2B context would be highly valuable in filling this gap and enhancing our understanding of these platforms and their processes. Additionally, recent studies suggest that certain industries such as healthcare and education are subject to higher levels of regulation (Ozalp et al., 2022), setting them apart from other industries like payment cards and game consoles that were previously examined in discussions of industry platforms. Given these differences, it would be insightful to explore how the processes that industry platform owners undergo vary between highly regulated industries and the more typical industries commonly discussed in literature. Finally, it is important to note that this review focused solely on the perspective of the platform owner, who is only one piece of the larger puzzle that constitutes the platform and its corresponding ecosystem (Van Alstyne et al., 2016a). To gain a more comprehensive understanding of industry platforms, it is essential to conduct similar studies from the perspectives of the various actors within the ecosystem. Conducting such studies can make a substantial contribution towards enhancing our understanding and creating a holistic view of industry platforms and their ecosystems.

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DESIGNING AND IMPLEMENTING OVERARCHING SERVITIZATION STRATEGIES IN B2B MANUFACTURING INDUSTRY

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ABSTRACT

Purpose: This paper explores how a B2B technology-driven industrial manufacturer of capital goods can organise a service exploration process to create value for customers and end-users downstream of its value supply chain.

Design/Methodology/Approach: We employed the action research (AR) methodology to design and implement interventions, build new knowledge on strategic exploration and organise a design process for designing service value propositions in a B2B domain.

Findings: Based on the design roadmapping approach, we designed an intervention framework of a strategic service exploration process that addresses the needs and behaviour of customers and end-users in their future living context.

Originality/Value: This paper contributes new knowledge about organising end-user-focused product-service design capabilities and applying strategic design methods to innovate product-service value propositions in the B2B manufacturing industry.

KEYWORDS: Overarching Servitization, Service Design, Strategic Design, Roadmapping, Service Innovation

1. INTRODUCTION

Engaging with customers and addressing end-users' values have become increasingly challenging within servitization strategies (Adrodegari, 2021; Bakir et al., 2021; Bluemink et al., 2021). Wise and Baumgartner (1999) argue that manufacturing companies adopt servitization strategies because it allows them to rise above their traditional role as a supplier of products that provides only a one-off value transaction when the product is sold. They can generate sustainable revenue streams by descending downstream of their value chain and offering services and customer experiences that add value throughout the product life cycle. Going downstream the value chain and creating loyal customers who generate revenue streams during the life cycle of products is now commonplace in business-to-consumer (B2C) practice (Cruz et al., 2022; Wise & Baumgartner, 1999). For instance, in the smartphone example, although the product is purchased once, the associated services create most of the value during the smartphone life cycle. In addition, the monetised value stream of services created around the physical product exceeds the transaction value of the smartphone many times over. With service contracts based on subscription business models, smartphone users are committed to the provider of product-related services for more extended periods. The smartphone has degenerated into a means of providing services. In some subscription models, it is offered at cost, or even less, to entice consumers to take out a long-term service contract.

These practices are still in their infancy in the business-to-business (B2B) domain. While it is expected that B2B manufacturers usually have strong relationships with their customers within their business domain and therefore focus on and provide services linked to their products, they usually do not have direct connections with the customers' customers, the end-users (Lievens & Blažević, 2021). This paper addresses the research question: *"How can technology-driven B2B industrial manufacturers organise designing product-service value propositions for end-users?"* We explore how B2B companies can design a servitization strategy for product-service value propositions further downstream the value chain to capture value from end-users. It reports on an ongoing longitudinal action research project in a B2B industrial manufacturer. The focal company is a technology-driven industrial manufacturer of

capital goods for smart internal logistics. The company launched its servitization strategy to expand its product portfolio with value propositions for services combined with products that address its customers' and their end-users' new and perhaps yet latent needs. This paper contributes new knowledge on designing and implementing interventions and business models for customer and end-user-centric service innovation related to B2B manufacturers' core products and services. It demonstrates how servitization strategies can be designed and implemented to build sustainable business relationships with the customer, the customer-of-the-customer and business partners that provide complementary capabilities by creating triadic relationships where values are exchanged between the three evolved actors and thus go beyond a one-to-one manufacturer-customer relation. We coined this as '*overarching servitization*' (Bluemink et al., 2020).

In this paper, we first report on the theoretical background of our research. We then report on the research set-up and the data we collected. Subsequently, we share our data analysis and the insights derived from it. Finally, we conclude the paper with theoretical and practical contributions and a reflective conclusion.

2. THEORETICAL BACKGROUND

Servitization is a valuable strategy for B2B manufacturers to expand their product portfolio with connected services. Kohtamäki et al. (2018) defined servitization as "*a transition process from selling products to selling product-service systems*". Neely (2008) defined servitization as "*the innovation of organisations' capabilities and processes to better create mutual value through a shift from selling products to selling product-service systems*". Embedded in both definitions is a direct relationship with customers and their needs. After all, the company will have to interact with its customers to get to know those customer needs. Hence, a servitization process fostering product-service innovation implies intensive engagement with customers and their needs. Jovanovic et al. (2021) explored how companies are using data platform technologies to facilitate customer engagement and interaction and govern differentiated services tailored to different types of customers and end users.

Technology-intensive manufacturers in the capital goods industry show a growing interest in servitization strategies to generate revenue streams from services. According to previous studies, manufacturers following a servitization strategy could significantly increase their revenues and profitability (Baines et al., 2010; Burton et al., 2017; Visnjic Kastalli & Van Looy, 2013). Jovanovic (2016) and Neely (2008) discuss the '*Power-by-the-Hour*' value proposition of Rolls Royce as a successful servitization example in B2B industry. Visnjic et al. (2017) describe the Rolls Royce case as an example where service design in the B2B domain may have played a vital role in transitioning to a service business model.

Other studies in the design stream argued that a design-driven approach is a helpful strategy for creating customer-centric product-service value propositions (Dong, 2015; R. Price & Kleinsmann, 2018). Research by Price et al. (2019), triggered by earlier research initiatives by Dong (Dong, 2015), showed that design-driven service innovation leads to successful outcomes. The field of industrial design has evolved from pure product design and engineering into designing product-service value propositions and innovation strategies. Hence, industrial designers are increasingly employed in strategic design processes to develop product-service strategies within the organisational context (Calabretta et al., 2017). *Design Roadmapping* is one such strategic design process for designing a servitization strategy because it brings together and integrates five essential strategic design activities into a strategic and tactical roadmap that help the company ideate and implement ideas for product-service value propositions: (1) creative trend research, (2) empathising with end-users, (3) future visioning, (4) value proposition ideation and (5) idea mapping (Simonse, 2018; Simonse et al., 2015). Canales Durón et al. (2019) add three more strategic design skills: (1) modelling value exchange relationships, (2) orchestrating service co-creation, and (3) transforming organisational networks. Overall, at the interplay of servitization and strategic design literature, we observed a knowledge gap in the role service design could play in creating *overarching servitization* strategies to engage end-users in a sustainable future B2B service business and capture value from them.

3. RESEARCH STRATEGY AND METHODOLOGY

To answer our research question, we followed the action research (AR) methodology described by Coghlan (2019) to build knowledge about designing and implementing a strategic design process for developing the servitization strategy for the customer. According to Coghlan (2019), AR focuses on research *'in action'* rather than *'about action'*. *'In action'* implies that new knowledge evolves while executing successive intervention cycles. AR is a scientific approach to studying the solution of an organisational issue together with the people directly experiencing the issue; AR is, therefore, a participatory approach.

Coghlan's (2019) AR methodology follows four steps: constructing, planning action, taking action and evaluating action. They are preceded by a preliminary step describing the purpose and context of the AR intervention. We deliberately chose an AR approach to investigate an *ongoing* servitization strategy design process *in* the client's organisation while employees participate in the research. For data collecting during the AR project, we used surveys among workshop participants, semi-structured interviews, group discussions, field notes, and workshop steps visualised in online digital boards. This paper describes the results of the client company's third action research cycle (ARC 3) within as part of a longitudinal action research program (consisting of four AR cycles).

4. FINDINGS

4.1. Preliminary Step of ARC 3

Coghlan's preliminary step is an activity that precedes each ARC and in which we define the purpose and context of the ARC. The purpose of the client company's ARC 3 is to contribute to answering the research question, *"How can technology-driven B2B industrial manufacturers design product-service value propositions for end-users"*? Furthermore, more specifically, how can the company design value propositions to establish business relationships with customers-of-the-customer in an *overarching* sense, as we discovered in the Rolls Royce case (Bluemink et al., 2020).

ARC 3 took place in the context of a longitudinal *servitization* study in the client company, a B2B industrial manufacturer of baggage handling systems. Previous interventions (ARC 1 and ARC 2) have led to key insights that we used as a starting point in constructing the interventions for ARC 3. We have divided the key insights into end-user insights and the client company's future strategy.

1) *End-user-related insights:*

- Creating interventions beyond the technology-focused innovation context can lead to end-user-focused product-service value propositions.
- Shifting the technical feasibility focus to end-user value focus fosters new service solution directions.
- Mixed teams of designers, in addition to engineers, foster end-user-driven product-service solutions.

2) *Future strategy-related insights:*

- Involving novice strategic designers generates a more future-oriented perspective on the B2B industry's context.
- Future visioning capabilities are drivers for ideating servitization strategies.
- Developing digital platform knowledge is a driver for transitioning to servitization strategies.
- Using strategic design roadmapping fosters overarching servitization strategies through future visioning of product-service solutions "from the end-users' point of view".
- Going beyond the company's current organised innovation processes, even if novice strategic designers do not have in-depth knowledge of the technology that goes with the company's manufacturing processes and mechanical products.

4.2. Constructing and Planning ARC 3 – *The Long Now*

In this section, we constructed and planned ARC 3 based on our preliminary ARCs and the design roadmapping process. We defined five strategic service exploration workshops preceded by a kick-off workshop (see Figure 1)

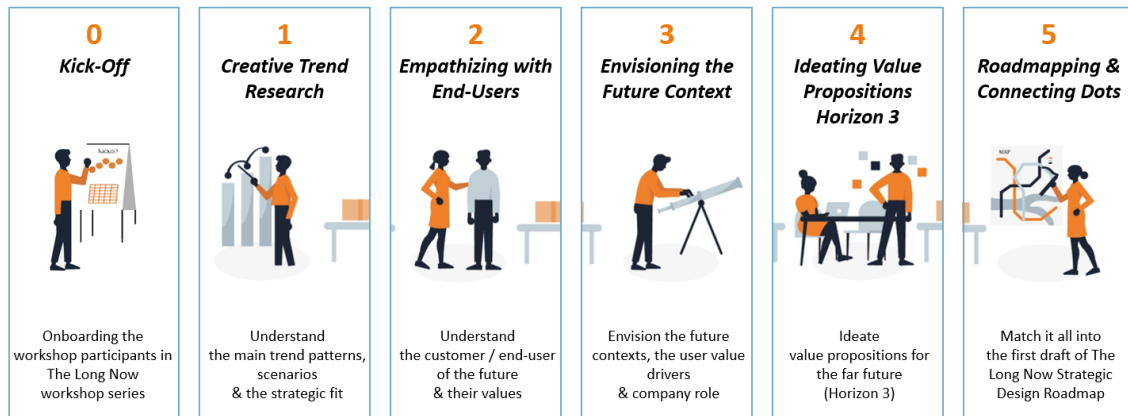


Figure 1 – The Long Now Workshop Overview of ARC3

Because ARC 3's strategic interventions are long-term (the year 2035), we have named the workshop series "*The Long Now*", suggesting that we explore and envision the end-user's context (future travelling in Europe) to make it tangible today into the 'now'.

Planning:

- Aim of ARC 3: to explore and envision the traveller's context (future travelling in Europe) and make it tangible by creating a strategic design roadmap for service value propositions.
- Participants: 16 employees with different backgrounds and experiences to foster cross-fertilisation of knowledge and expertise. Participants will be divided into two teams, A and B.
- Facilitation team: the UX design manager, an experienced service designer and an action researcher.
- Intervention type: 6 online workshop sessions.
- Tools: MS Teams™ communication tool and Miro™ digital whiteboards to facilitate the activities during the workshops.
- Workshop location: online meetings in MS Teams™.
- Timing: 6 workshops averaging 2 hours each at three-week intervals, starting in the second quarter of 2021. (1/4, 20/4, 10/5, 32/5, 21/6 and 15/7)

4.3. Taking Action

Kick-Off Workshop

During the kick-off, we introduced the scope of the strategic design workshop series and explained the design roadmapping method of Simonse (2018) we used as the basis for designing the successive workshops. We learned from ARC 1 and ARC 2 that there is much knowledge about technology and market developments in the various departments but that the rigid departmental structure is often a barrier to sharing knowledge in the organisation. For the workshops, we, therefore, selected employees from various departments and disciplines and brought them together as if detached from the siloed department structure. Although they are colleagues, they did not know each other very well. Therefore, the aim of the kick-off was to introduce participants to each other by an ice-breaker game, explain the workshop programme to create a shared understanding of what to expect and introduce them to the strategic design roadmapping method of Simonse (2018).

The participants expected the strategic workshops to be about baggage handling systems because, after all, those are the core products of the company's business unit. However, we deliberately adopted an *overarching* perspective to encourage participants from the end-user perspective, the

traveller as a customer of the aviation business. To explore strategic directions and scenarios, we, therefore, chose "*Travelling in Europe*" as a scope, taking the perspective of future travellers. The scope was not limited to the current business scope of the company as a provider of capital goods in the aviation business only. It included different (even future) travelling/transport modalities (high-speed trains, autonomous cars, hyperloop, drones). We argued that the company should not limit itself to its current business context when looking into the future context and exploring new service business opportunities.

Workshop 1 – Creative Trend research

In the creative trend research workshop, we examined trends and developments to create a future perspective for the company. In doing so, we looked for new directions to create value for travellers. The main goal of this workshop was to discover which trends are relevant for the company and can be important drivers for future service innovation. As performing trend analysis is a design skill and should take too much time in this workshop, two experienced designers prepared the trend research before the workshop. In the workshop, we use the results as a basis for discussion with participants. We encouraged them to discover trend clusters, patterns and user values that drive the future user context and put them on a timeline that strategically fit the company values. The result of exploring and interpreting trends was a basis for visualising what the future of travel might look like.

Workshop 2 – Empathizing with future end-users

The *design roadmapping* method by Simonse (2018) focuses on creating a future vision based on uncovered value drivers of the future end-user. It requires a deep understanding of his behaviour and needs in his future life world and calls for developing a clear and shared vision of the desired customer experience. B2B companies generally have little affinity with this, so too in the case company as it focuses primarily on business customers such as airports and airlines. To ensure that the end-user perspective is embedded in the service innovation process, we need to empathise with travellers and understand what drives them. Whereas Workshop 1 focused on discovering trends that fit the company's innovation strategy, this workshop focused on finding value drivers for future travellers. The next step in empathising with future travellers is to discuss *future personas*. Creating future personas would take too much time for non-designer participants during the workshop, so two experienced designers will prepare them before the workshop.

Workshop 3 – Envisioning the future context

This workshop aimed to explore what this desired future is and what value Vanderlande could bring to this future. We developed a future vision that captured the value aspirations that travellers have in the context of future travelling in Europe and translated it into a desired future for the company. The company's future vision was visualised and articulated in a future vision statement, expressing a desired future. We asked participants to create a newspaper for 2035 based on the relevant trends by writing articles on the issues that will be current then, accompanied by pictures they could find on the internet. The newspaper gave an impression of what the world could look like and by what values travellers are driven in that future world context. As a future vision simultaneously is a call to action for innovating value propositions that address the values of end-users in the future context, we proposed the following format for formulating the future vision statement: ***We [the company] want to...[verb]+[an unmet need, desire] for... [a specific persona or target group] in... [the context] by [verb]+[the object: a mechanism, service, product, experience, value].***

Workshop 4 – Ideating value propositions horizon 3

In the brainstorming workshop, we asked participants to develop ideas and scenarios that are valuable in the future world of life for travellers. To do so, they used the outcomes of Workshop 3 as inspiration. Participants were asked to think far ahead. They used the brainwriting technique in several rounds where teams of four each came up with an idea in two minutes, and each participant in the next round iterated on it for one minute and added new ideas. Eventually, ideas for value propositions for services

emerged and were discussed, clustered and placed on the third horizon of the roadmap because they are far in the future and cannot be realised today because the necessary technology, knowledge, resources or partnerships are not yet available to do so. The value of the ideating phase was that participants from cross-functional departments discussed ideas from different perspectives, enhancing the richness of the conceived future value propositions.

Workshop 5 – Roadmapping & connecting the dots

Workshop 5 consolidated the results from the previous workshops into a three-horizon strategic roadmap. Participants placed the trends, value drivers and future value propositions on a far Horizon 3 extending to 2035. The next activity involved back-casting the envisaged value propositions. Participants discussed and explored with each other what intermediate steps needed to be executed (in Horizons 1 and 2, preceding the long-term Horizon 3) to develop the service value propositions of Horizon 3. The creation by the participants of a long-term roadmap ensures that everyone has the same notion of where the company is heading; a strategic roadmap thus puts every participant on the same page. It serves as a boundary object to substantiate, communicate and discuss the ideated service value propositions and monitor the progress of the associated execution plans in the organisation. Figure 2 shows the structure and content (without details) of the company's strategic design roadmap as the result of ARC 3. It includes three future service value propositions for services in the third horizon. The four swimming lanes *Market*, *Service Solutions*, *Technology* and *Ecosystem* describe, in relation to each other, the activities required to realise the intended service value propositions.

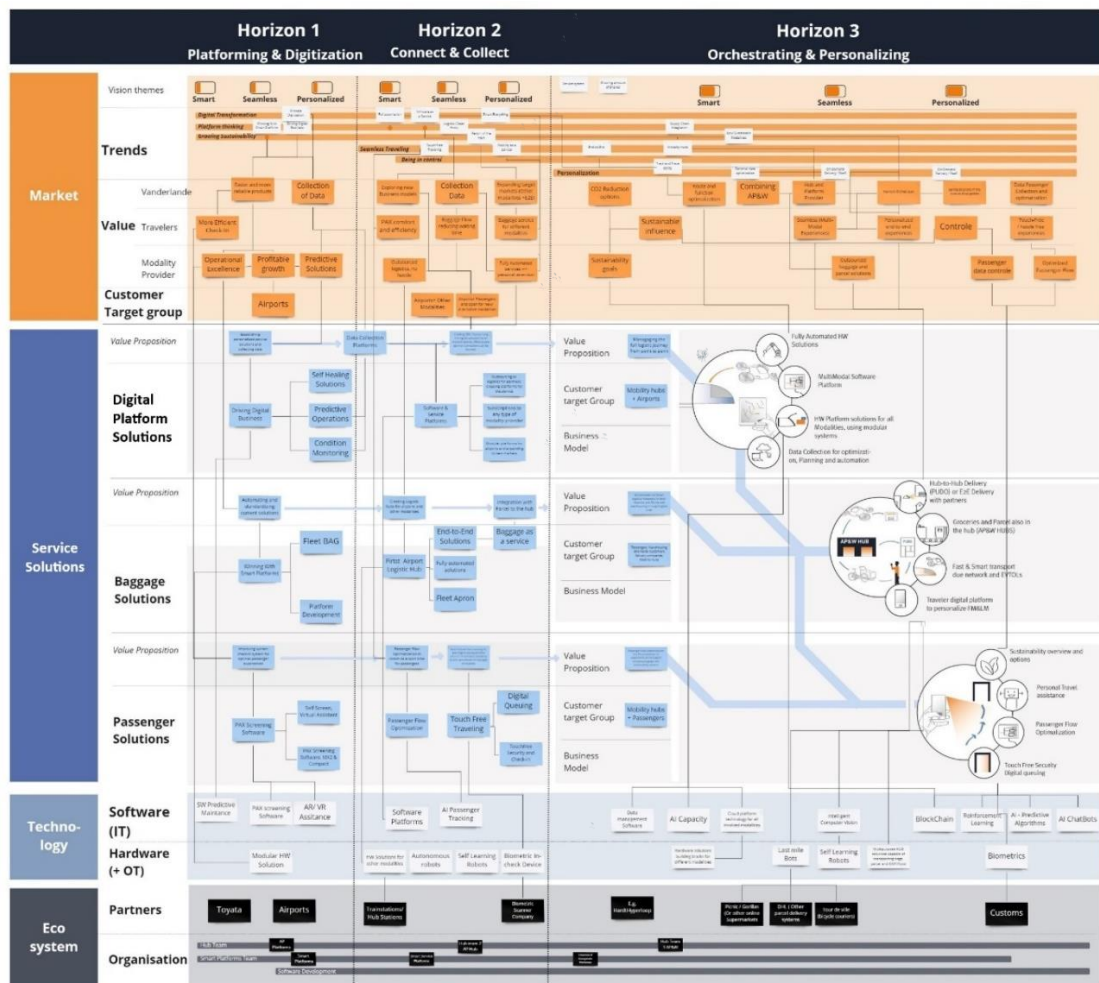


Figure 2 - Strategic Design Roadmap - The Long Now

5. EVALUATING OF RESULTS OF ARC 3

In the five The Long Now workshops, we designed and described three new value propositions around baggage transport in a rough concept form. Interestingly, the three service value propositions devised during ARC 3 went much further than the workshop participants could have imagined beforehand. Without realising it, they came up with 'overarching' service concepts. One of the solutions involves a *Baggage-as-a-Service* where the company generates service revenues from the customers-of-the-customer by providing a portfolio of door-to-door services to travellers. At the same time, the company supplies baggage *pick-up & drop-off units* (PUDOs) to airport, railway and hyperloop stations for handling baggage in the periphery of these mobility hubs and separated from passenger flows. Manufacturing industries in a B2B market setting usually strongly focus on their direct customers' needs, following a linear value supply chain, as shown in

Figure 3. The manufacturer (M) delivers a product-service to its customer (C). This customer (C) then delivers the product-service to an end-user (E). The blue arrows represent the value transactions between the actors of this linear value supply chain.

