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Dynamic capabilities-enabled servitization: the role of exploitative quality management

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ABSTRACT

Literature is silent on whether the impact of dynamic capabilities (DCs) on transformative efforts towards servitization is hampered by manufacturers' exploitative quality management (QM) employed to improve production efficiencies. Based on theoretical and empirical insights about 60 manufacturers this paper offers propositions on this question and a nuanced appreciation of the conflicts and barriers manufacturers face to effectively use DCs to servitize. It shows that DCs strengthen manufacturers' customer solution capabilities and service resources. However, although directly improving their service resources, exploitative QM weakens the positive impact of DCs on such resources, yet without necessarily affecting customer solution capabilities. Hence, manufacturers' use of exploitative QM can bolster their service resources yet concurrently reduce the impact of their transformative efforts towards servitization. The paper also delves into the tensions that can arise between the equipment and service parts of a manufacturing organisation and proposes managerial guidance on how to address them.

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Dynamic capabilities; exploitation/exploration; quality management; servitization; manufacturing

1. Introduction

Servitization requires a well-orchestrated mobilisation of operational resources and capabilities (Kindström, Kowalkowski, and Sandberg 2013; Baines et al. 2020) to deliver customer solutions (Fischer et al. 2010; Holgado and Macchi 2023; Gebauer, Paiola, and Edvardsson 2010). Manufacturers seeking to shift towards a service-based business must transition from solely providing tangible products to also delivering intangible, knowledge-intensive services (Kreye, Roehrich, and Lewis 2015; Rabetino et al. 2021). This means transforming their organisation and developing those resources and capabilities necessary for the provision of service-based solutions (e.g. Baines and Shi 2015; Witell and Löfgren 2013). Thus, in this study, we define servitization as the establishment of manufacturers' service business whilst maintaining the manufacturing business. This involves developing service resources that encompass the tangible and intangible assets enabling the implementation of service strategies, and customer solution capabilities that embody organisational routines that facilitate actual service delivery to provide customer solutions.

Improving operational efficiency in their manufacturing business continues in parallel to servitization (Gebauer, Ren, et al. 2012; Zatzick, Moliterno, and Fang 2012) and remains crucial for manufacturers to remain competitive (Gif et al. 2016). In doing so, they focus on production process and system automation (Lu, Xu, and Wang 2020) and production capacity optimisation (Goswami and Daultani 2023). This 'manufacturing-oriented way of doing business' (Brax 2005, 142) underpins how manufacturers function and characterises their dominant business logic (Mele, Colurcio, and Russo-Spena 2014), management approach (Soltani et al. 2012) and managerial mindsets (Liao, Soltani, and Wilkinson 2023). As a deeply rooted and 'more formal manufacturing business approach' (West, Gaiardelli, and Saccani 2022, 107), it is visible in an emphasis on the process and management control dimension of its quality management (QM), especially the efficiency-focused operational level of QM (Dahlgaard et al. 2019) which represents manufacturers' exploitative QM. Specifically, the two types of QM are defined as 'Exploitative QM focuses on controlling extant QM methods in order to achieve high levels of consistency and efficiency, whereas explorative QM is characterized by experimentation and innovation that generate novel QM solutions' (Ning and Gao 2021, 1).

While ample research substantiates servitization's performance benefits (e.g. Queiroz et al. 2020) and clarifies the practices supporting it (e.g. Fischer et al. 2010; Kowalkowski et al. 2012; Storbacka 2011), we lack a more precise understanding about how manufacturers develop their service business in the first instance (Holgado and Macchi 2023; Huikkola et al. 2020; Kurtz, Meyer, and Roth 2023; Valtakoski 2017), especially in consideration of their entrenched approach to conducting their business. The role of organisational contexts and tensions between traditional efficiency-oriented manufacturing logics with embedded operationally-focussed exploitative QM and flexible strategically-focussed exploratory servitization logics when manufacturers

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seek to develop a service-based business is particularly understudied (Huikkola et al. 2020; Qamar et al. 2020).

Handling this tension between improving operational efficiencies and strategic flexibility comes with further conflicts that can build between the equipment and service parts of the business. These conflicts are multifaceted. First, manufacturers traditionally emphasise product quality, efficiency, and cost control. Transitioning to a service-oriented model necessitates a cultural shift towards prioritising customer relationships, service quality, and value-added solutions. This may result in strategic misalignment between product-focused and service-focused units and requiring significant changes in organisational culture, goals and performance metrics to reduce the tension. Second, servitization requires substantial upfront investments in new capabilities, technologies, and training, conflicting with short-term financial goals focused on immediate profitability. While product sales provide immediate revenue, service contracts generate revenue over a longer period, this creates tensions in financial planning and performance evaluation, that can be addressed through a clear strategic direction. Third, servitization involves providing customised solutions tailored to individual customer needs, contrasting with the standardisation prevalent in manufacturing. Customisation increases complexity in operations, logistics, and supply chain management, making it challenging to maintain high levels of service quality. Fourth, manufacturing requires technical and engineering skills, whereas servitization demands skills in customer service, relationship management, and problem-solving. Bridging this skills gap necessitates training and development programs. Employees accustomed to a manufacturing environment may resist changes associated with servitization, requiring effective change management practices, clear communication, and leadership support. Fifth, servitization necessitates a customer-centric approach, shifting from an internal focus on product features and production processes to an external focus on customer needs and value creation. This shift can be difficult for manufacturers with a product-centric mindset. Building and maintaining strong customer relationships become crucial but challenging, requiring new capabilities in customer engagement and satisfaction measurement. Sixth, implementing servitization may require significant organisational changes, such as creating new service divisions or integrating service functions across departments. These changes can disrupt established hierarchies and workflows, and integrating service processes with existing manufacturing operations can be complex. Ensuring seamless coordination and avoiding silos is essential for effective servitization. Seventh, servitization often involves leveraging advanced technologies such as Internet of Things (IoT), data analytics, and Artificial Intelligence (AI) to deliver innovative services. Integrating these technologies into traditional manufacturing systems can be challenging and requires substantial investment. Eighth, encouraging innovation and experimentation for service development may conflict with the need for stability and risk aversion in manufacturing operations. Navigating these auxiliary conflicts between maintaining operational efficiencies and strategically transforming towards service provision poses a crucial challenge for manufacturers.

With this fundamental exploitation/exploration tension (Adler, Goldoftas, and Levine 1999; Eisenhardt, Furr, and Bingham 2010) and embedded conflicts, a pertinent question is whether manufacturers' exploitative QM hampers their efforts to transform towards a servitized business. As outlined, QM is fundamental to manufacturing and one of its commonest practices. The prevailing exploitative QM, markedly, is associated with cost control and tight management (Dahlgaard et al. 2019), while transformation towards servitization requires flexibility (Holgado and Macchi 2023; Huikkola et al. 2020; West, Gaiardelli, and Saccani 2022). But exploitative QM (Zhang, Linderman, and Schroeder 2012) rarely aligns with the flexibility that underpins transformation-focused initiatives to facilitate the development of bespoke customer solution capabilities (Peillon, Pellegrin, and Burlat 2015; Zatzick, Moliterno, and Fang 2012; Zhang, Linderman, and Schroeder 2012). Moreover, manufacturing-based thinking that privileges efficiency and standardisation, with ensuing exploitative QM, may undermine the exploratory efforts that transformations towards servitization demand (Biege, Lay, and Buschak 2012; Kohtamäki, Einola, and Rabetino 2020). Brax (2005, 142) sums this up by stating 'that many [servitization] challenges stemmed from the manufacturing-oriented way of doing business'. This implies manufacturers must leverage their capacity to refresh resources and build capabilities to transform meaningfully, in consideration of the exploitation/exploration tension that their exploitative QM creates. Dynamic capabilities (DCs)—defined as 'the [general] capacity of an organization to purposefully create, extend or modify its resource base' (Helfat et al. 2007, 1)—facilitate the transformation of a business, and hence manufacturers may need to exercise DCs to aid the development of a service business (Gebauer, Fleisch, and Friedli 2005; Lightfoot and Gebauer 2011), but where their prevailing exploitative QM may weaken the impact of exercising their DCs.