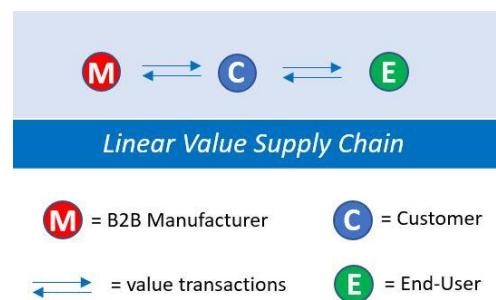


Figure 3 - Linear Value Supply Chain

Considering the three service value propositions of ARC 3 according to a linear value chain of Figure 3, they no longer fit this linear concept. We explain this using the *Baggage-as-a-Service* value proposition referring to our prior research (Bluemink et al., 2020) in which we proposed a design approach based on what we coined 'overarching servitization'. Selling PUDOs to mobility hubs for baggage handling generates a one-off revenue stream (product-related transactional business). We argue that the case company (M) designs and supplies PUDOs with related services mobility hubs (C). At the same time, the case company builds a business relationship with the end-user (E), the traveller, by designing and providing a door-to-door *Baggage-as-a-Service* value proposition. In this theoretical consideration, all three actors (M, C & E) exchange values with each other in a triadic value supply network; the manufacturer (M) is serving the needs of the mobility hubs (C) as well as the travellers (E). Figure 4 shows that its value supply chain has transformed from a linear supply chain into a triadic value supply network.

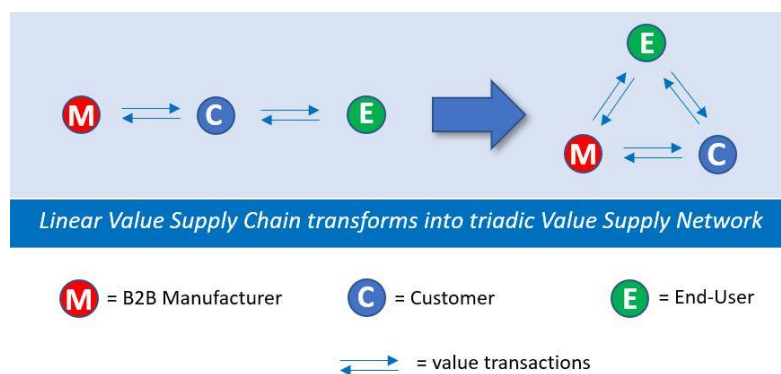


Figure 4 – a Linear Value Supply Chain transforms into a Triadic Value Supply Network

Here, the company supplies mobility hubs and creates a product-service ecosystem serving a value network from which three actors exchange value around a *Baggage-as-a-Service* value proposition. We call this overarching servitization; the company *overarches* its direct customer (the mobility hubs) and captures value from its direct customer (C) as well as from the customer's customers (E).

6. CONCLUSION AND INSIGHTS

In the preliminary step of ARC 3, we gathered end-user-centric and forward-looking insights that enabled a servitization strategy to design service value propositions. The company's current innovation processes mainly focus on physical products for a short-term horizon. Moreover, we concluded that the value creation process focused on capturing value from the *direct* B2B customer rather than the customer's customers (end-users) further downstream in the value chain. We, therefore, designed and implemented workshop interventions that focused on delivering value to end users and addressing unmet needs and desires in their future living environment. The successive workshops of ARC 3 fostered end-user-centred design capabilities and the company's servitization journey by applying the strategic design roadmapping of Simonse (2018) to create a '*design and implementation framework*' for *overarching* servitization strategies. With this framework, consisting of sequential workshop interventions, the case company designed a long-term servitization strategy manifested in future vision statements, a three-horizon roadmap for navigating the identified product-service value propositions and future business scenarios.

7. THEORETICAL AND PRACTICAL CONTRIBUTIONS

With our research, we contribute to the knowledge of B2B manufacturing industry practitioners on designing and implementing *overarching* servitization strategies. We developed a framework for strategic design interventions that B2B industrial companies can use to develop and implement an *overarching* servitization strategy.

Moreover, our framework fosters *end-user perspective* and *future thinking* capabilities in the B2B manufacturing industry by using *design thinking*, *service design*, and *strategic design methods* like *design roadmapping* to innovate product-service value propositions and formulate a sustainable servitization strategy.

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IMPACT OF ORGANIZATIONAL CULTURE ON SHIFTING TOWARDS A SERVITIZATION STRATEGY

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Shaun West, Bruce Wood

ABSTRACT

Purpose: To review papers relating to servitization and culture to develop a framework by identifying the key cultural characteristics/factors underpinning a successful transition to a servitization based business model.

Design/Methodology/Approach: A Systematic Literature Review (SLR) was conducted, which identified relevant papers on servitization, culture, and change management frameworks. Further analysis on the key cultural characteristics/factors was established based on the reviewed papers.

Findings: Synthesis from adjacent change literature of an initial Organizational Culture framework to facilitate the shift to servitization. Identification of contributory dimensions that may impact this transformation. To be followed by further empirical research.

Originality/Value: The successful implementation of a Service based strategy is highly influenced by organizational cultures. Managerial awareness of the contributory dimensions via the application of a theoretical framework will improve these efforts.

KEYWORDS: Servitization; Culture ; Transition ; Resistance to change ; Strategy.

1. INTRODUCTION

Servitization, the strategic transition from a product-centric to a service-oriented business model, confers competitive advantages to firms (Vandermerwe & Rada, 1988; Baines et al., 2009). Nonetheless, this paradigm shift entails multifaceted challenges encompassing cultural, operational, and technological dimensions (Anderson et al., 2021), necessitating firms to adeptly navigate these complexities to ensure successful implementation (Lightfoot et al., 2013). The critical barrier to servitization is the cultural shift, which demands alterations to the organizational mindset and values, particularly for firms with a product-oriented focus (Kowalkowski, 2011). This transition also mandates the development of new capabilities, entailing investment in employee training and upskilling (Baines et al., 2017).

Net Zero, defined as the balance between greenhouse gas emissions produced and removed from the atmosphere, plays a critical role in global climate change mitigation efforts (IPCC, 2018). The implementation of Net Zero regulations across various sectors prompts firms to embrace environmentally sustainable practices and invest in carbon-reducing technologies (Woodfield & Pullen, 2022). Thus, organizations must skilfully navigate these complexities of a shift to services to maintain competitiveness and regulatory compliance in a dynamic marketplace.

As highlighted by Baines et al. (2017), organizational factors have an impact on both servitization and innovation (Jagstedt et al., 2021), which merits further research. Nuutinen and Lappalainen (2012) state that from an organizational psychology perspective, the transition and particularly the cultural change, can be recognized and help overcome the obstacles to a service business model.

2. THEORETICAL BACKGROUND

Tan et al. (2009) assert that the performance of an organization depends on the optimal alignment between the external market environment, strategy, and the internal configuration of the organization. When shifting from a product to a service-oriented business model, firms often encounter tension arising from the need to balance their traditional product-centric focus with the new service-based approach. This tension is primarily due to the differences in organizational culture,

mindset, operational processes, and revenue models between product and service offerings (Kowalkowski, 2011). Firms must carefully navigate this tension to successfully implement servitization and reap its benefits, which can be challenging, particularly for firms deeply entrenched in product-oriented strategies (Baines et al., 2009) with a resistance to change. The following sections will detail aspects of change management and organisational culture and how they are linked to servitization.

2.1. Change Management

Change agents can have a significant influence on employee readiness for organizational change, with readiness to change being distinguished from resistance to change (Armenakis et al., 1993). However, change agents and managers must understand how to effectively deal with resistance to change. This can be undertaken by examining cognitive, affective, and behavioral dimensions of individual resistance and how it is influenced by individual predispositions towards openness and resistance to change; the threats and benefits of change; communication, understanding, participation, trust in management, management styles and the nature of relationships with the change agents. (Erwin & Garman, 2010). The Kübler-Ross model (Kübler-Ross, 1969) is often applied to understand the emotional stages of individuals during the change process. By addressing these dimensions of resistance and employing such models, organizations can better navigate the challenges associated with the servitization shift.

One of the barriers to servitization for firms is management resistance (Baines et al., 2009). Many managers and employees are hesitant to switch from product-centric business models to service-based ones due to limited experience in this area. There is also a fear that product sales will decrease. In addition, many managers are concerned about the loss of control that comes with product-service change, as service-based models necessitate more flexibility and adaptation to customer needs (Kowalkowski, 2011). These fears highlight the importance of organizational culture for servitization shift, yet it is an area that lacks significant investigation (Baines et al., 2009).

2.2. Organizational Culture

Culture can be defined as the collective values, beliefs, and practices that characterize the members of an organization (Schein, 1985). It manifests not only in the conspicuous aspects of cultural barriers within the organization, such as its mission and professed values, but also in the manner in which individuals behave, their expectations of one another, and the means by which they interpret each other's actions (McDermott & O'Dell, 2001).

There is a consensus among scholars and practitioners that cultivating a service-oriented culture or mindset is pivotal to organizational success. This concept involves the entire organization recognizing and embracing services, not merely as supplementary to products but as essential value-adding activities that lie at the core of business operations. Nevertheless, attitudes towards services and collaboration may differ within the organization (Sandberg & Werr, 2003). In order to transition to a service-oriented culture, organizations must embrace a more agile and decentralized structure that promotes empowerment and emphasizes teamwork. Successful organizations are increasingly generating employee support and enthusiasm for proposed change rather than focusing efforts on overcoming resistance (Piderit, 2000).

Psychological contracts are instrumental in mitigating resistance. Schein (1980) defined the psychological contract as the portrayal of the exchange relationship between an employee and the organization. However, Rousseau and Parks (1993) expanded this notion by introducing transactional and relational contracts. Transactional contracts, which could be associated with value in exchange, highlight the quantifiable, market-based aspects of employee-employer agreements, such as monetary compensation and working hours (Smith, 1776; Rousseau, 1989). Conversely, relational contracts aligned with value in usage, encompass intangible benefits derived from mutual commitment, trust, and loyalty (Smith, 1776; Rousseau, 1989). These contracts emphasize career development, job security, and shared values, contributing to the overall satisfaction and utility of the agreement. Although the value in usage from relational contracts may be less quantifiable or directly

comparable to market-based metrics, it is vital for fostering an enduring successful employee-employer relationship.

The difference between product and service-oriented cultures can cause a strain within organizations. The shift in the organization to be more service-oriented may lead to conflicts and rivalries. The challenge is to balance and maintain the symbiotic relationship between the cultures rather than totally substituting one value set for the other (Bowen et al. 1989). Organizations that are undergoing the shift are living between "two worlds" in which the product-selling core task still maintains priority, while the new, more customer and service-oriented core tasks are emerging. A lingering, product-related culture remains due to the ambiguity with the strategy (the Why?), common and individual goals (the What?), and the ways to proceed with them (the How?) appeared to be ambiguous among the staff as a whole (Gebauer and Friedli, 2005).

Hernandez et al. (2010) show that due to previous cultural barriers with outdated knowledge, this can impede the adoption of new configurations. Therefore, it is important for organizations to provide an appropriate environment for overcoming cultural barriers. Otherwise, new knowledge will not be acted on or incorporated into new services. Cultural barriers have a number of causes, for example, a lack of training or instruction, lack of motivation, lack of basic ability, etc. (Grugulis and Bevitt, 2006). Many training programs have focused attention on teaching organizational members to overcome cultural barriers (McDermott and O'Dell, 2001). For example, learning more about barriers to assuming new behavioral patterns is a strategy to judge the adequacy of assumptions and opinions among individuals (Sinkula, 2002).

Close customer contact is built upon trust and good relationships. Customers should feel that the providing firm is on the same side as themselves, eager to support them in their objectives and not simply increasing product sales (Galbraith 2002). Service-oriented firms should be willing to learn and understand what is critical to their customers and dedicate themselves to finding the best solutions for them. At the same time, firms must be willing to be open and share their knowledge and processes with their partners (Vandermerwe et al. 1989).

The literature indicates that there is tension when transitioning from a product to a more service-oriented business model, and the existing culture is a hindrance to change. To develop an enhanced understanding of the key cultural characteristics to a servitized business model, a detailed Systematic Literature Review (SLR) has been undertaken.

3. RESEARCH METHODOLOGY

To examine the relationship between culture and servitization, a SLR was conducted to identify all relevant papers. To find a large collection of literature related to the topic of servitization culture, utilizing a larger number of databases reduces the risk of overlooking key articles. For this search method four databases were utilized, including Engineering Village, SCOPUS, Web of Science, and IEEE Explore. The following sections will outline the search terms used and the criteria used for paper selection.

This stage of the study involves investigating the correct search terms (keywords) that will be applied against the databases. There are three aspects that need to be covered within the search method. The first relates to "servitization," secondly the "culture," and finally, the "change management" aspect. Table 1 shows the search terms that were used for each aspect. Combining Terms 1, Terms 2, and Terms 3 with the "AND" operand results in all three aspects being included.

Table 1: Keywords used for Systematic Literature Review

Term 1	("Servitization" OR "product-service-systems" OR "SD Logic" OR "servification" OR "servic*" OR "value co-creation" OR "value in use" OR "value in exchange")
Term 2	("Change management" OR "KPI" OR "Management KPI" OR "Resistan*" OR "Resistan* Framework" OR "Organizational Change" OR "Organisational Change" OR "Transformation" OR "Shift" OR "Business Model Innovation" OR "Barrier*")
Term 3	("Organizational culture" OR "Organisational culture")

Once the search terms shown in Table 1 were entered into the selected search engines, this resulted in a large number of articles, as seen in Figure 1, which showcases a flow diagram showing both the steps taken during the review process and the results of each stage.

After including the search terms in the databases, initially, a total of 3715 articles were identified. The "Screening" process involved three screening filters that were applied. Screen 1 involved identifying and removing all conference papers, as the focus is only on peer-reviewed journal papers. From this, 980 papers were removed, leaving 2172 papers. Screen 2 involved focusing on the Title and Abstract of each article and removing papers that were not related to "servitization" or "culture." 2112 articles were excluded as most were within the "Health and Medical" domain and focused on "service" rather than "servitization." Screen 3 focused on reviewing the remaining 60 full-text articles with an in-depth lens on whether the paper is relevant to the focus of this research. This meant a further 17 articles were excluded, leaving 43 papers for final analysis. Previous to the SLR process, 4 articles pertaining to servitization and culture were not picked up by the search engines. This meant using a backward and forward searching search strategy, these 4 papers were included for the final analysis. This meant 47 papers were included to be analyzed and reviewed.

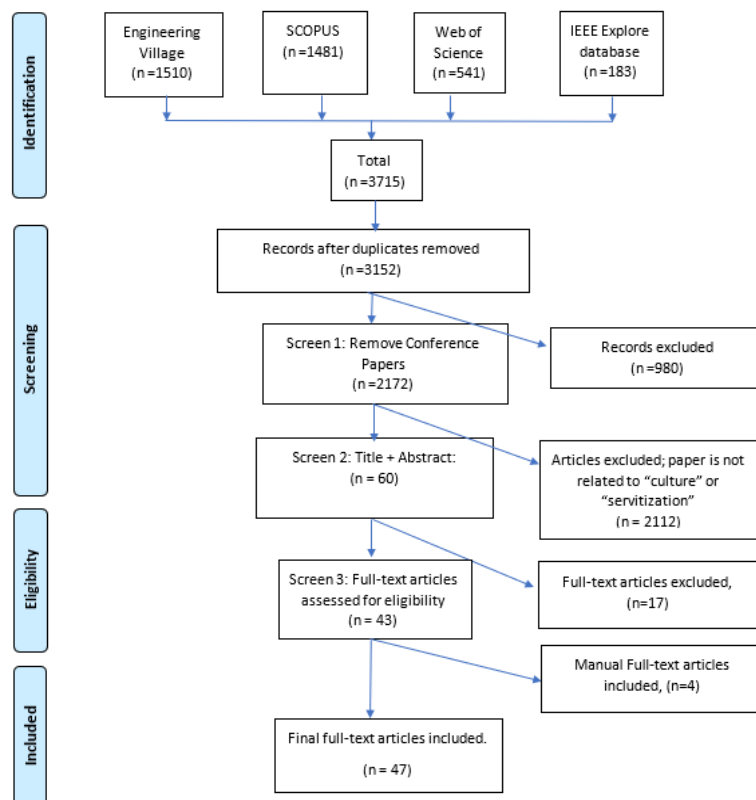


Figure 1: SLR Flowchart

4. FINDINGS

This section will focus on the frameworks that arose from the SLR and identification of servitization cultural factors.

4.1. Prominent Frameworks

The outcome of the literature review revealed prominent frameworks relating to organizational culture. These have been synthesized into an initial holistic framework and will be tested later upon organizations that are shifting to a service offer. A brief overview has been provided of the highly relevant frameworks in the literature below:

Conway, M. E. (1968). How do Committees Invent – Conway's Law can be articulated as follows: when an organization undertakes the design of a system, the resulting design will exhibit a structure that reflects the organization's communication framework. In short, the organizational structure and the products of any given firm are inextricably linked to one another. To gain a better understanding of how organizations can bring about change, a model based on this law has been utilized. Change, Organization, and Structure are the three primary components that make up this framework. The manner in which decisions are made, and the flow of information throughout an organization are both examples of its structure.