In following an abductive research approach, this paper proposes a set of arguments that synthesise DCs and exploitation/exploration tension literature with findings from survey data about 60 German machine manufacturing and plant engineering firms. Accordingly, it seeks to answer the main question *how does exploitative QM condition DCs-enabled servitization in manufacturing firms?* In turn, we contribute to the literature by addressing calls to understand better the microfoundations of servitization and related transformational capabilities (Huikkola et al. 2020; Valtakoski 2017). Specifically, our nuanced clarification of how manufacturers' exploitative QM could hamper transformative efforts towards servitization (Baines and Shi 2015; Jaakkola and Hallin 2018) substantiates the need to advance the literature on servitization-related DCs further (Kindström, Kowalkowski, and Sandberg 2013). While the servitization literature has gained much momentum (Rabetino et al. 2021), prior research omits whether DCs-enabled servitization is affected by manufacturers' efforts to enhance production and cost efficiencies through exploitative QM, hence we offer important, novel

insights. Aligning with prior literature, we confirm that DCs foster the development of the manufacturers' service resources and customer solution capabilities. However, responding to calls that we need to extend the DCs approach to servitization (Kindström, Kowalkowski, and Sandberg 2013; Rabetino et al. 2018), we explain that, whilst directly improving these resources, exploitative QM reduces the positive impact of DCs on them. Therefore, by weakening the DCs' impact, exploitative QM constitutes a boundary condition for how DCs enable servitization. We provide a much-needed explanation for the challenges with transformation that manufacturers face when seeking to develop a service-based business while simultaneously improving operational efficiencies in their manufacturing business (Baines et al. 2020) and further insights into potential contributors to servitization failure (Valtakoski 2017).

We next outline how servitizing manufacturers refocus strategically to compete by providing service-based customer solutions. We then develop a set of theoretically derived arguments about DCs' impacts and the role of exploitative QM in this use of DCs. After describing the empirical setting and analysis procedure, we discuss our findings in light of our theoretical arguments and put forward two propositions. Then, we present overall conclusions including theoretical contributions, managerial implications, and limitations with directions for future research.

2. Conceptual background

To develop a competitive edge, manufacturers increasingly look to offer service-based solutions (Gebauer, Fleisch, and Friedli 2005; Holgado and Macchi 2023; Oliva and Kallenberg 2003; Rabetino et al. 2021). While they need to keep their traditional manufacturing activities, they need to engage in servitization. A frequent challenge in this endeavour, is the weak capacity to marshal resources and capabilities appropriate for providing services (Kindström and Kowalkowski 2014). Service resources and customer solution capabilities are two essential building blocks servitizing manufacturers need to develop. Both differ fundamentally from traditional manufacturing (Biege, Lay, and Buschak 2012; Datta and Roy 2011). For example, manufacturers' service resources require skilled employees with solution-focused knowledge and competencies (e.g. Ulaga and Reinartz 2011), technology infrastructure complementing the installed base (e.g. Allmendinger and Lombreglia 2005), and a reputation for service quality (e.g. Raddats, Burton, and Ashman 2015). Such resources and embedded knowledge provide a basis for manufacturers to deliver commercially viable services and strengthen their product utilisation (Ayala et al. 2017). Thus, applying resource- and knowledge-based theoretical reasoning (Barney 1991; Grant 1996) and servitization-related research (e.g. Raddats, Burton, and Ashman 2015), the resources needed encompass fitting tangible and intangible assets that will let manufacturers implement service strategies.

In support, the capabilities manufacturers tap to provide customer solutions embody organisational routines (Cepeda and Vera 2007) that facilitate actual service delivery, so industrial customers can improve their own production capacity and efficiency and meet their own goals (e.g. Storbacka 2011). These customer solution capabilities encompass solution development and fulfilment processes (Galbraith 2002; Holgado and Macchi 2023) to handle service offerings (Oliva and Kallenberg 2003). They enable producing and delivering service-based solutions (Biege, Lay, and Buschak 2012) and are centred on the customers' needs (Ayala et al. 2017). Again, applying the knowledge-based view, this reflects firms' importance as coordinators and integrators of their knowledge and that of the customers (Grant 1996).

However, adding to manufacturers' existing manufacturing-focused resources and capabilities adequate service resources and customer solution capabilities is challenging (Davies, Brady, and Hobday 2006). That is, developing a service business while maintaining the manufacturing business is taxing. Kindström, Kowalkowski, and Sandberg (2013, 1063) argue that 'To be able to develop new services continuously and comprehend the underlying business logic of service provision, firms must develop dynamic capabilities'. In embracing this notion, our study goes beyond service innovation: it focuses on how manufacturers' servitization cumulates into establishing the service business that rests on them exercising their DCs.

Operationally, DCs modify firms' resources and capabilities and notably catalyse changes in products or production processes towards services and delivery processes (Cepeda and Vera 2007). Hence, they can propel the development of manufacturers' service business, in parallel to their manufacturing business, by developing service resources and customer solution capabilities (Fischer et al. 2010; Kowalkowski et al. 2012; Storbacka 2011; Storbacka et al. 2013). Changes in manufacturers' environments and consequent opportunities and threats from servitization 'influence the capability gap' between existing capability and 'the corresponding value-maximizing configuration', i.e. 'the most valuable capability configuration potentially available in the post-change environment' (Lavie 2006, p. 155). An evolving competitive landscape where customers demand service-based solutions requires manufacturers to develop new resources and capabilities. Hence the case for DCs, which enable changing manufacturers' resources and capabilities (Bititci et al. 2011; Fosso Wamba and Queiroz 2022; Qamar et al. 2020), to facilitate the development of the service business essential for servitization (Huikkola et al. 2020).

The conceptual background of our theorising is crystallised in Figure 1. Figure 1 contextualises manufacturers' development of their service business, parallel to maintaining their manufacturing business. This conceptualisation acknowledges the role of their DCs in reconfiguring their business and producing strategic change. While DCs-enabled strategic change can pertain to the manufacturing business, because it is well documented (e.g. Helfat et al. 2007), we focus here instead on DCs-enabled servitization (e.g. Kindström, Kowalkowski, and Sandberg 2013) observable in the development of manufacturers' service resources and customer solution capabilities. Besides, our conceptualisation captures the important role of exploitative QM for

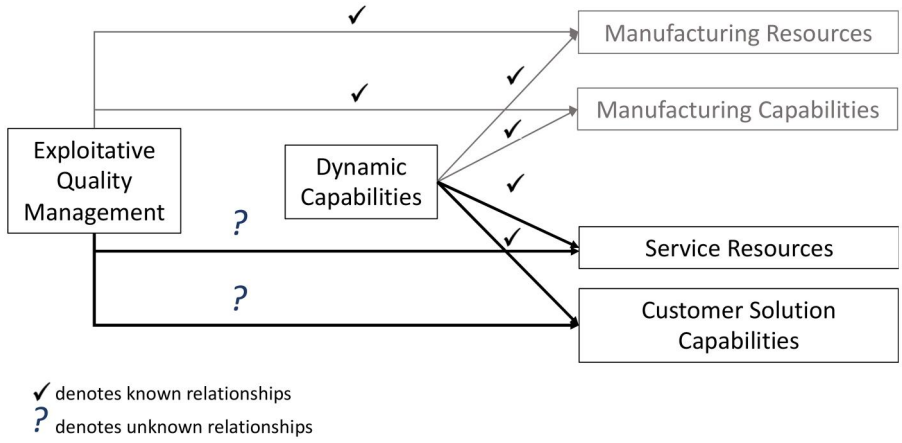

Figure 1. Conceptual background.