Orr (2014). Local Government Chief Executives' Everyday Hauntings: Towards a Theory of Organizational Ghosts with regards to the Organizational dimension, Orr defines organizational ghosts as "historical, cultural and structural legacies that continue to shape organizational life even after they are no longer visible or acknowledged." These legacies can include past practices, beliefs, and structures that continue to influence the behavior and decisions of individuals within an organization, despite their lack of awareness. Orr (2014) argues that these "ghosts" can take a variety of forms, including:

- i. Historical legacies: Organizational ghosts may consist of traditions, practices, and values that have been passed down through an organization's history. These legacies can continue to influence the culture and behavior of the organization, even if they are no longer explicitly acknowledged or practiced.
- ii. Cultural influences: Organizational ghosts can also be influenced by larger cultural forces that influence the organization, such as social norms, beliefs, and expectations.
- iii. Structural factors: Organizational ghosts can be embedded in the organization's structure and design, such as formal policies and procedures, hierarchies, and power dynamics.

They can either positively or negatively affect those around them. Positive ghosts may include traditions or values that have contributed to an organization's long-term success, whereas negative ghosts may include discriminatory practices or entrenched power dynamics that hold the organization back. In either case, they can have a significant impact on the functioning and effectiveness of an organization, and they must be acknowledged and addressed to promote positive change and growth.

Pettigrew. (1988). The Management of strategic change –the Context, Content, Process (CCP) framework is a comprehensive approach to managing organizational change, emphasizing the importance of understanding stakeholders' attitudes and behaviors to ensure successful change initiatives (Pettigrew, 1988). This framework requires considering existing organizational structures, aligning them with desired change outcomes, evaluating external factors and internal resource management strategies, and acknowledging the impact of people's attitudes, beliefs, and values on the change process.

Weng, & Chang (2017). Shaping organizational culture by using work songs as a ritual: A case study of the Zonson Sports Corporation in China – a novel approach on how workplace rituals, such as work-songs, influence the organizational culture of a firm by communicating values. They propose a theoretical framework for culture building, as shown in Figure 2, showing the input from the founders and the environment, creating a paradigm of shared assumptions and value for the organization. This, in turn, influences culture communication via mechanisms of leadership, common stories, rituals and symbols, recognition and reward systems, and organizational structures.

Research on the influence of social and cultural dynamics within servitization per se is limited. Some correlation is offered by Ramafalo et al. (2019), who highlight that poor communication flow and the nature of contractual arrangements, which foster further fragmentation are probable barriers to the adoption of servitization within industry. Likewise, Laužikas, M., & Dailydaitė, S. (2014) consider the concept of social capital, derived from social relations, human capital development, and innovation/knowledge diffusion, as key factors for successful innovation. In a similar manner, Garcia

(2016) states that fear of failure, avoidance of uncertainty, and a lack of trust all work against transformational leadership and communication, and having a shared organisational culture helps establish a collective commitment and influence behaviour by a shared understanding of aims.

However, as can be seen from the existing literature, the impact of culture on general change and technological innovation may be applicable. Through analysis of the literature, an Initial framework was determined, which would later be tested to validate such a concept.

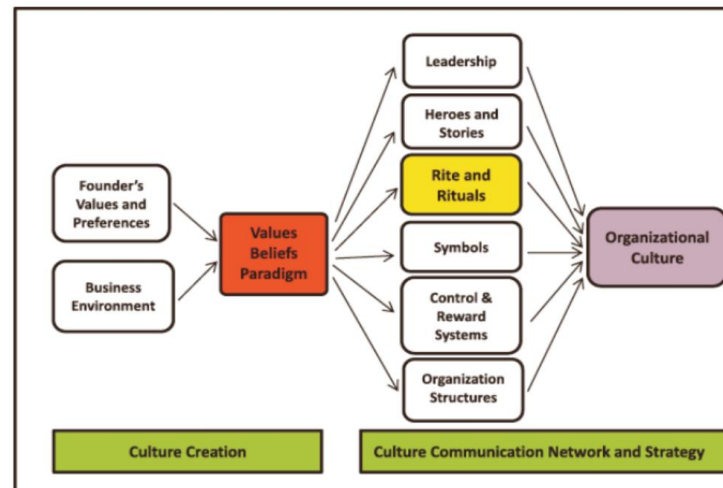


Figure 2: A Theoretical Framework for Culture Building (Weng, & Chang, 2017))

4.2. Key cultural characteristics

Following the SLR, the key characteristics/factors that authors have mentioned for servitization cultural success can be seen in Table 2, clustered according to the service excellence barriers used by West, Gaiardelli, & Sacconi (2022). There was a significant variety of characteristics mentioned by the authors. However, through further analysis, many of the definitions have common attributes; this suggests that the ontology of the characteristics needs to be further refined.

5. Theoretical Implications

This paper has conducted an in-depth review and highlighted various factors/characteristics that influence "culture" within a firm, in particular relating to the servitization domain. The three most mentioned factors for cultural success are leadership/management commitment, workplace rituals/routines, and employee training and reward systems, respectively. In addition, there are several frameworks, as mentioned in this paper which give a different perspective on how to build an enabling culture within a firm. The importance of workplace ritual and empowerment is long established within firms, and continuous improvement methodologies such as lean manufacturing (Liker, 2004) are based upon instilling an individual's enthusiasm and capacity to improve their working practices.

6. Managerial Implications

From a managerial perspective, the review and framework created allows managers in firms already in a servitization business model or transitioning to view the major cultural characteristics/factors which are imperative to servitization success. At a minimum, they can be aware of the factors and build upon these efforts where applicable.

Table 2: Key cultural characteristics clustered according to West, Gaiardelli, & Saccani (2022)

Characteristic	Details
Organizational structure and culture	
Leadership/management commitment	Top-level management promoting servitization culture and values throughout the firm Lijauco et al. (2020); Yan et al. (2021); Nguyen & Aoyama (2015); Ferreira Junior et al. (2022); Moraes & Cunha (2022); Hillestad, (2017); Pezeshkian & Hamidi (2020); Othman & Elkady (2021), Wijethilake et al. (2021), Erthal & Marques (2022); Lin (2014); Weng & Chang (2017); Nukic & Huemann (2016); Adamonien et al. (2021).
Organizational structure	Arrangement of roles, responsibilities, and relationships within a firm Pezeshkian and Hamidi, 2020; Moraes and Cunha, 2022
Individual behaviours/values	The personal attitudes, beliefs, and actions of employees of a firm Bertassini et al.
Rewards	A tangible or intangible incentive-based system that recognizes employee achievements and reinforces certain behaviors Bertassini et al., Lijauco et al., 2020, Pezeshkian and Hamidi, 2020, Yan et al., 2021, Tan et al., 2009
Workplace rituals/employee routines	Establishing recurring activities, practices, and customs within the work environment that reinforces values, norms, and culture Weng and Chang, 2017, Pezeshkian and Hamidi, 2020, Garcia, 2016, Yan et al., 2021, Tan et al., 2009, Smith, 2019, Hernandez-Mogollon et al., 2010, Moraes and Cunha, 2022
Market orientation	Understanding and responding to the needs, preferences, and expectations of customers, their competition, and the broader market environment Lijauco et al., 2020
Heroes and stories	The influential figures and narratives that embody and convey the values, beliefs, and traditions of a firm Weng and Chang, 2017, Yan et al., 2021, Weng and Chang, 2017
Tensions	The conflict or opposing forces that arise as a source of inertia within a firm Nuutinen and Ojasalo, 2014
Knowledge and information	
Employee training	Investing in educating and developing employee skills Wijethilake et al., 2021, Yan et al., 2021, Nguyen and Aoyama, 2015, Tan et al., 2009
Communication	Exchange of information, ideas, feedback, among individuals and teams within a firm and externally to relevant stakeholders Nguyen and Aoyama, 2015, Hillestad, 2017, Pezeshkian and Hamidi, 2020, Adamonien et al., 2021
Cooperation	Willingness and ability to work effectively between stakeholders Moraes and Cunha, 2022, Adamonien et al., 2021
Work process/knowledge management	Influences the product lifecycle and customer activity Pezeshkian and Hamidi, 2020, Alavi et al., 2005, Tan et al., 2010, Nuutinen and Ojasalo, 2014
Products and activities	
Service development practices	Developing service-related culture and service firm understanding Nuutinen and Lappalainen, 2012
Capabilities and Resources	The collective skills, knowledge, assets, and support systems that enable a firm to achieve its goals and objectives Othman and Elkady, 2021, Tan et al., 2010, Nuutinen and Ojasalo, 2014, Wijethilake et al., 2021, Bertassini et al., 2021, Lin, 2014, Pezeshkian and Hamidi, 2020
Economics and finance	
Key performance indicators	A measurable value or metric that demonstrates the firm's effectiveness in achieving a desirable outcome Tan et al., 2010, Weng and Chang, 2017

7. CONCLUSIONS AND LIMITATIONS

This research has limitations that need to be addressed in the future. Firstly the frameworks identified need to be applied in a real setting through multiple case studies to examine in detail the key cultural factors and barriers that affect firms transitioning towards a servitization business model. Secondly, the SLR should have identified all articles relevant to servitization culture. Some studies may have been overlooked and therefore not included. This is a standard limitation within review articles.

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UNFOLDING SERVICE-CENTRIC BUSINESS MODEL INNOVATION ACROSS GEOGRAPHIC MARKETS

Leon Marcel Adler, Heiko Gebauer

ABSTRACT

Purpose: This paper investigates how a service-centric *Business Model Innovation (BMI)* of a selected health care equipment manufacturer unfolds across main geographic.

Methodology: An in-depth qualitative research study together with a single health care equipment manufacturer was conducted. Hereby, a discovery-oriented, theories-in-use approach was applied.

Findings: Since a service-centric BMI require (digital and physical) services and software applications, the value creation between the company and its local customers is rather complex and heterogenous. Therefore, it is rational that the process for letting service-centric BMI unfold is intertwined with the characteristics of geographic markets. This paper provides a process framework, which describes how service-centric BMI unfold across geographic markets.

Originality: While previous literature assume that service-centric BMIs unfold globally and neglects role of geographic markets, our process framework demonstrates how (digital and physical) services and software applications emerge within and across different markets.

KEYWORDS: Business Model Innovation, Healthcare Sector, Value Creation

1. INTRODUCTION

A service-centric business model represents a crucial innovation for any product manufacturer. Service-centric business models are a specific form of *Business Model Innovation (BMI)* that arises as products become increasingly augmented with service offerings. These service offerings evolve from a simple to more advanced service portfolio to eventually becoming *Product-Service-Software Systems (PSSS)* (Sjödín et al. 2020b). Such service portfolios consist of digital and physical services and basically emerge through a design and implementation phase.

In the first design phase, product manufacturers have to design their service portfolios and individual services to match customer needs. They have to ensure that the value proposed through its services matches customer needs and preferences. Services can be either rather standardized for all customers or customized to the individual customer needs. If services can be rather standardized across the global customer base, it is less relevant to include market organizations in the design process. If services need to be rather customized, it is important to include market organizations into the design processes due to their proximity to their customers and their in-depth understanding of individual customer needs.

In the second implementation phase, product manufacturers have to think through the way how the services in the service portfolio are provided to the customers. Since service portfolios consist basically of digital and physical services, the value creation emphasizes *Place Logics (PL)* and *Space Logics (SL)* (Siddiqui et al. 2021). Physical services require most likely a PL. In this PL, market organizations with their organizational structures, people, and culture and competences are a key factor in the value creation. Digital services follow a SL, whereby value can be created relatively independently from market organizations.

Despite the demonstrated importance of market organizations in the various geographic markets in the process for letting service-centric BMIs unfold, literature has largely neglected the topic. Most studies have focused on Northern and Western Europe and North America, and only a few on emerging markets such as China (Adrodegari und Sacconi 2017).

There are two dominating basic assumptions. First – *global approach* –, service-centric business model are designed globally leading to a highly standardized service global service portfolio. This portfolio is implemented through a global rollout in the market organizations across geographic

markets. Second – *local approach* – , local market organizations are responsible for designing the service-centric business model and develop the service portfolio. Market organizations implement these services in their geographic markets without any global rollout. But these assumption should be jeopardized for at least two reasons.

On the one hand, there are sectors where geographic markets are very different. A typical example is the health care sector. Due to different regulations and market structure, health care markets differ substantially. Therefore, health care equipment manufacturers are quite unlikely to deploy a global approach to unfold its service-centric BMIs. On the other hand, service portfolios increasingly include digital services. In the health care sector, health care equipment manufacturers offer remote services and leverage their equipment connectivity to provide digital features, and software applications. These digital services can be provided relatively independently from the market organization. This questions the local approach.

To advance previous literature, this paper investigates how a service-centric BMI unfolds across main geographic markets. We conducted an in-depth qualitative research study together with a single health care equipment manufacturer. Accordingly, this paper tries to answer following research question: How does a health care equipment manufacturer unfold its service-centric BMI with its digital and physical services across main geographic markets (American, European, and Asian markets)? The answer to this question informs a process framework describing service-centric BMIs across geographic markets.

2. THEORETICAL BACKGROUND ON Service-Centric Business Model Innovation

Business models have generally been defined as the “design or architecture of the value creation, delivery, and capture mechanisms” of a firm (Teece 2010, p. 172). Service-centric business models first originated from the concept of servitization (Baines et al. 2017), which describes the shift in a product firm from providing products to providing advanced PSSS (Forkmann et al. 2017). It concerns moving away from providing value-in-exchange to creating value-in-use (Sjödin et al. 2020; Raddats et al. 2019). Instead of buying products, customers want to receive the value inherently offered by product use, thus consuming it as a service (Cusumano et al. 2015).

Digital servitization has been as a new dimension whereby PSSS enable value creation and capture through monitoring, control, optimization, and autonomous functioning (Kohtamäki et al. 2019). Digital servitization suggests that service-centric BMIs increasingly includes digital services. These digital services shape the key business model components leading to changes in the value proposition, value creation, and value capture mechanisms. While there has been an increasing number of contributions on service-centric business models (Parida et al. 2019; Burström et al. 2021; Sjödin et al. 2020b), there is still little knowledge about the process for letting service-centric BMIs unfolds especially across geographic markets.

There is still a need to examine the key stages, activities, and roles of customers and partners in value creation (Parida et al. 2019). To be successful, firms should focus on understanding customer value-creating processes and providing support for co-creation (Green et al. 2017). Linear development processes are not sufficient in the fast-paced environment of digital servitization. While there are specific process models for service co-creation and service innovation, there is a need to adapt these to the dynamic environment of service-centric BMIs.

Since service-centric business models capture digital and physical services, two logics – the SL and the PL determine the unfolding across geographic markets. The PL describes how service-centric business model should be aligned with the market organizations in the geographic markets. The SL suggest that service-centric business models business models are relatively independently from the market organizations. Physical services are associated with the place logic and digital services with the space logic (Siddiqui et al. 2021).

Increasing product connectivity and more sophisticated usage of product data do not only let the physical and digital services convergence in service-centric business models. They also enforce a digital business fusion. This digital business fusion defines the process of integrating digital technologies, services, and platforms to create a more personalized and integrated digital

ecosystem. It involves the integration of previously separate digital technologies and services such as mobile devices, cloud computing, social media, big data analytics, artificial intelligence, and the Internet of Things. The outcome is a connected and intelligent digital environment that leverages technologies to create a more comprehensive user experience. Digital business fusion drives the need for businesses to provide more personalized and seamless digital experiences to customers, as well as the desire of individuals to have greater control and convenience in their digital lives.

3. RESEARCH METHOD

Our study took place in the health care sector. Globally, this sector attempts to ensure service quality with reasonable costs. While the various geographic health care markets share comparable challenges; they are quite diverse and fragmented. Health care sector *BMI* offers promising opportunities for health care manufacturers to deploy service-centric BMIs. For this study, we selected a health care equipment manufacturer (e.g. 1.5 billion Euro revenue, 5,000 employees in 24 countries covering main markets in America, Europe, and Asia). This company has recently initiated service-centric BMIs. Given the limited literature on how BMI unfolds from a process perspective (Sjodin et al. 2020), a discovery-oriented, theories-in-use approach was adopted (Glaser and Strauss 2017; Zaltman et al. 1982). Our case work relied on an inductive approach.

Data were collected in 2022. The company had already invested significant efforts into building its technological infrastructure for its service-centric business model, but had not yet realized expected customer value or monetary gains. In response, the firm launched a cross-business unit project aimed at innovating its service-centric business model to create value. The project used a discovery-oriented, theories-in-use approach (Glaser and Strauss 2017; Zaltman et al. 1982) from the outset and developed a process framework for successful service-centric BMI implementation. Altogether, we conducted 100 in-depth semi-structured interviews with top management, product management, service, R&D, application specialist, and marketing employed at a healthcare equipment manufacturer and suppliers across different markets.

The data was analysed using open coding to identify emerging concepts and categories and to gain a deep understanding of customers. Preliminary artefacts were validated through interviews with healthcare suppliers and customers. After selecting a central category that tied together the other categories, a theory was developed based on this central category using selective coding. The insights were transferred to a service-centric business model, which was iteratively validated internally and with four research teams conducting in-depth interviews and on-site observations. The findings were triangulated across different countries to create a service-centric business model framework the firm. It involved in-depth data collection and analysis, extensive validation with suppliers and customers, and iterative refinement of the proposed service-centric business model.

4. FINDINGS

4.1 Application-Oriented Service-Centric Business Model Innovation Process Framework

Our findings revealed a process framework. This framework presents a service-centric BMI process involving customers, suppliers, and firms, based on an application-oriented approach. The insights from a case study of a manufacturer primarily concerned with the American and European markets.

The BMI consists of four stages: Preparation, Ideation and Internal Research, Triangulation of Service-Centric Business Model, and Validation and Creation of a Service-Centric Business Model. Each stage comprises various activities, roles played by firms, and the influence of customers and suppliers across different geographic markets [as shown in Figure 1]. The logical sequence of each stage comprises triggers, aims, actions, and stumbling blocks. It is essential to adapt and incorporate insights gained from earlier stages iteratively since the fast-paced nature of digital servitization renders linear development processes inadequate. The roles played by firms in the service-centric BMI process are critical to its success, and it is crucial to involve the firm holistically in the approach. Some roles are rigid, while others are dynamic, leading to different conflicts and opportunities. Dynamic roles can be reconsidered and changed after entering the next stage. The roles considered in this study include Top Management, Innovation Process Manager, Cross-Firm

Team, Sounding Board, and Geographic Markets consisting of customers and suppliers. The ability to complete one stage and move to the next stage is a key contribution to the model. We found that servitization literature proposed process frameworks that tend to withhold the goal of the process and where it is intended to lead. In the scholarly article authored by Sjödin et al. (2020), an unaddressed matter pertains to the specific percentage increase required to boost sales. Our proposal involves a direct link between the process goal and cost savings and revenue levers for a period of five years. Cost savings are anticipated to result from remote activities, with the aim of enabling updates for up to 70% of devices remotely. Revenue levers are segregated into two categories: sale of the service-centric business model and increased device sales attributable to the value proposition offered to customers. We project a tentative annual increase of 5% for both.

Overall, establishing feasible quantitative metrics enhances the resilience of the service-centric deployment process against internal conflicts. In the following section, we proceed to elaborate on the process framework. This framework presents a service-centric BMI process for customers, suppliers, and firms. It's based on an application-oriented approach and insights from a case study of a manufacturer primarily concerned with the American and European markets.

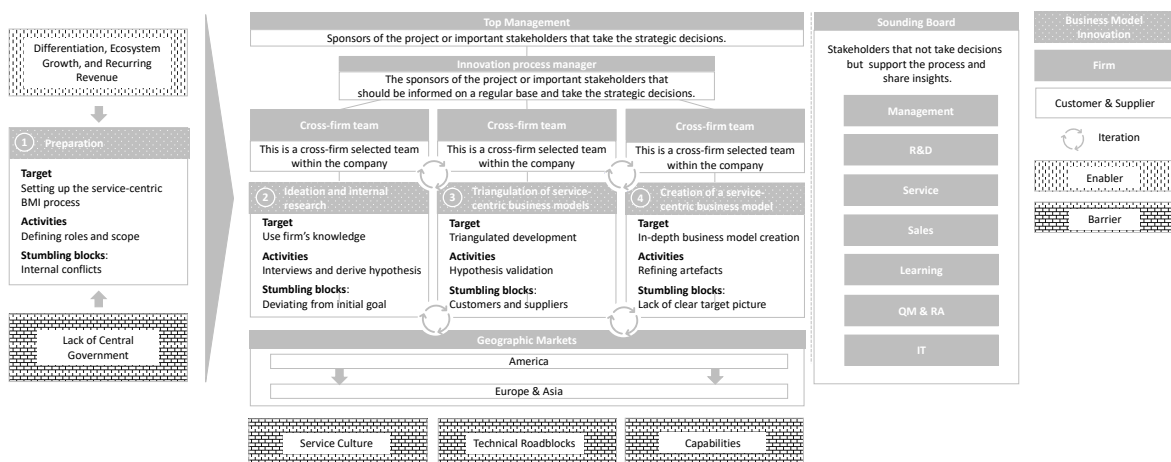


Figure 1: Application-oriented service-centric BMI process across geographic markets

The first stage of implementing a service-centric BMI is the "preparation stage," which is initiated by the commitment of top management. The objective of this stage is to establish service-centric BMI in terms of processes, roles, and organization. To achieve this, five activities are necessary.

Firstly, an individual should be designated as an Innovation Process Manager to lead the process team and oversee the entirety of the innovation process while planning and preparing for upcoming steps. This role should be situated between the various business units within the organization to ensure a comprehensive and holistic perspective on the company.

Secondly, both internal and external resources should be allocated to establish a dynamic, cross-firm team capable of identifying the roles required throughout the BMI process. The organization begins by using more external resources and gradually shifts to more internal resources during early digital servitization stages because resources for may not be in place. The cross-firm team usually includes a mix of existing firm employees and external resources. This brings separate business units together and creates an interdisciplinary environment. The team roles will evolve after each stage to reflect the changing resource requirements. The core team should have representation from each business sector to secure the buy-in of the organization.

Thirdly, establishing sounding mechanisms promote transparency, facilitate communication, and shape the culture of the firm. One approach is the implementation of a sounding board, composed of a diverse group of stakeholders from across the organization. This aims for continuous training, supports cultural changes, provides strategic support.

Fourthly, the decision on which markets to focus the service-oriented BMI process must be made by evaluating the profitability, accessibility, and organizational structure of the market. Justify long-

term investments with profitability assessment and align markets with company strategy. With the increasing shift in focus from the Asian market back to the American market due to the change in strategy in Asia (e.g., China) from "globalization to localization," the strategic importance of the selected market needs to be questioned. The market's accessibility may be difficult to reach customers due to suppliers or dealers. Additionally, the critical infrastructure needs to be considered, especially in healthcare sectors, to ensure the secure transmission of data. The organizational structure of the market and its management team is important to reflect. For example, some markets are country-specific or bundled (e.g. BeNeLux, Nordics, etc.), while the American market is relatively homogeneous compared to the European market. Decisions should be made of which to explore more in-depth, such as a manageable niche market or a large market. This decision can be made with the management team in the selected market, which must be willing to cooperate. Setting a focus has been proven to be beneficial for service-centric BMI.

During the implementation of BMI, the following stumbling blocks have been observed: (i) selection and composition of the team is crucial, (ii) political awareness avoids counterproductive internal conflicts within the organization, (iii) Asian market tension between value creation and value delivery dimensions, and (iv) aligning all relevant stakeholders.

The second stage of the BMI process is called the "Ideation and Internal Research Stage." This stage starts with a process setup and goal communications. This stage utilizes following activities.

Firstly, interviews with top management are conducted to understand their priorities and visions. Secondly, interviews with individuals across all geographic markets help to create valuable customer insights. Thirdly, acquired insights are iteratively checked with decision-makers of other market organizations. Fourthly, existing technology and data roadmaps are examined, and possible roadblocks with relevant solutions are communicated. Finally, service-centric business model scenarios are developed for experimenting with customers and suppliers in the next stage.

However, these activities face following stumbling blocks: (i) deviating too much from initial goal and (ii) getting overwhelmed with the information obtained by too many interviews.

The third stage of the service-centric BMI process is the "Triangulation of service-centric business model," which is triggered after internal data gathering. The target of this stage is to develop a service-centric business model through a triangulated validation approach that involves the firm's customers and suppliers across markets. To achieve this, three activities are required.

Firstly, internal hypotheses derived from the previous stage are validated with real customers and suppliers in digital and face-to-face semi-structured interviews. During this stage, key customer pains are identified to create a holistic service-centric business model with three significant opportunity clusters: availability, performance, and sustainability. For instance, in the healthcare sector, the customer pain on avoiding device downtime can be addressed.

Secondly, the identified findings are validated further with the sounding board and selective firm stakeholders. Since there are longer intervals between validations, it is crucial to engage with relevant stakeholders early on the process steps. Regular validations are established with highly relevant stakeholders to ensure alignment with ongoing parallel processes. After synthesizing the triangulated findings iteratively, they are shared with top management.

Thirdly, top management defines the business potential for each scenario. Establishing the initial justifications for investment is critical as it helps quantify the business potential and derive significant metrics. The earlier the business potential can be quantified, the more robust the BMI process becomes. However, it is important to note that digital servitization not only brings external value creation but also internal value creation. Therefore, the business model can offer service-centric digital offerings and generate revenue, while achieving internal cost savings (e.g., remote fixes and elimination of travel time) or application error correction based on the data obtained.

Both perspectives need to be considered in assessing the business potential. These activities face the stumbling blocks: (i) data confidentiality and local regulation prevent customers and suppliers to participate, (ii) multiple projects absorb too many resources and delay the process, and (iii) inability to estimate the business impact prevents resource commitments.

The fourth stage is about the "Validation and Creation of a Service-Centric Business Model." It is initiated by the management's decision to advance the triangulated results. The objective is to conduct another round of in-depth triangulation to transfer the insights about service-centric BMIs. To do so, five activities are required, which includes defining a target picture and roadmap. A robust target picture is essential for shaping organizational culture and aligning related activities.

In this stage, the research team iteratively triangulates the insights gained from the previous stages internally and conducts in-depth interviews and on-site observations with customers and suppliers. The in-depth validation is essential to confirm the service-centric business model on a detailed level with the customers and suppliers before implementation. To achieve this, four research teams conduct two weeks of in-depth interviews and on-site observations with a small number of customers in the US and Germany. This approach allows for precise results in co-creation and strengthens the relationship with customers and suppliers.

The research team then cross-checks the findings from the in-depth interviews and observations with other countries during digital semi-structured interviews. This step is necessary to holistically adapt the business model. Additionally, the team elaborates on the business potential in parallel to communicate the value to the top management and justify the innovation process. To achieve this, the team focuses on the important opportunity levers for prioritized technologies, which are divided into cost savings and revenue-generating opportunities.

Finally, the team refines the initially created artifacts, such as vision, value proposition, and the future customer journey, and creates a service-centric business model for the firm. This model reflects the opportunity clusters that were defined in the previous stage. Overall, this stage is critical in creating a service-centric business model that meets the needs of customers and suppliers while generating revenue for the organization.

Again, these activities face possible stumbling blocks: (i) no lack of a clear target picture, (ii) sticking to technologic possibilities instead of the customer value.

4.2 Triangulated Co-Creation Leading to Holistic Business Models

To enable the emergence of a service-centric BMI, we adopt an iterative triangulation approach [as shown in Figure 2]. This includes experimenting with the company, the customer and the supplier at each stage of the process from three different perspectives of co-creation. However, this approach cannot be applied to the entire BMI process model, but rather must be applied to specific business model sub-dimensions, such as the value creation stages 1-4. The triangulation process consists of two phases: "Experimentation" and "Definition."

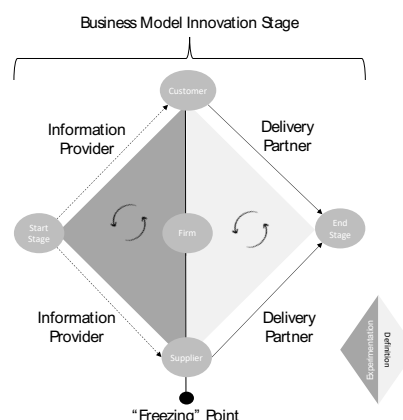


Figure 2: Triangulating service-centric BMI

The "Experimentation" phase starts entering one of the four stages of the service-centric BMI process framework. The objective of this phase is to quickly and broadly understand the respective roles in the stage and to solve necessary activities. This is achieved through iterative experiments with the firm and, if Stage 3 or 4 has been reached, with the customers and suppliers. The aim is

to reach a "freezing point," at which insights are consolidated to achieve efficiency and avoid endless iterations. However, determining this point can be challenging. Although we reserve the right to return to this phase, it should only be done if the customer escalates it in the next phase.

The second phase, "Definition," is initiated after reaching the "freezing point." The objective of this phase is to precisely define the insights gathered in the "Experimentation" phase and to solve necessary activities. To achieve this, there is a role change in the triangulation process, where relevant roles transition from information providers to delivery partners, committing to co-created insights together. This phase is focused on becoming more precise and reducing inconsistencies. If there is no agreement after this phase, the 2-phase process can also be repeated.

4.3 Application Across Geographic Markets

We have adopted a global market perspective that encompasses the European, American and Asian markets, in order to gain a more comprehensive understanding of service-centric BMI.

"Preparation" stage of the BMI process requires careful consideration of the appropriate starting point for success. Our approach involved conducting a thorough analysis of each market's specific characteristics and business objectives to select our starting points in different markets. Initially, we chose to initiate our operations in the European market, starting with the GER market where our company's headquarters were located, which we expected to yield quick results. As the process model progressed, we shifted our focus to the company's largest market the US in American market, given its vast and homogeneous nature compared to the country-specific markets in European market. To ensure the robustness of our analysis, we also selected other countries in European market, such as the UK and CZ, for cross-validation. The UK was notable for its advanced results in service-centric BMI for the company, while CZ had to work efficiently towards the same service-centric business model with few resources and costs. To the American market, we added CAN due to its progress, similar to the UK but extending to far greater distances. For the Asian market, we considered our focus on CHN as the second largest market for the company and IND as a fast-growing market. We also included the SEA market due to the unique characteristics of its sub-markets, including wildly varying resources, partly no infrastructure, high to no security concerns. *Proposition 1: The selection of an appropriate geographic starting and specific countries for cross-validation facilitates the robustness of the BMI process.*

In the "Ideation and Internal Research" stage of the BMI process, gathering extensive knowledge about the firm and the market in a timely and comprehensive manner is crucial. The incorporation of the GER market facilitated prompt insights due to its convenient market access, and the education standard prevalent in this market enabled effective communication, enabling a seamless exchange of information. Similarly, the UK served as a valuable partner in advancing the service-centric BMI by sharing advanced insights. The CZ, being a relatively niche market in Europe, provided a lucid perspective on the most pressing issues, contributing substantially to the overall process model. Constant digital communication facilitated the American market access. Notably, a significant portion of the US business was transacted through dealers who served as intermediaries. CAN provided an opportunity to re-consider the UK European market perspective to validate or reject proposals related to American market. The primary focus has been on the US, where the digital servicing industry has made significant progress. Nonetheless, the complexity of the US market has necessitated a gradual increase in the company's involvement during the next phase. The involvement of the Asian market, including CHN, SEA, and IND, was scheduled last due to its complexity and challenges. Although CHN presents a vast market, its political situation presents significant hurdles, including the possibility of a lockdown and stringent regulatory requirements. As a result, service-centric BMI in China has progressed slowly. Conversely, India demonstrated a very open attitude and high market accessibility, which favored the process. Although the SEA market is an open market, infrastructure and resources vary greatly between sub-markets, leading to its classification as less critical for the first phase of the process. *Proposition 2: Incorporating various advanced markets across various geographic markets facilitates the prompt acquisition of insights and contributes to the overall process model.*

During the "Triangulation of service-centric business model" stage, the company aims to gain insights into the markets by conducting interviews with both suppliers and customers. The US market has become the most critical, and a specific emphasis has been placed on it, necessitating a closer collaboration with dealers. This, in turn, has led to constant communication about the process, resulting in a slowdown. Nonetheless, as the primary point of contact in the market, dealers serve as the mouthpiece to customers, making their feedback particularly valuable. It is noteworthy that the American healthcare market is under significant pressure to remain profitable, making access to customers and suppliers more challenging. The results were triangulated with Asian market and European market to ensure consistency globally. US-specific issues in the ecosystem have been addressed differently, and cross-checks with Asian market and European market have helped consolidate core knowledge globally. Individual features have been adjusted accordingly. *Proposition 3: A market triangulation, taking into account the peculiarities of the respective ecosystem, leads to a merging of the different market perspectives.*

During the "Creation of a service-centric business model" stage, we conduct on-site observations and in-depth interviews with customers and suppliers in the American market. However, direct access to customers on-site poses a challenge due to market institutionalization and reliance on suppliers. Therefore, we contact suppliers directly for customer contacts that meet our requirements and credential ourselves for the appropriate institutional facilities. In contrast, in European market, we can contact customers directly without credentialing. In the Asian market, due to resource limitations, we do not carry out any on-site verifications, which is certainly a weak point in the process model carried out. We complete this stage after digital cross-checks with Asian market, refine initial artifacts (e.g., vision, value proposition, and customer journey), and develop a service-centric business model for the firm. *Proposition 4: Direct customer and supplier access through in-depth market research facilitates the development of a service-centric business model.*

4.4 Enablers and Barriers of the BMI Process Framework

Three enablers - Differentiation, Ecosystem Growth, and Recurring Revenue - have been identified. *Differentiation*: Product connectivity can be an important differentiation. Through connectivity, products can be linked and customers can become more loyal. One manager stated: *"we want to create new service-centric business models with unique customer value that differentiate our core products at point of sale and exceed customers expectation. Thus, we drive customer loyalty which facilitates our digital transformation moving from a vendor to a partner"*.

Ecosystem Growth: Rapid growth of platform ecosystems by increasing the number of users. Companies must create many entry points to quickly acquire a many customers. Customers should easily connect to the platform to rapidly facilitate new user groups, as explained by one manager: *"we can utilize service-centric business models as standard connectivity-based application to create upsell path for our applications. Furthermore, getting new customer groups into the platform ecosystem and applications with data to enable new use cases and enhanced customer value"*.

Recurring Revenue: Generating recurring revenues is an important benefit of service-centric BMI. Customers must value of services and should be willing to pay more for it. A manager emphasized: *"the Design of the new service-centric business models generate higher monthly payments and thus increase customer lifetime value. It facilitate sales to increase amount of service contracts at the point of sale with device"*.

Besides these enablers, there are also four barriers which we only mention due to the length of the article: *Lack of Central Government, Service Culture, Technical Roadblock, and Capability*.

5. DISCUSSION AND CONCLUSION

The study emphasizes the need for health care product manufacturers to embark on service-centric BMIs. We provide a clear process framework based on an in-depth case study with the American and European markets of how service-centric BMI unfolds. The process framework elucidates the key stages, activities, and roles that are involved in the BMI process, with a focus on application-oriented considerations. Thereby, it is important to recognize the impact of geographic markets on

the process of service-centric BMI, and to take into account the enablers and barriers that pertain to service-centric business models in the healthcare sector. We assume that the framework is generally applicable to both physical and digital components. Overall, the study suggests that healthcare service providers and manufacturers of healthcare devices can leverage the opportunities presented by digital technologies and service-centric business models to improve healthcare service quality, costs, CO2 emissions.

Of course, the research focuses on a single OEM, which restricts the generalizability of the findings to other companies or sectors. The study only considers in-depth interviews and observations in the American and European markets, ignoring in-depth interviews and observations in other markets that could present different challenges and opportunities for service-centric BMI. Future research can address these limitations by explore service-centric BMI processes in other companies and sectors and by considering other markets.

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INTERNATIONAL COMPARISON OF MANUFACTURING SERVITIZATION: SWEDEN AND JAPAN

Keiko Toya, Patrik Ström

ABSTRACT

The purpose of this study is to examine how sociocultural differences affect corporate culture and whether they promote or hinder Servitization. In the manufacturing industry, there is a difference in whether Servitization is viewed at the level of integration of goods and services or at the original Servitization level, which includes value co-creation with customers. Based on the results of a quantitative survey in Sweden and Japan, we tested the hypothesis that these levels are affected by differences in attitudes toward accepting an uncertain future, commitment to manufacturing, and a long-term perspective between the two regions.

The results showed that most of the factors had no effect on Servitization in Japan, and extrapolated from the Swedish results. In Sweden, uncertainty avoidance and manufacturing culture were found to have a negative impact on Servitization; factors with a negative impact on Servitization were found to have a positive impact on Service Infusion. Among the uncertainty avoidance tendencies initially thought to be higher in Japan, reliance on government and industry associations and investment in long-term relationships with customers were found to be higher in Sweden. Uncertainty avoidance and a move away from a manufacturing culture will allow manufacturing to move from mere added services to true Servitization.

Keywords: Servitization, Uncertainty avoidance, Corporate culture, Monozukuri

1. INTRODUCTION

The purpose of this study is to examine how social cultural differences affect corporate culture, and whether they promote or hinder Servitization. We will test hypotheses based on quantitative survey results from Sweden and Japan regarding differences in resources and attitudes toward accepting an uncertain future between the two regions.

2. THEORETICAL BACKGROUND

According to Hofstede's (1980, 1988) six cultural measures, Japan is the most uncertainty avoidance culture (Hereafter abbreviated as UAI) nation in the world. Although the cultural measures are not directly applicable to individual firms or individuals (Sivakumar, 2001), they are indicative of national characteristics. Several studies have pointed to the influence of national culture on corporate culture (Vitell, 1993).

In addition to the high uncertainty avoidance, the recently formed manufacturing culture; 'Monozukuri' is deeply embedded in the manufacturing sector in Japan. In other words, uncertainty avoidance has formed the culture that values perfection, and it has enforced in a manufacturing culture as 'Monozukuri' (Toya, 2022).

'Monozukuri' culture is a term that describes a culture that combines two aspects of seed thinking, in other words, an emphasis on technology and an aesthetic of craftsmanship that seeks perfection. In Japan, people believe that it is the base of 1980s' prosperity of Japanese economy and has strength even now. The aspect of craftsmanship is thought to be largely influenced by a social culture of uncertainty avoidance. That is the major reason why

manufacturers showed strong resistance for the change by services that are new and uncertain for them (Toya 2016).

Sweden was chosen as a comparator because of its progress in transforming its business model to one highly associated with Servitization, such as the smart-city concept and the continues up-grading of their industries towards service value added activity across sub-industries (Ström & Wahlqvist, 2010), and because it is the largest economy among Nordic countries. The percentage of manufacturing in Sweden is 65.33% (in 2021), which is not as high as Japan's 73%. However, in terms of business model innovation, these countries have maintained a high ranking in the Global Innovation Index every year. Furthermore, Hofstede (1980, 1988) and subsequent studies using the same scale (1993, 2001, etc.) have shown that Japan is unique in that it is at the opposite end of the spectrum from Japan in its tendency to avoid uncertainty.

3. RESEARCH METHODOLOGY

The following hypothetical model (Figure.1) was developed based on previous studies, and data from the two countries are used to check the fit of the model. Service has the feature of IHIP, which means that its production and consumption are ongoing in the context. Customers' participation of the process makes it more unstable. Hence it is inevitable to have uncertainty. Uncertainty avoidance and Monozukuri culture have negative influence in Servitization. Then service strategy needs longer perspective than goods.

For the model validation, first, the difference between the means of the two countries is tested, and then the correlation coefficients between the causal and outcome variables are used to clarify the relationship.