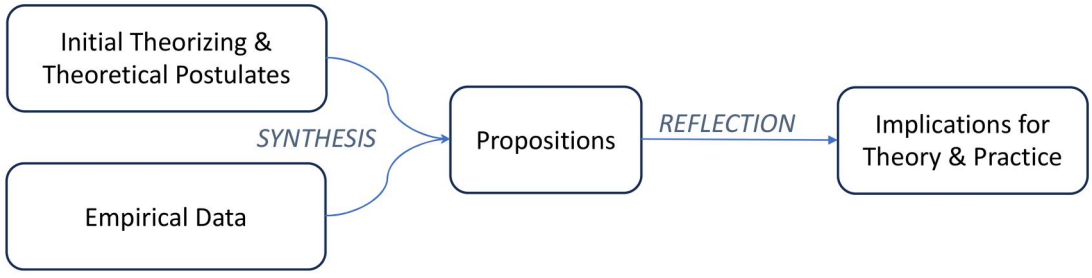

Figure 2. Abductive approach.

manufacturers to improve operational efficiencies in their manufacturing business (e.g. Dahlgaard et al. 2019). So, we focus on the thus far neglected impact of exploitative QM on DCs-enabled servitization, referred to as *unknown relationships* in Figure 1. Accordingly, in this study, we seek to answer the question *how does exploitative QM condition DCs-enabled servitization in manufacturing firms?* Having defined our scope, we next explain our underpinning research approach and theorising.

3. Research approach

Applying an abductive research approach, this study synthesises theoretical reasoning from the DCs and exploitation/exploration tension literature with findings from survey data about 60 German machine manufacturing and plant engineering firms (analyzed using partial least squares structural equation modelling (PLS-SEM) following Akter, Fosso Wamba, and Dewan (2017) and Cepeda-Carrion, Cegarra-Navarro, and Cillo (2019)). The abductive research approach enables addressing the research questions by combining the strengths of both inductive and deductive inquiry. It involves reasoning from concrete data to extend or refine existing theoretical postulates. By moving back and forth between theoretical postulates and empirical observations, it facilitates theory-refinement. Figure 2 illustrates the abductive approach drawn on in this study.

This research approach is appropriate in the present study for the following reasons. First, our research aims to refine theorising on DCs-enabled servitization rather than to build an entirely new theory like an inductive approach would. Second, unlike a deductive approach, our research does not test hypotheses but instead sets out to refine theorising. Therefore, drawing on existing literature on the role of DCs in servitization and the exploitation/exploration tension, our research draws on empirical data to clarify how exploitative QM conditions DCs-enabled servitization in manufacturing firms. In this way, our abductive approach systematically combines existing theorising on DCs in servitization and exploitation/exploration tension with empirical evidence gained from 60 German machine manufacturing and plant engineering firms, enabling the extension of current theoretical understanding (Dubois and Gadde 2002). Moving back and forth between theory and empirical evidence in our discussion enhanced the interpretive utility of our research (Eisenhardt and Graebner 2007).

3.1. Initial theorising

3.1.1. Dynamic capabilities–enabled servitization

As explained above DCs are about transformation and sensing, seizing, and reconfiguring constitute their microfoundations that enable manufacturers to develop their service business. Sensing and seizing foster strategic situational awareness. Through them, firms engage in knowledge search to discover opportunities and threats and make efficacious decisions. Reconfiguring takes proficient management to pursue opportunities and simultaneously weigh possible organisational impacts. When servitizing, manufacturers transform to establish new service-based customer solution capabilities

and resources. The needed DCs to accomplish this transformation are explorative and transformative (Fischer et al. 2010; Randhawa, Wilden, and Gudergan 2021). Exploration comprises searching and experimenting; at its core it encompasses the search for new knowledge and is future-oriented. This is why in efforts to transition towards a servitized business, explorative DCs dominate. In contrast, as ensuing from exploitative QM, exploitation produces minor refinements to current products and manufacturing processes by building on existing knowledge and skills (March 1991). In short, exploitation is replicative, and exploration generative (Li et al. 2018).

Sensing allows manufacturers to identify concrete servitization gaps in their customer solution capabilities and service resources, which grow as the environment shifts and providing customer solutions takes priority. Knowledge about external changes and their implications, gained from sensing and scanning the environment, throws into relief what adaptation in dynamic markets will call for (e.g. Rahman et al. 2020). If, for example, customers demand assurances backing up the functionality of the installed product base, servitizing manufacturers who understand the service resources and customer solution capabilities necessary to provide these assurances can develop them to provide solutions that improve customers' operations. Those manufacturers will also learn what new service routines they require. Indeed, this detailed understanding can become a foundation for providing customer solutions and a fulcrum for leveraging new opportunities (Casson and Wadeson 2007). Thus, manufacturers with better-developed sensing can recognise and comprehend (1) servitization opportunities, (2) gaps in their service resource base and customer solution capabilities, and (3) possible service resources and customer solution capabilities to fill them. As a result, such manufacturers should accrue superior service resources and customer solution capabilities. Sensing is particularly difficult within the servitization context as it requires a deep-involvement with customers, their context, meaning that they need to develop strong relationships with them so that they can sense how new service offerings can create value to both themselves and their customers (Kindström, Kowalkowski, and Sandberg 2013).

High-quality sensing supplies inputs for manufacturers' strategic decision-making. Without it, they lack the understanding to leverage customer solution opportunities. Consequently, after sensing, seizing facilitates decision-making to specify possible customer solution-focused business models and allocate investments. More particularly, commercial assessments and evaluations of information help manufacturers specify how to adjust their resource base and customer solution capabilities to utilise selected opportunities. For example, having identified servitization opportunities, manufacturers must evaluate and determine the specific service resources and customer solution capabilities necessary to establish a competitive service business. This process involves strategic decisions about whether to invest in developing a service business with embedded resources and capabilities. This process, however, may be difficult given the exploitative QM and product-centric dominant logic that many manufacturers hold (Kindström, Kowalkowski, and Sandberg 2013; West, Gaiardelli, and Saccani 2022).

Seizing draws on the outputs of sensing to specify a customer solution-focused business model that can fill the firm's servitization gap. The guidance that results should culminate in better-quality service resources and customer solutions capabilities. However, seizing does not extend to implementing these changes. This happens during the reconfiguration process, the third DCs' microfoundation.

Implementation is essential to launch competitive service operations. Reconfiguring lets manufacturers establish the concrete service operations and fill the servitization gap, realising the strategy that emerged from seizing. To develop the service resources necessary to create the service business around the specified business model, manufacturers can: hire employees with solution-focused competencies; establish service- and solution-oriented knowledge bases (e.g. engaging consulting services or hiring a service executive); forge a supportive technology infrastructure that complements the installed base; and build their reputation for service quality. The reconfiguring process further involves specifying and implementing service blueprints (organisational routines) that support delivering services that yield customer solutions. Reconfiguring thus helps implement a new business model by emplacing suitable service resources and customer solution capabilities. It means breaking the product-centric path dependency. Once again this is challenging as the ways of doing things, and long embedded organisational resources and capabilities can defy easy reconfiguration (Szulanski 1996). As such, a firm's historical expertise in providing manufactured products can impede reconfiguring. Ultimately, concerted reconfiguring efforts should better fit the new service resources and customer solution capabilities to the servitization gap.