Data is collected through a request for survey cooperation by mail and quantitative validation using data obtained in the form of Internet responses. The survey was conducted January 2023 in Japan, and February in Sweden. For Sweden, 2,000 companies were selected by a stratified random sampling from a commercially available database, divided into sectors and large or small and mid-sized companies according to their sales size. For Japan, 23,000 companies were selected. We have been conducting a large-scale fixed-point survey every year from 2014 in Japan. Then we used same sampling method by large and small companies, and by industry. The questionnaire included Servitization rank, paid or unpaid, corporate culture of uncertainty avoidance, Monozukuri culture and short/long strategic perspective.

In the survey, we measure the following three items from previous studies as UAI, the following two items about manufacturing culture, and the following two items about long-term management perspective, using a five-point Likert and a scale for management subjectivity (Table.1).

Table 1: Causal Variables

UAI	We are open to rely on authorities when they are reliable and competent.
	A good manager is an expert who knows more than his/her coworkers.
	At work, structures, procedures and rules should be clear; ambiguity should be avoided at all costs.
Long Term Perspective	The profits in 10 years time is more important than the immediate profits.
	We invest in networking and building up human relations in a long run perspective.
Monozukuri Culture	The manual verification by our employees is essential for ensuring the quality of our products.
	We consider that products delivered to the customers must be of the perfect quality.

We also use two variables as outcome. One is a variable on service infusion in the area of service marketing and management, asking about the need to combine products and services. This is a lower level of service that does not include value co-creation, which is not what Servitization originally aimed for. The other is the stage of Servitization, which is determined by

the type of service being offered. Since some manufacturing firms perceive Servitization as simply adding services to their products, we set a different scale.

From the previous research review, we can assume a model in which the three factors of UAI, Monozukuri culture, and long-term perspective influence and shape the perception of the need for Servitization, which in turn manifests itself in the current Servitization stage (Figure1).

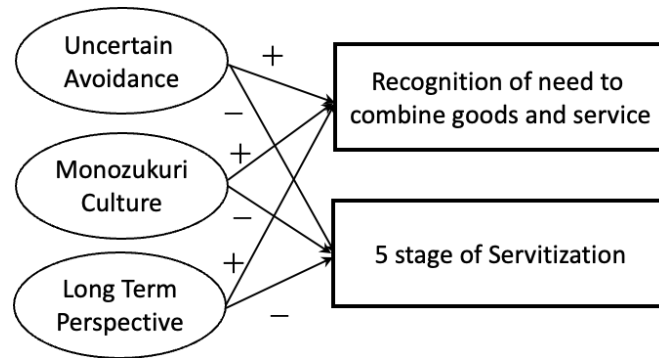


Figure 1: Conceptual model of corporate culture and Servitization

4. RESULT OF SURVEY

We collected 2,636 responses from Japan, 175 responses from Sweden. We selected only large firms for our analysis, 260 and 75 samples, given the stability of the data. As shown in the Fig.1, in both Japan and Sweden, the large number of respondents came from the metal industry, followed by the machinery industry in Japan, and the paper & forest products industry in Sweden. Sweden is characterized by a large number of respondents from 'Others' (33.3%). It indicates that the industries are complex and no single industry can be selected by respondents. As SME accounts for 96.6% in Japan, 62.5% in Sweden, we have weighted and adjusted Swedish percentage to be equal to the Japanese percentage in the subsequent analysis.

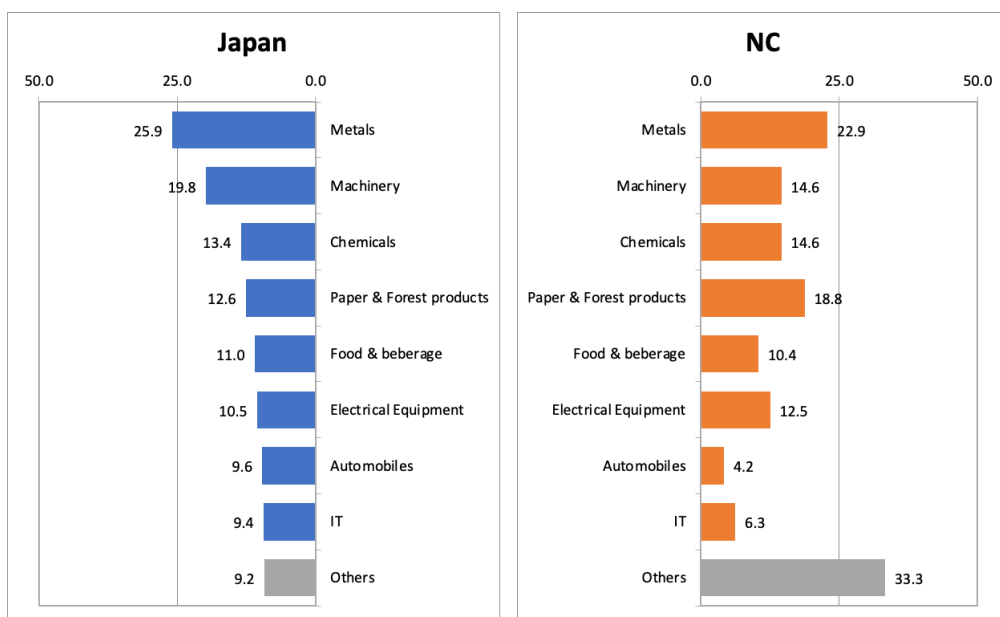


Figure 2: Sectors of responded companies

Looking at the composition of the Servitization stage, after matching the criteria for firm size and industry, the proportion of manufacturing firms that do not provide services is only 13% in the Sweden, compared to 45% in Japan. Another unique feature is that a large number of firms in the Sweden (48.2%) have reached the third level of Servitization, compared to 11.6% in Japan.

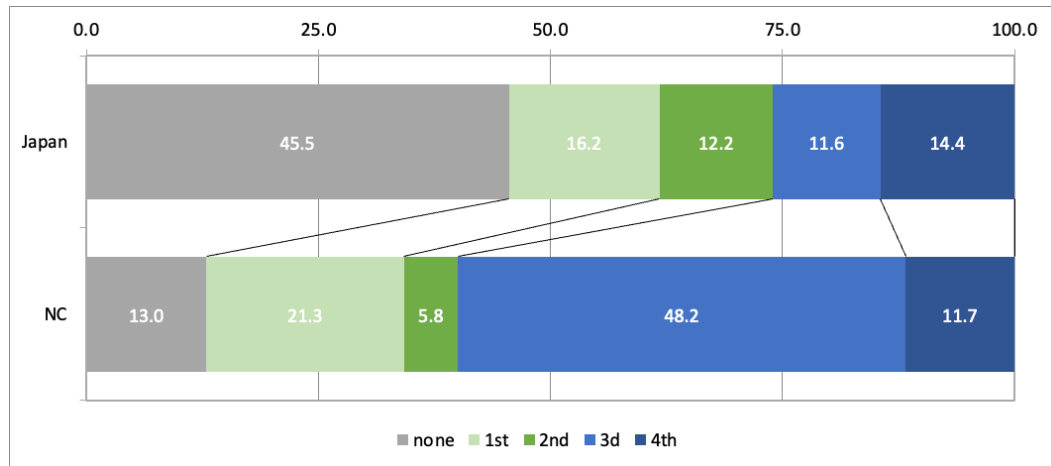


Figure 3: Servitization Stage

Table 2: T test and Correlation result

Category	Question	Countries	Average	P value	Correlation	
					Recognition of Servitization	Stage of Servitization
UAI	Rely on authority	Japan	3.7		-0.06	-0.01
		Sweden	4.4	p< 0.01	0.00	-0.32
	A good manager is an expert who knows more	Japan	3.6		0.05	0.05
		Sweden	2.2	p< 0.01	0.17	-0.14
Long Term Perspective	At work, rules should be clear	Japan	4.2		-0.22	0.01
		Sweden	3.7	p< 0.1	0.58	-0.37
	The profits in 10 years is important	Japan	3.2		0.01	0.01
		Sweden	3.8	p< n.s.	0.06	0.09
Monozukuri Culture	Invest in human relations in a long run perspective	Japan	3.4		-0.11	0.07
		Sweden	4.3	p< 0.1	0.29	0.08
	Human verification is essential for the quality	Japan	3.3		0.17	0.16
		Sweden	3.7	p< n.s.	0.58	-0.20
	Products must be of the perfect quality.	Japan	4.4		0.06	0.24
		Sweden	4.7	p< n.s.	0.00	-0.29

5. DISCUSSION

Table 2 shows the mean and t-test results for the difference between Japan and Sweden. The correlation with 7 causal variables (3 UAI, 2 Long Term Perspective and 2 Monozukuri culture) the outcome variables (The recognition of need to combine goods and service and Servitization stage) are also shown.

First, the T-test results show that the two items that are significantly higher in Sweden are 'Relying on authority' and 'Investing in long-term relationships.' The items that were higher in Japan were, 'A good manager is an expert who knows more' and 'At work, rules should be clear.' Both are UAI items. Although 'Relying on authority' is a UAI item, Sweden has a higher level of trust in government and industry associations, and relying on these organizations can be considered rational. The result that 'investment in human relations in a long run perspective' is also higher in Sweden. It may be influenced by differences in the degree of penetration of shareholder capitalism. Large Japanese manufacturing companies are strongly exposed to

institutional investors' demands to secure short-term profits and increase shareholder dividends. (Family businesses in Japan are more prevalent in the small service sector.) On the other hand, Sweden's large shareholder structure has a high percentage of family ownership, which is considered to enable investment from a longer-term perspective. (Faccio & Lang, 2002).

Next, looking at the relationship between the cause variables and effect variables, in the case of Japan, there was almost no correlation between them. On the other hand, in Sweden, four items (two UAI items and two items of Monozukuri culture) showed negative correlations with the Servitization stage as we expected. Firms with high service-infusion stage were found to have lower uncertainty avoidance and lower commitment to manufacturing culture. On the other hand, service infusion had positive correlations with three items, one UAI item, one long-term perspective item, and one manufacturing culture item. In other words, characteristics typical of the manufacturing industry, such as not allowing ambiguity in work procedures and rules, using human eyes and hands to check the quality of work is essential for high quality, and forming long-term, close relationships with customers, are thought to promote the old type of service-infused perceptions that manufacturing companies believe.

6. FINDINGS

The purpose of this study was to clarify how cultural differences between the two countries affect Servitization by surveying manufacturing executives in Japan and Sweden. The survey results indicate that there are differences in uncertainty avoidance tendencies and long-term management perspectives. However, among the uncertainty avoidance tendencies that were initially thought to be higher in Japan, the reliance on government and industry associations and investment in long-term relationships with customers were found to be higher in Sweden. With regard to the impact on Servitization, most of the factors have no impact in Japan, and we extrapolate from the Swedish results. In Sweden, uncertainty aversion and manufacturing culture are found to have a negative impact on Servitization. Factors that have a negative impact on Servitization have a positive impact on service infusion, and a shift away from uncertainty avoidance and manufacturing culture would allow manufacturing industries to move from mere additive services to true Servitization.

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SSC 2023 Executive Summaries

DIGITAL CAPABILITIES ENABLING SERVICES

G Varad, S Sukanya

RESEARCH MOTIVATION

Digital Transformation enabled companies to acquire new Digital capabilities and identification of the right technology and business model played a crucial role in determining the sustainability and outcome of the Transformation. It also led to the kind of services enabled in the journey. To this aim, Manufacturing, Energy & Resources, and Utility companies undergoing Digital Transformation were analyzed for identifying the motivating factors or levers for the Digital Transformation, underlying technologies, Digital capability, and the associated services opportunities.

Evolving needs of consumers, regulatory bodies, and Sustainability targets, are pushing companies towards a journey where they want to be connected, collaborative & cognitive and have visibility of their products across the value chain i.e., starting from sourcing to the consumption and extending to the end of life, i.e., the recycling/responsible disposal. This cradle-to-cradle circularity is pushing companies to adopt innovative technologies which require newer business models. The effective and efficient use of technologies will determine the successful Digital Capability and results in enhancing the customer experience, improving operational efficiency, and unlocking new business opportunities.

This paper mainly aims at studying how companies identify the digital capabilities enabled by the technologies required for the growth & transformation of the company and identify the potential services that are enabled in the journey.

CONTRIBUTION TO THEORY AND PRACTICE

Digital technologies have made companies realize the potential of data and its abundance and how it can help them overcome the challenges in the market. Advanced Analytics, Artificial Intelligence, Machine learning, and IoT along with Industrial automation changing the way the plant operates and functions ex: Remote plant diagnostics, Modular Plant, etc., Data-led decision-making is enabled through real-time data enabled by IoT, Digital Twin, and Edge Computing. 5G and Blockchain are leveraged for secured connectivity within and across the value chain seamlessly.

The real challenges for companies lie in identifying the right technology to reap the maximum ROI. Also, Legacy Systems, Cyber Security, Data Quality, Workforce Skills, Regulatory Compliance, and Organizational Change slow down or create silo-ed Digital transformation initiatives. Hence, many companies begin their journey towards digital transformation with cloud adoption, IoT-based applications, big data, standardized ERP systems across functions, and transformation from old legacy systems to the latest connected systems and look at capitalizing the digital capabilities across their value chain for maximum benefit. Plant Digitization, Electrification of the Fleet is also done to upgrade old assets in the plants with the latest capabilities. This has resulted in new business models and additional revenue growth for the companies.

Thus, Digital capabilities have the potential to enable value-added services and lead to Servitization with newer and sustainable business model opportunities and additional revenue. Servitization refers to the transformation of manufacturing companies from traditional product-focused businesses to service-oriented businesses. Technology has played a significant role in enabling Servitization by providing the necessary tools and infrastructure to support service-oriented business models.

KEY DISCUSSION POINTS

1. **150+ Manufacturing, Energy & Resources, and Utility** companies were studied in this research.
2. **Key Technologies:** Advanced Analytics, AI/ML and IoT and Automation & Robotics, Digital Twin and Digital Collaborative platforms. Other Technologies include Renewable Energy Technology, Digital Platforms, Edge computing, Cyber Security, Computer Vision, Cloud Computing, AR/VR, Additive Manufacturing. The technology for the Digital capability depends on the business model and there could be more than one technology for a specific Capability.
3. **Top levers for Digital Transformation:** Operational Resilience & Adaptability and Digital Customer Experience. Other levers where a rise in Digital Transformation is seen is for Adjacency Growth, New Business Model/Revenue Diversification, Strategic Cost Management and Sustainability, Circular Economy & Recycling.
4. **Challenges in scaling Digital Capabilities:** Legacy Systems, Cyber Security, Data Quality, Workforce Skills, Regulatory Compliance, Organizational Change

5. **Few examples of Services Enabled through Digital Capabilities across various Industries,**
 - a. **Manufacturing** – Predictive Maintenance & Remote monitoring, Asset Tracking & Maintenance, Quality Control, Supply Chain Management & Optimisation, Intelligent Fleet Management, Product Optimization

Example Service Business Models: Plant Digitization as a Service, Mobility as a Service, Maintenance as a Service, Asset as a Service (Pay per part, Pay per use)

- b. **Energy & Resources** – Smart Grid Management, Predictive maintenance for Oil & Gas, Renewable Energy Trading, Carbon Emission Trading, Exploration & Production, Supply Chain Optimization

Example Service Business Models: Energy as a Service (incl Renewable), Equipment as a Service, Energy Management Service, Carbon Capture as a Service

- c. **Utility Industries** – Smart Metering, Water Management, Energy Trading, Grid Management, Bills & Payments, Customer Engagement

Example Service Business Models: Energy Efficiency & Management Services, Smart Energy Solutions, Future Energy Platforms, Zero-Carbon Transition Services

Companies can scale their Digital Capabilities towards enabling Advanced services through Service Business Models. However, overcoming the challenges of legacy systems, Data Quality, ecosystem play, and Organizational acceptance is critical in a journey toward Servitization. Assessment of the existing Digital capability and technology stack will also be required to move towards newer business models such as: Servitization. There is scope for further research to study the journey toward Service Business Model and to identify the capabilities and enablers for successful transformation.

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SEARCHING FOR SERVICES: EMERGING NARRATIVES FOR CIRCULAR BUSINESS MODELS

Hugo Firmo

RESEARCH MOTIVATION

Climate change has challenged our assumptions about economic activity and the way we understand business, forcing organizations and their leaders to provide new narratives. Economic activity has resulted in severe environmental degradation. At its core are business and economic models designed at a time when ecological concerns were only superficially addressed. Servitization drives business model innovation and entails a shift from being product-oriented to being use- or result-oriented. Service-based business models can be used to enable the principles of the circular economy (CE) through circular business models. In extant narratives, these are presented as a part of the solution for companies to operate in ways that are compatible with the planet. Besides the interest from practitioners in circular business models, research in the field is also growing. Still, prior studies have neglected how service-based and circular business models come alongside the construction and enactment of new narratives. Within servitization, there is a demand for alternative paradigms that incorporate sustainability. It remains unclear how new narratives influence the environmental and economic success of circular business models. This article focuses on how companies navigate the tensions in their narrative and construct a new one in the process of becoming sustainable.

Business models can be seen as a mental model, a rationale of how to create, deliver and capture value. To succeed, they must pass the narrative test, their story must make sense and be based on valid assumptions, such as properly integrating sustainability. Narratives encode how people make sense of experience in a temporal framework. Portions of the past can be mobilized to support imagined futures for firms. Within servitization in the CE, the future is one that incorporates sustainability into business practices to deliver a positive impact beyond pecuniary gains.

This multiple-case study focused on three construction projects in Norway and their main actors over the course of five years. Data collection relied on a variety of sources, including semi-structured interviews, newspaper articles and company reports. Data analysis followed cross-case pattern recognition.

The narrative of how to do business is being reconstructed. There is a shift from a product to a result-oriented mentality, observable in project planning and interfirm collaborations. Companies handle sustainability with seemingly paradoxical solutions, adopting strategies that accommodate both problems – financial and environmental concerns. Tensions are simultaneously addressed and accepted, with constant shifts between linear and circular thinking. Business models, which incorporate a cognitive dimension, facilitate the shift to sustainable business practices. Servitization takes place in tandem with a transition to a service orientation. The shift in narrative is not boundaryless, but dependent on time, entity and project.

CONTRIBUTION TO THEORY AND PRACTICE

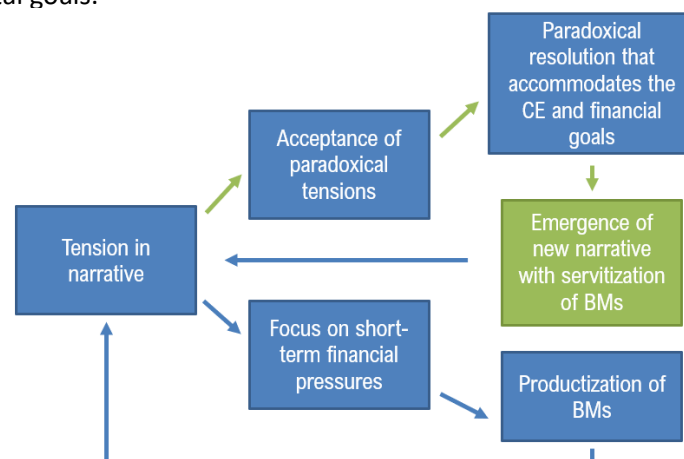
This study contributes to the fields of servitization and circular business model innovation by advancing the understanding of how organizations make sense of the tensions in the narrative and reconstruct it as they modify their business models.

This article puts servitization as a fundamental aspect of the emerging narrative of what it means to do business. This narrative has two particular features: first, doing business can equate to providing an outcome or a service and, second, doing business includes providing value for society and the environment. These two factors are intertwined and enable each other.

New narratives emerge as societal pressures to be sustainable increase. Multiple stakeholders take part in narrative construction. Top management plays a prominent role and has strong agency. They actively envision, experiment and explore new circular business models. Service thinking is in the minds of many leaders, but is often lost along the way, as projects develop. Alignment with middle managers is crucial for narrative enactment. Narratives often do not match behavior, but they still play an important cognitive role. They indicate intent, influence behavior and help create the future.

Conflicting objectives result in paradoxical tensions. Firms reconcile these paradoxical objectives by accommodating them and accepting the difficult balance between commercial and environmental objectives, coming to a paradoxical resolution. New narratives emerge with a result-oriented perspective, including in terms of environmental concerns. When new tensions arise, firms can then choose to continue their servitization journey or accommodate short-term financial pressures instead, with a productization of the business model. These shifts to product orientation come with lower circular performance. Tensions frequently arise between new narratives and the old identity, as old lenses and heuristics are often at odds with new ambitions. Yet, old practices are still used in a back-and-forth process between servitization and productization.

Servitization is, besides a phenomenon, a heuristic: the end result or function is what ultimately matters. When one of the functions of a company is to be sustainable, servitization enables and supports circular business models. Conversely, a return to a product-centric mentality can mean losing track of environmental goals.



KEY DISCUSSION POINTS

- New narratives are being constructed. These incorporate environmental sustainability and service-based business models.
- A return to product-oriented business models is a possible response to short-term pressures, threatening environmental performance.
- Servitization enables circular business models through two key mechanisms: service orientation, companies are incentivized to provide the end result, and cognitive effects, one should think about providing services and value to customers, society and the environment.

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VALUE ARCHITECTURE OF RESULT-ORIENTED PSS: AN INTEGRATION OF VALUE NETWORK PARTNERS

Dipti Rath, Johanna Knapp, Antonio Masi, Nazifa Nisha

RESEARCH MOTIVATION

Servitization is a process whereby manufacturers transform from offering physical products to comprehensive bundles of integrated products and services, known as Product-Service Systems (PSSs). PSSs can be classified as either product-oriented, use-oriented, or result-oriented. In result-oriented PSSs, customers are charged based on achieved outcomes rather than specific products or services. An example of a result-oriented PSS is Heat-as-a-Service (HaaS), which is the focus of this study.

Customers of HaaS pay for the achievement of a warmth level instead of being charged for fuel consumption. They sign a contract, i.e., a “heat plan”, setting a room-by-room, hour-by-hour heating schedule. This formula has several advantages. For instance, it incentivizes HaaS suppliers to provide the agreed level of heating at the lowest cost possible, which leads to increased energy efficiency and, consequently, higher environmental sustainability. To provide HaaS, manufacturers must effectively manage interactions with multiple network partners, such as suppliers, distributors, and customers. Yet, although all stakeholders may benefit from such result-oriented business models, until today, only limited adoption can be observed across industries. In fact, the scalable implementation of HaaS requires overcoming several challenges related to technology, customer responsiveness, regulations, and financing.

Moreover, limited literature is available, particularly on HaaS, highlighting the importance of assessing these challenges and identifying suitable approaches to overcome them. In particular, it is still unclear how HaaS changes an organisation’s value creation, value delivery, and value capture processes, i.e., its value architecture (VA). As each value process involves interactions with different network partners, it is also necessary to understand how the integration of these partners may enable servitizing manufacturers to design their VA for HaaS. Therefore, this study aims to address this gap by seeking an answer to the following research question (RQ): How can the VA of HaaS be designed?

To address this RQ, a methodology consisting of a literature review and a single case study research will be used. The literature review will summarize extant knowledge on HaaS and, at a higher level, on the design of the VA for result-oriented PSS. The case study will be based on semi-structured interviews with managers of a company that plans to introduce HaaS but is struggling with several challenges. To ensure data triangulation, interviews will be complemented with information from the company’s website as well as additional forms of data shared by the interviewees and their colleagues. Data will be analysed using a coding process, which will result in the development of a conceptual framework. This framework will enable a better understanding of the challenges in designing an effective value architecture for HaaS, which will be helpful for both managers and practitioners. The framework may provide a basis for further exploration of the challenges organisations offering various types of result-oriented PSS encounter in creating, capturing, and delivering value. Future research should focus on identifying possible solutions to such challenges.

CONTRIBUTION TO THEORY AND PRACTICE

The extant literature on HaaS discusses some of its implications for each element of the VA of a company, summarized in the table below.

The first element of the VA is the value creation process, which describes how organisations meet customer needs. The value creation process usually involves the development of a value proposition aiming to fulfil specific customer needs. The value proposition of HaaS consists of undertaking the full responsibility for owning, fuelling, maintaining, and operating heating systems to offer customers an agreed level of warmth. A research gap is the need to identify the different barriers to HaaS depending on the features of each market segment.

VA components	Challenges of HaaS
Value creation	- Low customer responsiveness to the proposed advantages of HaaS - Different market segments perceive different barriers to HaaS
Value delivery	- Need for technological improvements to collect, analyse and protect vast amounts of data - Lack of adequate and coherent regulations - Financial risks stemming from the ownership of the heating equipment entirely shifted to HaaS providers
Value capture	- Unclear monetary benefits of HaaS for both providers and customers

The second element of the VA is the value delivery process, which refers to how organisations provide their customers with the necessary tools to experience the value proposition. It is strictly connected to value creation. As the table shows, most of the challenges of HaaS deal with the value delivery process. Integration, alignment, and information sharing among network partners are necessary to address these challenges. However, there is little research explaining how to do so.

The last element of the VA is the value capture process, which refers to the monetary and non-monetary benefits organisations aim to achieve after delivering value. Concerning HaaS, it is still being determined whether it is viable for providers and attractive to customers.

In conclusion, as firms try to incorporate HaaS, it is necessary better to understand the complex interactions between their value network partners. The findings of this study can help address this gap in literature while also enabling firms to learn more about improving their servitization process through increased coordination among different partners within their network.

KEY DISCUSSION POINTS

- Result-oriented PSSs, such as HaaS, require managing interactions and co-creating value with multiple network partners, such as suppliers, distributors, and customers.
- There is a lack of extant literature on how the provision of HaaS may impact the overall value architecture.
- The use of a single case study may enable a deeper understanding of how integrating different value network partners can help create, deliver, and capture value efficiently.
- The developed framework can help identify challenges and solutions for other types of result-oriented PSS.

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ADDRESSING THE STANDARDISATION VS CUSTOMISATION PARADOXICAL TENSION OF ADVANCED SERVITIZATION OFFERINGS WITH ADEQUATE PRICING PROCEDURES.

Silvia Sander

RESEARCH MOTIVATION

Servitization is gaining continued attention from academia and practitioners who discuss manufacturing companies' moves from selling products to selling advanced services. Despite the advantages for manufacturers, it was found that various paradoxical challenges are inherently embedded in the provision of advanced offerings. Specifically, when providers invite customers to cooperate, an over-reliance on the customers' needs to the detriment of standardisation possibilities can negatively affect the firm's profitability. This article focuses on the tension between standardisation and customisation and applies the lens of pricing to investigate coping practices for addressing this paradoxical challenge. If adequate pricing could help to address the tension between customisation and standardisation, the question of how to conduct this process is highly relevant. Prior work has focused on pricing in terms of *what* pricing methodology should be applied. However, scholars have given much less attention to the concrete actions and practices in this context; in other words: *how should* advanced offerings be priced? Therefore, this article fills in, at least partially, this gap by exploring the following:

How to address and balance the paradoxical tension (standardisation vs customisation) of advanced servitization offerings with adequate pricing procedures?

The ongoing exploratory, in-depth single case study allowed the researcher to explore and propose an optimal pricing procedure that encompasses both viewpoints (customer and supplier) in a customer-centric pricing approach. While multiple cases would allow comparison across firms and generalisations, this research provides a comprehensive and rich narrative of an optimised pricing procedure. It is based on secondary data and interviews with twenty experienced practitioners from different company layers (pricing, solution, sales, top managers, and customers). The identified case company fits the profile of a servitization company very well: 1) MNE company in mature industries 2) Offering advanced solutions and solutions in a B2B2C context. 3) Applying value-based pricing 4) Providing access to data. Regarding data transferability, the context, company size, industry, and type of advanced offerings likely influence the results. Yet, there is no reason to believe that the results are unique to the case company.

CONTRIBUTION TO THEORY AND PRACTICE

This study seeks to enhance theoretical rigour in servitization research by utilising paradox theory to identify coping practices. Previous research has attempted to address the paradox between effectiveness and efficiency from various perspectives, and this present study can offer an alternative solution from a pricing perspective. Methodologically, different to many other studies, the study explores interactive processes between multiple actors by including the customer lens. Guided by the research question and the philosophical stance, the meta-theoretical framework (see Figure 1) unpacks how the pricing activities for advanced offerings unfold (actual level) and explain the tendencies and causal powers of the underlying paradox (real level). Interestingly, the data analysis revealed a similar paradoxical tension, called 'The buyer's paradox', from the customer perspective. Each developed theme provides a core idea of how to address the tensions: 'The LEGO analogy' centres around the modularisation concept, 'It's a numbers game' shows the core concept of pricing to balance

customisation and standardisation requirements, 'The process flip' highlights the processual order of the pricing process, 'The wishful cycle' adds the iterative and magical dynamics to the process and, finally, 'Beyond salesforce level' and 'It needs two to tango', focus on the collaborative notion between the actors in the provider and customer organisation. Overall, the results reveal various ways to cope with the challenges of providing advanced offerings.

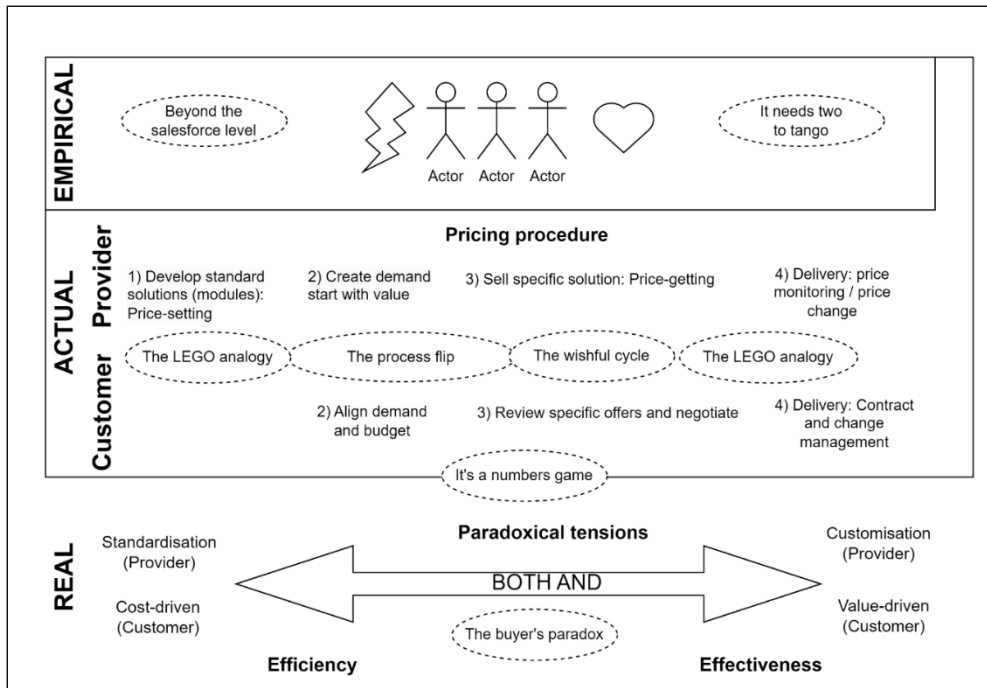


Figure 1: Preliminary Results: Multi-dimensional framework

As most firms struggle to provide customised services and solutions efficiently and effectively, this study provides a potential significant managerial contribution by helping industry practitioners with actionable recommendations. Due to the limitations of a single case study, it is not claimed that the developed model can be used universally. Still, it relies on the reader's expertise to transfer them to the specific situation. Future research studies can explore this model in other companies and contexts. To summarise, this ongoing study seeks to add theoretical rigour to servitization research while maintaining practical relevance and managerial applicability.

KEY DISCUSSION POINTS

- The importance of the multi-dimensional framework: understanding the actions and events for pricing advanced offerings is insufficient, but the emphasis is on the real level and pricing practices to cope with the paradoxes.
- Following the customer-centric notion of value-based pricing, coping practices from the provider and customer perspective are identified and suggested.
- The particularities of the B2B2C context where both the provider and the business customer face the tension between (cost) efficiency and (value) effectiveness.

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A CASE STUDY-BASED ANALYSIS OF SERVICES INNOVATION BY LEADING “DECANTER CENTRIFUGE” MANUFACTURERS

Shriram Dusane, Ali Z. Bigdeli

RESEARCH MOTIVATION

Author's motivation

During his tenure at *Alfa Laval*, the author observed the shift towards a customer-centric approach that necessitated the firm to extend beyond the conventional practice of selling equipment and parts and assume responsibility for the full product life cycle. The proposed research investigates how much decanter manufacturing firms have servitized their business model, leveraging the author's prior experience in the industry and exposure to the concept during an MBA program.

Drive from Industry & Market

As process industries and municipal corporations try to reduce capital expenditure and operating expenditure on solid liquid separation & dewatering applications in their processes, the decanter centrifuge industry is experiencing the push from customers to offer more compelling, cost-effective solutions that meet their needs. This has pushed the decanter centrifuge industry to compete through services as manufacturers cannot reduce the cost of production of this specialised equipment after certain extent. Recent technological advancements have enabled decanter manufacturers to offer intermediate services like predictive maintenance, remote monitoring, and advanced services, including long-term contracts, process optimization, and connected services. Centrifuge manufacturers have an opportunity to offer outcome-based contracts, lifting the burden of high capital expenditure and providing additional benefits of maintenance responsibility. The manufacturer gains a long-term client and deeper customer insights, building stronger relationships and capturing more value.

Gaps identified from the literature

Numerous product manufacturing companies, such as Xerox, Caterpillar, Rolls-Royce, IBM, and Philips, have shifted to service-led business models. Similarly, the decanter centrifuge industry has been servitizing, with companies providing value-added services to differentiate and compete in the market. To support this trend, researchers have proposed product-service-system (PSS) models, servitization stage models, and identified necessary operant resources. However, no study evaluates the existing level of servitization in a company. This research aims to fill that gap by examining the level servitization of four top centrifuge manufacturers.

CONTRIBUTION TO THEORY AND PRACTICE

This research was aimed to understand the degree of servitization in leading decanter manufacturing companies and the overall scope of servitization in the decanter market and contributes to the literature by being the first to analyse decanter centrifuge manufacturers.

The "advance services transformation roadmap" model was found to be suitable for analysis over a given timeline, but a new evaluative model was proposed to investigate the current degree of servitization within a firm using the current capabilities and resources as an indicator.

This method includes eleven evaluative criteria that link company's fundamental resources and capabilities required for realizing servitization in a systematic manner. These eleven evaluative criteria are condensed into elements that enable to identify information about the firm. These elements are

further categorised into four high-level groups – Organization structure, Service communication, Current service offerings & available resources, and Use of IoT in current service offerings. Each firm is then analysed based on four high-level groups. Analysis of the sub-categories (elements) provides insight on the eleven criteria which consequently helps to determine the extent of servitization within each firm.

The proposed model can be a foundational tool for the firms to evaluate and compare their position on the product-service continuum with competitors. Researchers or practitioners can utilise this method to further develop this into a framework and provide guidance to firms seeking support in their servitization journey. This research also highlights how the elements of different models proposed in the literature can complement each other in developing new models.

KEY DISCUSSION POINTS

- It is apparent from the evaluation and comparison of the selected firms that although the decanter manufacturers provide value added services with the machine, the overall decanter centrifuge industry is still product focussed. All the firms realise the potential market due to huge installed base; yet, they have not been able to change their mind set from being a product supplier to a service provider.
- It was found that the “advance services transformation roadmap” model is suitable for analysis of firms when the investigation is done over given period of time or as per the sequential stages proposed in the model. However, this study proposed a new evaluative model that can be correlated with the transformation roadmap to being able to investigate the current degree of servitization within a firm with the data that represents snapshot of the capabilities & resources of the firms.
- This study also contributes to the literature by being the first to analyse decanter centrifuge manufacturers. In the future, it would be valuable to do deeper research on such manufacturers to have more robust empirical data and a wider comparison which can enable researchers to assess the effectiveness of the model proposed.

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DATA-DRIVEN DECISION SUPPORT FRAMEWORK FOR INDUSTRIAL SMART SERVICES DESIGN AND OPERATIONS

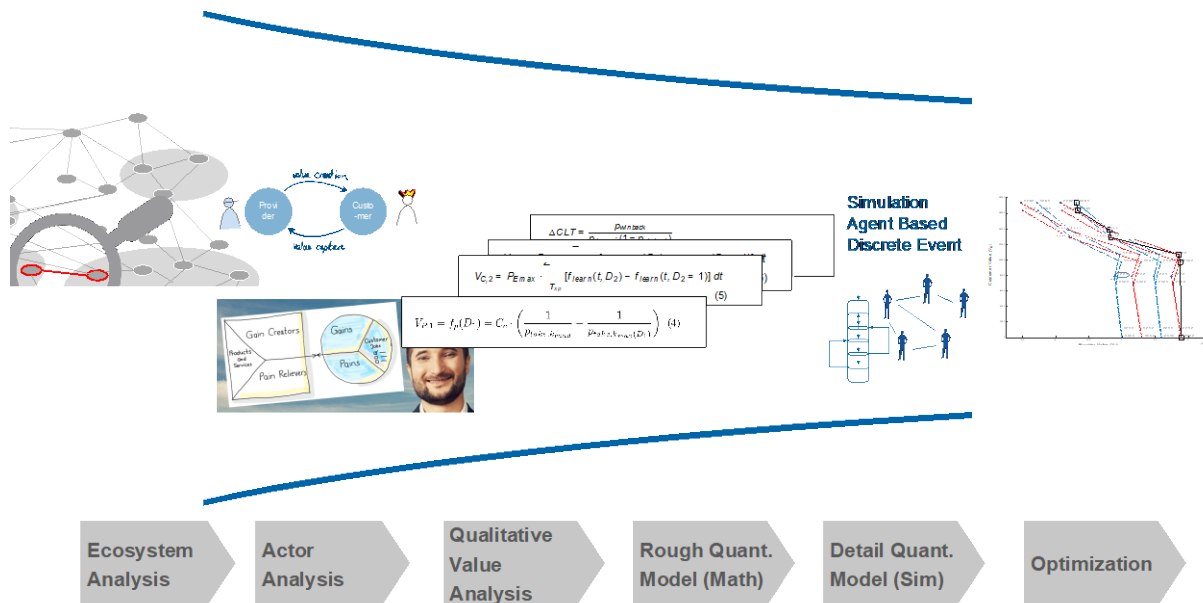
Jürg Meierhofer, Rodolfo Benedech, Lukas Schweiger

RESEARCH MOTIVATION

Smart services in an industrial context have the purpose of creating mutual value for the diverse actors of a business ecosystem (Baines & Lightfoot, 2013; Rapaccini & Adrodegari, 2022). To enable sustained value creation in dynamically changing contexts, managers must make decisions at different levels about allocating or reconfiguring service-oriented resources (Meierhofer et al., 2021). On an operational level, event-driven decisions, such as specific maintenance actions on equipment, are required (Schweiger et al., 2022). On a strategic level, there are decisions about resource reconfigurations, e.g., for adjusting the structure or capabilities of the service resources to a changing context. The decisions to allocate or reconfigure resources may have significant implications on operational costs or customer performance, thus customer satisfaction and loyalty (Schweiger & Meierhofer, 2023). Therefore, correcting decisions after their implementation generates high costs. With the data available in digitally enabled service systems, i.e., smart service systems, the decision makers can be supported by data-based models to a large extent and thus take better informed decisions, which reduces the risks for operational costs and customer performance. However, utilizing data-driven decisions represents a high hurdle to overcome, in particular for SMEs (Kugler, 2020). The purpose of this contribution is therefore to propose a decision support framework that enables SMEs to overcome the hurdles for utilizing data-driven decision making in the design and operations of industrial smart services.

CONTRIBUTION TO THEORY AND PRACTICE

SMEs recognize the importance of data for informing their decisions but lack methodologies for quantitative decision support. To support this decision procedure and keep the costs of decision making manageable for SMEs, we developed a multi-step decision support framework. It starts with a qualitative analysis of the decision problem, followed by quantitative steps. In the first quantitative step, a rough calculation of the mutual value creation for different decision scenarios is derived based on system models of the service processes. On the strategic level, for example, this comprises different service configurations and their contribution to mutual value creation in the ecosystem. If this rough quantification does not provide sufficient actionable insights or detailed operational decision parameters need to be found, one moves to the second quantitative step of the procedure. Here, a more refined simulation model comprising the specific service processes is developed, allowing for the comparison of different service scenarios in detail. In a final step, one selects the optimum decisions. This final step is semi-quantitative, as it combines the quantified outcomes of the models with human experience taking into account factors that cannot reflect technical data (Rowley, 2007).



The new decision support framework for smart services integrates service value creation concepts with quantitative modeling of business processes into a procedural framework. It thus advances the methodology for designing and operating smart service systems. Moreover, the framework has been developed and validated with industrial partners, making it designed to be applicable by practitioners in their business environments.

KEY DISCUSSION POINTS

- How can the data for the rough quantitative model be obtained effectively in a real company situation?
- Will the result of the rough quantitative analysis be of sufficient quality for enabling the required decisions?
- Will the effort to develop the simulation model for the detailed analysis be worth the additional decision quality?

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ARTIFICIAL INTELLIGENCE ENABLING PRODUCT-SERVICE INNOVATION MODELS: PAST ACHIEVEMENTS AND FUTURE DIRECTIONS

Rimsha Naeem, Marko Kohtamäki, Vinit Parida

RESEARCH MOTIVATION

Digital technology such as Artificial Intelligence(AI) creates key radical opportunities with digital servitization (Kohtamäki et al., 2019), but the knowledge of implementation is limited and not cohesively decided in terms of product-service innovation (PSI) models. Our research offers a holistic overview of past research that is still evolving at a rapid pace and offers insight into how AI as a whole including all affiliated technologies like machine learning and deep learning and others are enabling product-service business models to innovate. The business model when infused with AI capabilities helps in transforming businesses and maintaining competitiveness through digital servitization (Iansiti & Lakhani, 2020). It is also discussed that in order to maximize the utilization of AI technology to create value to adopt new routines, processes, and skills involved in operations and business models (Sjödin et al., 2021). The lack of generalization in this regard and the omission of other AI technologies make a way for a better conclusive approach. The literature is still scarce on AI in business model innovation, and hence a need exists to identify and structure the past literature to conduct a systematic analysis and review to propose suggestions for future studies.

Previously, in Artificial Intelligence, some bibliometric reviews have been conducted in finance (Ahmed et al., 2022), accounting/auditing (Agusti et al., 2022; Goodell et al., 2021), human resource and management (Palos-Sánchez et al., 2022), B2B marketing (Han et al., 2021). All of these additions are pretty recent to the literature, and so far, there have been no reviews created on the role of AI in product-service innovation. According to Kulkov (2021), there is a lack of AI business literature for analyzing firms through theoretical concepts and frameworks. The emerging literature has begun to identify business models, offerings, technologies, and capabilities that enable value creation and capture from artificial intelligence tools (Sjödin et al., 2021). Previously, the reason explained for research prompted in use of AI as an enabler for the innovation process is for business managers to overcome challenges faced in highly volatile business environments because of rival technologies and competitive global markets (Jones et al., 2016; O'Cass & Wetzels, 2018; Spieth et al., 2014). But this lacks in explaining, what AI capabilities are needed and what level of design changes occur in the business model. Our study includes most of the AI methods, models, theories, and capabilities in the context of product-service innovation (PSI) and reviews the existing literature, and identifies gaps, thus leading to future research directions.

CONTRIBUTION TO THEORY AND PRACTICE

This study explores the theoretical perspective of AI and discusses empirical gaps and models of AI in view of product service innovation (PSI) models. It contributes to the literature on AI and product-service innovation systems/models using bibliometric analysis and systematic review of the data. Hence, the study does not only intend to grasp the whole field of AI, but instead focus on the role of AI in product service innovation-related business models including product-service systems (PSS), servitization, and digital servitization. Thus, in addition to the literature on artificial intelligence, the study contributes to the literature on the product-service system (PSS), servitization, and digital servitization.

KEY DISCUSSION POINTS

- We used VOSviewer software (Waltman et al., 2010) to conduct bibliographic coupling with 159 articles on AI in product-service innovation(PSI). We chose bibliographic coupling as an analysis method, as it uses individual articles as a unit of analysis, which functions well with a relatively limited number of data (Xu et al., 2018).

- After performing the bibliometric analysis on the dataset, we move towards conducting a systematic review of the content by thoroughly reading the articles comprising each cluster and coding them accordingly based on the research content involved.
- Accordingly, the five (5) clusters are labeled as (1) Innovation Process and Barriers (2) Data Driven Capabilities (3) Digitally Enabled Business Model Innovation (4) Design Changes and Sustainability, and (5) Sectorial Application.
- In findings we suggest the application of multiple methodologies including field experiments and surveys, therefore avoiding the generalization of the setting in which the research is conducted.
- Empirical research on how interactions with devices proceed over time. These devices have not been in the market for a longer time, so their impact on the business community is still a question and a need for longitudinal studies arises.
- Meta-heuristic methods may be utilized to aid in the selection of suitable hyperparameters by using Machine Learning (ML) models in order to increase consistency and evaluate forecasting power (Rosati et al., 2022).
- Future literature research could make greater utilization of data mining technologies as well as better integrate qualitative and quantitative evaluations. The PEST framework was specifically identified as a potential future study direction (Hofmann et al., 2020).

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MONETIZATION OF PRODUCT-SERVICES SYSTEMS (PSS): A BIBLIOMETRIC REVIEW

Tayyab Warraich, Marko Kohtamäki

RESEARCH MOTIVATION

Manufacturing firms are attempting new business models to create and capture value. Following, manufacturing firms through a business model innovation changed the product-orientation to service-orientation, known as servitization business model (Kohtamäki et al., 2018). Servitization has different perspectives, one of them being product-service systems which is viewed as a special case of servitization (Baines et al., 2007). Goedkoop (1999) proposed the idea of PSS as, “a system of products, services network of ‘players’ and supporting infrastructure that continuously strives to be competitive, satisfies customer needs and have a lower environmental effect than traditional business models”. Since the advent of this concept, a considerable number of studies attempted to define the PSS (Kohtamäki et al., 2018; Baines et al., 2007), and investigating its design, barriers, technology involvement, benefits, applications, practicing methodologies, and implementations (Adrodegari et al., 2021; Akbar & Hoffmann, 2018; Kohtamäki et al., 2021; Matschewsky et al., 2020; Watanabe et al., 2020)

Alongside value capturing in product-service systems through servitization (Kohtamäki et al., 2020), business model innovation (Gebauer et al., 2020), pricing strategies (Schroeder et al., 2022), and revenue models (Heinis et al., 2018), now the manufacturing and solution industry also strives to explore new value-capturing phenomenon's. Arguably data is new oil for industry and have capabilities for value proposition (Ebel et al., 2022), value creation (Zheng et al., 2018) and value capturing (Sjödin et al., 2021). To capture value from data is also known as monetization of data (Teece & Linden, 2017). The research on data monetization is very limited to date, and the majority of data monetization literature thrives on either defining the concept of data monetization or highlighting how disruptive technologies can be used to monetize the data (Parvinen, Pöyry, Gustafsson, Laitila, & Rossi, 2020). Previously through a literature review, researchers have studied value creation based on data in product-service systems (Machchhar et al., 2022), implications of data-driven product design (Wang et al., 2022), why to adopt big data analysis (Li et al., 2022), and data-driven service innovation (Schymanietz et al., 2022). Due to digitalization, escalation in acquiring the integrated systems in PSS firms is producing a huge volume of data which we posit have a great value and potential to generate new revenue streams and monetary. In this regard, it is crucial to align this novel concept, data monetization, in product-service systems research. However, there is no empirical study which investigated how the concept of value capturing / monetization of data is evolving in product-service systems literature. Alongside, the literature also lacks in providing a holistic overview of PSS along with valuable insights regarding novel monetary streams based on data. Thus, the motivation behind this study is to bridge this gap and explore data monetization in the context of product-service systems, theoretically, contextually, and methodologically.

CONTRIBUTION TO THEORY AND PRACTICE

This present study bridges the data monetization and product-service systems literature, postulating a holistic picture regarding past, on-going and future research. Theoretically, this study provides insights how the concept of monetization of data has evolved in PSS through bibliographic analysis and suggests the crucial areas of future research based on systematic content analysis. This study also examined the research approaches and suggested research methodologies which researchers should consider in future. Consequently, this study will help researchers in developing futuristic and revolutionary research agendas, based on the four identified research streams. Practically, with the immense integration of advanced technologies in manufacturing firms, producing a huge amount of data, firms are striving to find novel approaches in order to benefit from data. Thus, this study provides an overall overview to the managers to find new approaches to monetize the data and capture new value. Along with, it also highlights how sustainable growth of PSS firms is linked to the digital analytics and ultimately contribution towards regenerative and circular economy. In addition, this study also highlights the barriers and paradoxes

emerging in PSS regarding digital technologies and data analytics and solutions literature suggested in order to overcome them.

KEY DISCUSSION POINTS

- We employed Scopus to search the scientific literature regarding monetization of data in product-service systems and used Vos Viewer to run the Bibliographic coupling analysis on 185 articles.
- Bibliometric analysis helped us to identify four streams. Then through systematic content analysis of entire articles we coded them.
- Namely; Business Model Innovation, Circular / Regenerative Sustainable Systems, Drivers and Barriers to PSS Monetization, and Data-Driven Design Innovation.
- The systematic review of the dataset also assisted us in developing future research agenda's and methodologies suggestion for each identified novel stream.

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SUPPORTING CUSTOMERS' SUSTAINABILITY THROUGH DIGITAL SERVITIZATION: VALUE CO-CREATION PROCESS LEVERAGING AI AND CIRCULARITY PRINCIPLES

Taylan Kilinc, David Sjödin, Vinit Parida

RESEARCH MOTIVATION

The current climate change crisis is calling on industrial manufacturers to take greater responsibility for the transition to a more sustainable industry (Bocken et al, 2018; Frishammar & Parida, 2021). To address this challenge, the combination of digital servitization and artificial intelligence (AI) has been portrayed as an important transformative force to make the industry more sustainable and competitive (Sjödin et al, 2021). However, this requires a wide-scale transformation in processes, capabilities, and offerings within industrial firms and their associate ecosystems to progressively create, deliver, and capture increased service and sustainability value arising from a broad range of enabling digital technologies. For example, different processes and approaches to customer engagement may be required to enable digital solutions that reduce, reuse, and recycle material and energy resources (Frishammar & Parida, 2021).

The approach to customer engagement is a key challenge. Indeed, traditional product-based selling engagement approaches are not appropriate for customized and idiosyncratic digital solution sales (Tronvoll et al., 2020). Prior studies have indicated the need for agile co-creation processes (Sjödin et al, 2020), closer collaboration with customers (Tronvoll et al., 2020), and investment in digital assets (Kamalaldin et al., 2020). However, there is a lack of studies describing the processes of value co-creation customer engagement to facilitate the identification and commercialization of digital solutions and their sustainability potential.

The purpose of this paper is to explore how providers can leverage digital technology and AI in co-creation processes with customers to identify sustainable business opportunities. By doing so, we aim to provide insights and recommendations for industry practitioners and researchers working towards more sustainable and value-generating solutions.

CONTRIBUTION TO THEORY AND PRACTICE

We contribute to the literature on digital servitization, circularity, and sustainability in several ways. First, we provide an in-depth examination of the processes of value co-creation for realizing the sustainability potential of digital servitization. We show how the combination of digital and AI technology allows the identification of problems and circularity principles to provide a sensemaking device for selecting improvement opportunities. Second, we include an exploration of the potential of AI-enabled site optimization solutions for capturing sustainable value through the adoption of circularity principles. This contributes to the growing body of literature on the use of AI in sustainable industries, specifically on the intersection of AI and circularity principles. It also refers to the importance of considering the economic, social, and environmental dimensions of sustainability in the implementation of AI-driven solutions as well as the need for ecosystem collaboration, and the need for a holistic approach that takes into account the interrelated nature of these dimensions.

The practical contributions include insights and recommendations for industry practitioners and researchers working towards more sustainable and value-rich solutions, particularly through the integration of AI-driven site optimization opportunities within CBMs by considering circularity principles. This can help guide decision-making and strategies for driving the necessary transformation towards more sustainable industries on a broader scale. Additionally, the exploration of the specific

CBM opportunities concerning the intersection between AI and circularity principles can inform the development of effective and efficient solutions for sustainable value creation, delivery, and capture.

KEY DISCUSSION POINTS

- Developing a process for sustainability-oriented value (co)creation in digital servitization.
- Emphasis on customer input in the processes of digital servitization and why this is still a big challenge.
- The interplay between digital technology implementation and supporting customer sustainability initiatives.
- Co-creation process in order to identify opportune solutions to customers' sustainability concerns.

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UNRAVELLING THE SERVITIZATION TRANSFORMATION: THE ROLES OF DIGITAL TECHNOLOGIES AND GOVERNMENT POLICIES

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RESEARCH MOTIVATION

During the past two decades, Chinese manufacturers have adopted servitization strategies and built revenue streams from services. The motivation of this research attempts to explore servitization strategies adopted by Chinese manufacturers and the impacts of digital technologies and government policies on the implementation of servitization strategies. Underlying these perspectives, this study uses an exploratory multiple-case study approach and collect data from four Chinese manufacturers. Therefore, our research tries to answer three research questions including: (1) What are the servitization strategies adopted by Chinese manufacturers? (2) How do digital technologies affect the implementation of servitization strategies? (3) How do government policies affect the implantation of servitization strategies? This research provides empirical evidence on how digital technologies and government policies affect a firm's adoption of servitization and the transformation of different servitization strategies (Baines et al., 2020; Dmitrijeva et al., 2019).

CONTRIBUTION TO THEORY AND PRACTICE

This study contributes to the servitization literature in three ways. First, this study provides novel explorative evidence that Chinese manufacturers have adopted three servitization strategies, enhancing the current understanding of the evolution of the servitization implementation (Kohtamäki et al., 2021; Marjanovic et al., 2020). The findings reveal that manufacturing companies may start their servitization journeys by loosely bundling products and services. Then, they may extend the boundary of the servitization by redesigning physical products based on smart technologies and then devising and delivering innovative services based on platform technologies. The findings thus show that a manufacturer can advance its servitization by designing the innovative tangible and/or intangible components of the solution. The results provide insights into how a traditional manufacturer can be servitized and the path of the servitization journey.

Second, the findings enhance current literature by clarifying how advanced digital technologies influence a manufacturer's servitization journey. These results improve the understanding of the enablers of servitization (Kohtamäki et al., 2021; Marjanovic et al., 2020; Kamal et al., 2020; Baines et al., 2020). Although the literature has highlighted that digitalization plays a critical role in servitization (Coreynen et al., 2020; Kohtamäki et al., 2021; Favoretto, 2022), there is limited empirical evidence on how different digital technologies affect a firm's servitization journey. Our research illustrates how smart and platform technologies affect the implementation of servitization. We find that smart technologies allow firms to redesign tangible products by integrating physical, smart and connectivity components to provide digital solutions. Platform technologies enable manufacturers to extend their business networks by integrating with third-party service providers, business partners, and consumers. The findings thus enrich existing digital servitization literature.

Third, our research provides empirical evidence on the role of governments in the implementation of servitization and how central and provincial government policies affect the adoption of servitization strategies in China. Most of the existing literature focuses on the impacts of a manufacturer's processes, strategies, practices, and capabilities on the implementation of servitization (Favoretto et al., 2022; Baines et al., 2020). This study extends the existing literature by providing evidence on the impacts of the regulative institutional environment on a manufacturer's servitization journey. Our results show that the evolution of servitization is driven by government policies, which reflect how the government affects the development of industries and extends firms' boundaries of servitization. Moreover, the findings reveal that central and provincial government

policies play different roles in supporting the implementation of servitization, contributing to the literature.

This study provides guidelines for managers and policymakers on how to implement servitization in China. We suggest that Chinese manufacturers could implement servitization by adopting three different strategies. Manufacturers could start their servitization journeys by offering product-oriented services. For example, a manufacturer could adopt servitization by providing maintenance and repairs, after-sales, recycling and logistics services that are related to tangible products and can facilitate the sales and usage of products. Moreover, we suggest that manufacturers implement advanced digital technologies to expand the boundaries of servitization strategies. Managers should be aware that digital technologies may play different roles in promoting the implementation of servitization. Specifically, we suggest manufacturers adopt smart technologies such as virtual and augmented reality, AI and big data analytics, cloud computing and datafication technologies to redesign and redevelop products. Based on smart products, manufacturers could provide digital solutions including monitoring and testing, and product control services. We also recommend that manufacturers adopt platform technologies, such as IoT and web 2.0, blockchain technology, ERP systems, and database and data warehouses. Manufacturers could use platform technologies to link and integrate with business partners to offer platform-enabled services, such as financing, leasing, consulting, product life-cycle management, and high-end customized services.

This study also provides evidence that government policies play critical roles in promoting the implementation of servitization. Therefore, policymakers in the central and provincial governments should be aware of the different impacts of their policies on manufacturers' strategies and investment decisions in their servitization journeys. To facilitate the implementation of servitization and digitalization, we recommend that policymakers in the central government devise directive policies to guide manufacturers' strategic investment decisions and policymakers in the provincial government policies devise support policies to provide subsidies and financial resources to them.

KEY DISCUSSION POINTS

- Proposition 1: During the servitization journey, manufacturers may adopt three kinds of servitization strategies (i.e., product-oriented service, digital solution, and platform-enabled service).
- Proposition 2: Digital technologies play critical roles in a manufacturer's servitization journey.
 - Proposition 2(a): Smart technologies enable manufacturers to design and develop smart products to provide digital solutions.
 - Proposition 2(b): Platform technologies provide an infrastructure from manufacturers to integrate business partners to provide platform-enabled services.
- Proposition 3: Government policies facilitate the adoption of servitization strategies both directly and indirectly by motivating the implementation of digital technologies.
 - Proposition 3(a): Central government policy motivates manufacturers to adopt servitization by promoting internal investment.
 - Proposition 3(b): Provincial government policy motivates manufacturers to adopt servitization by providing subsidies and support.

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IMPLEMENTING AI IN DIGITAL SERVITIZATION: EXPLORING AI PROCUREMENT SERVICES IN THE AVIATION INDUSTRY

Stephanie Müller and Marin Jovanovic

RESEARCH MOTIVATION

The motivation for this study is to address a research gap regarding the value creation opportunities and challenges of establishing AI in the digital servitization context, specifically procurement services. The authors note that while many studies have focused on the advantages and disadvantages of AI implementation in general, few have explored the specific context of procurement services. By conducting a qualitative case study within the dyadic company setting of Airbus and Satair, the authors aimed to identify procurement-specific advantages and challenges of AI implementation and outline preconditions for success. The study's findings and academic framework provide valuable insights for scholars and practitioners who are considering researching or implementing AI in procurement in various settings.

CONTRIBUTION TO THEORY AND PRACTICE

This study explores the conditions for implementing AI in procurement at Airbus and Satair. It's a rare case since few authors have researched this area, albeit in different settings. For instance, Cui et al. (2021) examined how AI usage affects suppliers' pricing strategies, Sloane et al. (2021) investigated AI's application in public procurement, and Fu et al. (2017) inspected AI integration into negotiation pricing. Sammalkorpi and Teppala (2019) and Chopra (2019) presented general implications, advantages, and challenges of AI in procurement without delving into a specific use case. The study's novelty lies in exploring the dyadic relationship between Airbus and Satair, focusing on AI implementation preconditions, value creation opportunities, and challenges in the aerospace industry's procurement context.

In addition to bridging the research gaps in the area of AI in procurement, this study presents a significant contribution in the form of a framework. The framework was specifically developed to address the research questions at hand by elucidating on the establishment of standardized processes and transparency within an organization for the effective implementation and sustenance of AI in procurement. Furthermore, the framework aims to capitalize on the value creation opportunities and overcome the associated challenges while providing an actionable and verifiable blueprint for practitioners and researchers to leverage.

The developed framework emphasizes the importance of recognizing AI's value creation opportunities and challenges in the organization and procurement department. Incorporating AI in business processes may lead to a competitive advantage, as it reduces repetitive tasks, increases efficiency, and reduces the probability of errors. Additionally, AI algorithms can complement managers' decision-making and enable companies to emphasize long-term impact strategic initiatives. However, access to more data gained by using AI may lead to unfair competition. Combining various internal data sources can create department-overlapping reports, but it must be taken with caution as flawed data can lead to erroneous forecasts. Accessing or generating the required data to train and maintain the algorithm is a highly challenging and time-consuming process. Human bias can be unconsciously inserted into AI codes, negatively influencing future decision-making. Creating and maintaining AI in procurement is not only highly resource-intensive but also requires enormous dedication and often a mindset change.

It may increase the risk of business stoppages if the algorithm breaks down and the reduced workforce is unable to stem the tasks manually.

The second component of the framework underscores the importance of organizing AI in procurement. This entails aligning digital infrastructure, business strategy, procurement and company structures, as emphasized by Chopra (2019), Fu et al. (2017), Sammalkorpi and Teppala (2019), Tilson et al. (2010), and van Hoek et al. (2022). The study recommends that procurement align or establish business processes to facilitate AI implementation, as noted by Davenport and Brain (2018), while ensuring adequate budget and time frames, as well as mature data baselines, as suggested by Sammalkorpi and Teppala (2019) and Chopra (2019). The study further highlights that creating a data lake is not enough; the organization must also make use of the data, as 80% of procurement data remains unused and may hold value (Sammalkorpi and Teppala, 2019). However, legacy systems may limit tool implementation possibilities and business model adaptation, as indicated by Pepin et al. (2015) and Tilson et al. (2010), which the interviewees also noted. Thus, assessing whether an in-house solution or external help is required is crucial, as recommended by Sammalkorpi and Teppala (2019) and the interview participants.

This study recommends a gradual approach to implementing AI in procurement by starting with the development of MVPs that lead to AI solutions. To begin, it is crucial to understand the issue that the AI solution is meant to solve, as emphasized by both the interviewees and existing literature. Once a clear vision has been established, this study proposes following a lean and agile development process to develop an MVP, which can be tested through several sprints. High quality data is also essential to train the algorithm, and customer feedback should be incorporated into the process to modify the AI solution. To facilitate this process, this study suggests setting up an internal network of agile operators who can provide valuable feedback for transforming the MVP into a suitable AI solution.

The framework proposed advocates for the maintenance and scaling of the AI solution across functions, incorporating lessons learned from existing and future AI projects. While Sammalkorpi and Teppala (2019) consider maintenance as an additional cost, this study emphasizes its importance, especially in data management and performance. Ghezzi and Cavallo (2020) support the need for continuous alignment of operations to maintain internal consistency and scale the AI solution for procurement within the organization. However, they suggest external validation through customer feedback, unlike the present study. The importance of scaling the AI solution is acknowledged by several authors. This study recommends utilizing the established network for building and scaling the AI solution cross-functionally, in line with van Hoek et al. (2022). The study emphasizes the value of starting small and scaling using lessons learned, as also proposed by van Hoek et al. (2022) and advocates for an iterative approach to incorporate arising issues and lessons learned, consistent with existing literature (Ghezzi and Cavallo, 2020; Ries, 2009; van Hoek et al., 2022).

KEY DISCUSSION POINTS

- AI in procurement services
- AI in digital servitization
- Lean and agile development process in digital servitization

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IDENTIFYING UNCERTAINTIES AND DIGITAL CAPABILITIES FOR ADVANCED SERVICES: A SERVICE NETWORK ACTOR PERSPECTIVE

Dipti Rathi, Andreas Schroeder, Ali Ziaee Bigdeli

RESEARCH MOTIVATION

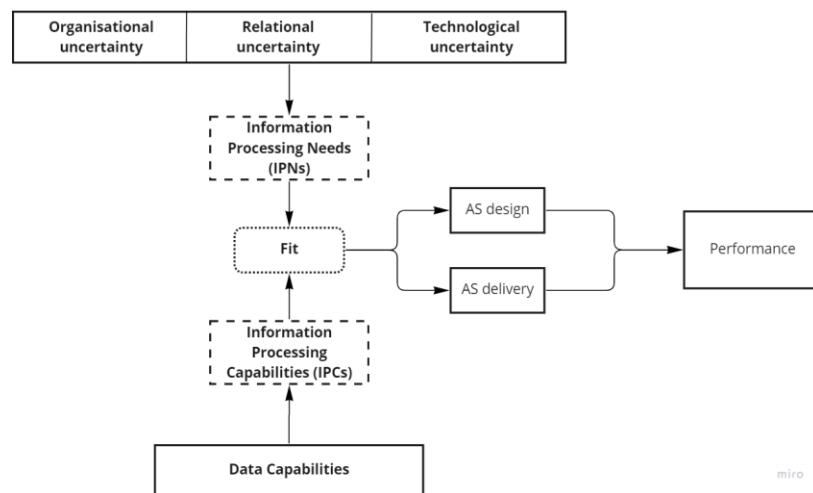
Recently, manufacturers have begun to offer advanced services (AS), which are complex value propositions focused on providing customers with performance outcomes instead of the products themselves. The design and delivery of these AS requires different sets of technologies, product, and service activities. Manufacturers often lack information or available data for the effective design and delivery of AS which creates various uncertainties for them (Erkoyuncu et al., 2011)

Uncertainty is widely recognized in the studies of strategy, operations, organisational behaviour, psychology, entrepreneurship, and innovations, where the identification and reduction of uncertainties are core research objectives (Griffin and Grote, 2020). Uncertainty has also been identified as the core challenge for manufacturers in the servitization literature where studies have looked at multiple sources of uncertainties (e.g., organisational, technological, relational, environmental, etc) (Kreye, 2018). However, for successful design and delivery of AS, servitizing manufacturers must identify and reduce these multi-source uncertainties they face in a systematic way, an area that is comparatively less researched. The focus of the present study is on three main uncertainties that can arise from advanced services: organisational, relational, and technological.

A promising approach to handle the uncertainties is through information processing capabilities (IPCs) - capabilities to obtain, analyse and process the information in a way that facilitates decision-making (Jat et al, 2023). Indeed, studies have started investigating the critical role and benefits IPCs can offer manufacturers. For the present study, these capabilities would mainly include IT support tools (Premkumar et al, 2005) and data activities for constant remote data acquisition and future predictions which accelerate the AS design and delivery (Agarwal et al., 2022). However, less is known on how IPCs can help in reducing the manufacturers' uncertainty.

It is becoming more and more evident that AS design and delivery involves not only the manufacturers but also the wider service network actors (customers, suppliers, partners, etc) (Alghisi and Saccani, 2015). Consequently, these uncertainties are affecting a range of wider service network actors. Therefore, it is important to extend the scope and integrate the service network actors to identify and address these uncertainties through IPCs for the successful design and delivery of AS. The study investigates ***how servitizing manufacturers and their service network actors can reduce uncertainties for AS design and delivery*** of a single case of manufacturer who are in the journey of AS.

The research draws on the organisational information processing theory (OIPT) (Galbraith, 1974) to develop a research framework. Following OIPT, organisations must enhance their IPCs to fulfil their information processing needs (IPNs) for any tasks or activities and deal with the uncertainty associated with these activities. Therefore, the study adopts the theory to systematically identify the uncertainties and information processing needs for AS design and delivery activities and utilising IPCs to reduce these uncertainties. The below figure illustrates the research framework developed for the purpose of the research partially adopted from the literature.



To address this RQ, the research employs a qualitative, single case-study approach to investigate manufacturing firm and their service network actors who are involved in the AS design and delivery process. The selection criteria of the case were based on: Servitizing manufacturers in the process of AS provision, growing relative importance of the service network actor engagement and pursuing digital developments. The case selection criteria capture the scope of the research and the research question. Data analysis is conducted in three distinct flows of activity: data condensation, data display and drawing verification and conclusions. Regarding the generalizability of results and contributions, one manufacturing case may create significant risks and challenges. To improve this, cross-case analysis, which involves identifying patterns across the embedded cases of network actors will be carried.

CONTRIBUTION TO THEORY AND PRACTICE

The study contributes to the servitization and OIPT literature in AS context by providing a systematic way of reducing uncertainties through IPCs. It also contributes to manufacturers and their service network, by helping them to identify the uncertainties and IPCs necessary to reduce these uncertainties for AS design and delivery.

KEY DISCUSSION POINTS

- For servitizing manufacturers, the ability to effectively integrate service network actors into their digital infrastructure and support them with their specific requirements, becomes critical for the manufacturer's ability to design and deliver advanced services on a global scale.
- There is lack of extant literature on understanding how the uncertainties can be reduced and various opportunities manufacturers can utilise.
- The research framework will help to systematically identify the uncertainties and link them with the IPCs.
- The single case study with the embedded cases of extended service network provides a deeper understanding on the uncertainties and capabilities.

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MOTIVES FOR DESERVITIZATION: INSIGHTS FROM THE VIDEO GAME INDUSTRY

Louis-Etienne Dubois, Alex Chalk

RESEARCH MOTIVATION

Research on servitization, that is the process by which organizations, mainly in the manufacturing sector, move downstream of the value chain and turn to services in addition to or instead of products has grown steadily over the past two decades. The decision to pursue such a strategy is generally said to be driven by financial, strategic and marketing motives. However, the literature also questions the notion of manufacturers' unidirectional transition from products to services, and increasingly looks into servitization's downsides and challenges as well as the corresponding "deservitization" strategy of intentionally withdrawing service offerings. Yet, research on why these changes occur remains scarce. Thus, the goal of this exploratory study is to examine motives behind deservitization. Drawing from a series of well documented cases in the video game industry, who in recent years has embarked on a servitization trajectory known as "games as a service" (GaaS), this paper seeks to better understand why studios later choose to pull back on their strategy within games marketed as services.

CONTRIBUTION TO THEORY AND PRACTICE

The results suggest a typology of motives for deservitization, namely: *Attending to the company*; *Attending to the customers*; and *Attending to the product*. They also point to important life-cycle considerations and to servitization-deservitization "loops" in which the addition and removal of service components can purposefully planned for and proactively managed by firms. This article also contributes to the servitization literature on three levels: First, it answers calls for more empirical research on the nature of the challenges inherent to servitization, especially those related to use of digital technologies. Second, it adds to the scant literature on deservitization and its causes. Third, by focusing on the video game sector, it further expands the servitization research into non-manufacturing sectors, and in particular in the ever transforming cultural and creative industries.

KEY DISCUSSION POINTS

- When presented with an underperforming service business, organizations may choose to roll back these offerings or withdraw them altogether. Deservitization refers to the elimination of service offerings, or a gradual shift from a service-centric to a product-centric business model.
- Nevertheless, why and how the decision to ramp down service offerings after having introduced them to market is made remains relatively misunderstood to date.
- The rise of GaaS not only aims to retain the player base, but extend longevity and profitability in an oversaturated and hype-driven marketplace. However, even as service models are enthusiastically taken up, we also witness firms already scaling down existing service offerings or walking away from them entirely. Specifically, deservitization in this context implies either removing or curtailing support or content updates on a given game title, or introducing a new standalone instalment in a franchise that was intended to revolve around a single title.
- The motives to deservitize can be summed up into three themes: *Attending to the company*; *Attending to the product*; and *Attending to the customers*. We discuss those themes in turn.
- The GaaS model requires a heavy investment in labour power, capital, and network infrastructure, which together can severely tax a firm's capacities. Indeed, maintaining a thriving service experience means continually producing new content, implementing fixes, and supporting players, requiring ongoing commitment from developers post-launch. These concurrent demands pose significant logistical challenges where, priorities to expand the service and improve it can wind up tying up scarce resources.

- Deservitization may also become desirable when a service ceases to be profitable or becomes difficult to maintain. Services may bring in less revenue due to attrition as preferences change over time, or as competing offerings take up market share. Scaling down can help draw out an underperforming game's playable lifespan rather than terminating it altogether.
- Reductions in service may cut costs enough while continuing to bring in some revenue from ongoing purchases, and more importantly, extend the cultural life of the game and keep up a relationship between fans and developers.
- Hence, the decision to deservitize can be triggered by a range of internal and external motives, be they related to human or structural, technological, customers or reputational issues.
- Those motives are not mutually exclusive and often influence each other: unhappy employees, disgruntled customers and subpar performance often go together. Financial considerations are not always explicitly mentioned and that all parent companies are still in business today.
- Rather than seeing deservitization as a failure, our findings support the idea that such strategy can indeed be restorative. Namely, instead of conceptualizing transitions between products and services along a continuum, servitized firms should consider operating a series of beneficial maintenance loops across a given offering's life cycle.
- In short, while a servitized game provides endless possibilities from a narrative standpoint, studios still need to account for ever-evolving employees, technologies, and customers, and proactively identify 'windows' to cut back to better perform.
- Future research should explore servitization-deservitization loops both within and outside of manufacturing, seek to test the motives against first-hand accounts of decision makers, as well as against financial data to determine whether or not they met the intended results.

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PRICING STRATEGIES FOR DIGITAL SERVICES: A TYPOLOGY TO ENABLE VALUE CAPTURE FROM DIGITAL SERVICITIZATION

Jawwad Z. Raja, Ismail Golgeci, Thomas Frandsen & Isabelle Fabienne Neufang

RESEARCH MOTIVATION

Digitalization is a transformative force in today's business landscape, fundamentally altering how firms operate and compete. Even traditional original equipment manufacturers (OEMs) are not immune to its influence and are striving to redefine their competitive approach by integrating digital services, a phenomenon referred to as digital servitization (Frandsen et al., 2022; Kohtamäki et al., 2019; Sklyar et al., 2019). Such digital services utilize innovative technologies, including cloud computing, digital platforms, the industrial internet of things (IIoT), digital twins, and data analytics, necessitating firms to develop new capabilities to create, deliver, and extract value from digital services (Linde et al., 2023; Sjödin et al., 2020).

Despite the perceived benefits of digital services, the process of digital servitization is often accompanied by challenges and tensions. Firms may face internal challenges associated with the need for new capabilities and personnel with relevant analytical skills that may disrupt established units (Tronvoll et al., 2020). Sales staff accustomed to selling services may experience difficulties when promoting digital services to customers. Additionally, the "digitalization paradox" may arise when firms are unable to derive benefits from their investments in support of their digital strategy (Gebauer et al., 2020; Raja et al., 2022). Such challenges are compounded when external challenges are combined with customers who are hesitant to allow digital technologies to access and collect data from their equipment on an ongoing basis (Eggert et al., 2022). Consequently, the efforts to advance a digital strategy can be constrained, severely hindering value capture.

The process of extracting value from digital services can be a complex endeavour for firms, as they may face several difficulties such as devising appropriate pricing strategies (Karami et al., 2022; Raja et al., 2020), managing changing customer expectations (Sklyar et al., 2019), and generating revenue from monetizing digital services (Markfort et al., 2021). Despite these obstacles, firms are motivated to capitalize on digital servitization to expand and establish recurring revenue streams.

Limited attention has been devoted to capturing value from digital servitization and digital services (Linde et al., 2023). Pricing options available to firms transitioning from selling equipment and traditional services to digital services are largely unknown. Therefore, there is a need to investigate the pricing logic that firms can adopt during digital servitization. To this end, we propose a pricing typology for firms to capture value from digital servitization based on a case study undertaken.

CONTRIBUTION TO THEORY AND PRACTICE

The study contributes a typology of options available to businesses when pricing digital offerings (see Figure 1).

Ad-hoc pricing: The first option for businesses is to price digital services on an ad-hoc basis, usually on a cost-plus basis. This may occur when a new digital service is being tested in the market, or when certain customers want to purchase specific digital services from the portfolio. The motivational forces for offering and recurring revenue from ad-hoc pricing are likely to be low, especially when they are one-offs. However, customers may want to buy certain digital services once the warranty or 'freemium' trial period expires. Digital services sold on an ad-hoc basis are likely to be part of a service agreement provided. Lastly, the recurring revenue from ad-hoc pricing of digital services is likely to be low.

Market-based pricing: The second option involves a market-based approach to pricing, mainly on a competition basis. Intermediaries such as systems integrators may offer digital services on the business's behalf as part of a tender or customer request. In such cases, the motivational forces at

play will be to maintain the relationship with the intermediary firm and, in no small part, ultimately sell equipment. This may also be the case for the provider business if it seeks to win equipment tenders in the open market. Moreover, data access to monitor equipment in real-time, depending on the customers' specific circumstances and openness, may be an issue. However, there is potential to capture a greater share of the value created based on the value of the tenders and customer segment.

Standardized pricing: The third option involves devising standardized (modular) concepts/packages that bundle digital services into clearly distinct and limited categories. Typically, digital services are offered on a subscription-based model, which is commonplace in the software industry and online streaming services. The motivational force for doing so is that it enables businesses to manage complexity by simplifying options to a limited number of possibilities. However, companies should be mindful of the drawbacks of a hard bundle. Moreover, such an approach means using standardized service agreements and ensures recurring revenue.

Customised pricing: The fourth option involves a customised approach to pricing digital services, ideally based on a value-based or dynamic approach. With customised pricing of digital services, the provider is likely seeking to be a value partner to customers (Matthyssens & Vandenbempt, 2010; Strufy et al., 2021). Undoubtedly, this is the most demanding approach to pricing, but it is also the most financially rewarding, especially if it is tied to achieving certain parameters such as output, uptime, or optimization. This approach can also entail greater risk sharing with the customer. Service agreements for customized pricing will likely be tailored to the specific needs of high-value customers. Customised pricing will provide recurring revenue if a close relationship with customers is maintained. A value-based approach provides the best possibility for value capture but requires a close relationship with the customer.

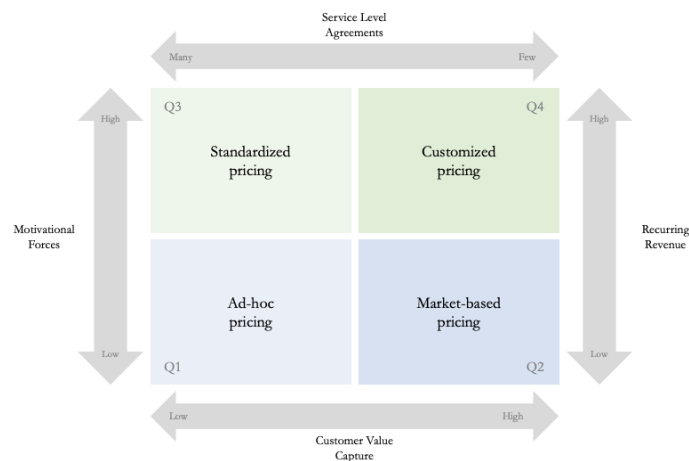


Figure 1: Typology of pricing options

KEY DISCUSSION POINTS

- Each pricing option is not be used in isolation, but rather to consider different combinations that may be applicable depending on the conditions firms face over time or targeted for different customer segments.
- Understanding pricing strategies and effectively capturing value from digital services is critical for OEMs to maintain a competitive edge in the rapidly evolving digital landscape.

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