In summary, this argument brings forward that the three microfoundations that underpin DCs contribute to transforming a manufacturer into a servitized firm. Manufacturers who exercise DCs should experience less organisational inertia (Suddaby et al. 2020) and so more effective servitization. The others only develop their service resources and customer solution capabilities by chance. Thus, manufacturers' DCs should be of benefit to developing both their service resources and customer solution capabilities (Fischer et al. 2010; Gebauer, Paiola, et al. 2012; Kowalkowski et al. 2012; Storbacka 2011). Hence our following postulates:

Postulate 1: Manufacturers' dynamic capabilities positively impact their service resources.

Postulate 2: Manufacturers' dynamic capabilities positively impact their customer solution capabilities.

3.1.2. Exploitative quality management and dynamic capabilities–enabled servitization

DCs shape manufacturers' service resources and customer solution capabilities, and they are subject to boundary conditions, i.e. to factors that may constrain their functioning or

application (Eisenhardt and Martin 2000). For instance, DCs' impact is stronger for firms with more organic (versus mechanistic) organisational structures (Wilden et al. 2013). This implies that strategic alignment among internal features is crucial for effective organisational transformation, an insight that also applies to effective servitization (Alghisi and Saccani 2015; Gebauer, Ren, et al. 2012; Kindström 2010; Lightfoot and Gebauer 2011). In manufacturing firms, exploitative QM is a fundamental practice. It is widely applied (Samson and Terziovski 1999) and core to understanding their performance (Nair 2006). Hence, it deserves scrutiny. But exploitative QM rarely aligns with their servitization efforts (Alghisi and Saccani 2015; Biege, Lay, and Buschak 2012). Moreover, since manufacturers commonly deploy exploitative QM, it is necessary to unravel how this efficiency-focused operational level of QM conditions their DCs-enabled servitization efforts.

This task requires understanding the distinctive roles of exploitation- and exploration-focused QM (Zhang, Linderman, and Schroeder 2012). QM's focus can vary significantly (Ahire and Dreyfus 2000; Douglas and Judge 2001). Based on the learning literature argument (March 1991; Li et al. 2018), Zhang, Linderman, and Schroeder (2012) propose two main QM types: exploitative and explorative. As explained before, exploitative QM emphasises ways to refine existing organisational processes. Explorative QM focuses on changing the firm's capacity to explore new aspects of its operating environment. To be effective, any QM efforts should be congruent with the firm's servitization efforts (Biege, Lay, and Buschak 2012; Peillon, Pellegrin, and Burlat 2015; Zatzick, Moliterno, and Fang 2012). Any incongruence likely emerges due to the manufacturers' dominant logic (Bettis and Prahalad 1995; Tuli, Kohli, and Bharadwaj 2007). That is, manufacturers tend to favour efficiency improvements over flexibility (Kindström and Kowalkowski 2014; Storbacka 2011; Strandvik, Holmlund, and Edvardsson 2012). This, in turn, can compromise the proficiency of their DCs and, in a vicious circle, reinforce the use and impact of exploitative QM.

This discussion indicates that QM is not universally beneficial (Foster 2006; Sousa and Voss 2008) and hence may be a boundary condition for DCs. For a notable example, when manufacturers deploy DCs to establish new service resources and customer solution capabilities, simultaneously applying exploitative QM may dampen the DCs' beneficial effects. As exploitative QM encapsulates the efficiency-focused operational level of QM, it focuses on and refines existing internal production operations (Shah and Ward 2007) through optimisation and automation procedures (Carme et al. 2014; Ratnadeep and Anand 2015) which prioritise efficiency. The commonly detailed standard operating procedures emphasise 'the importance of stability and consistency in the production process' (Shen and Chen 2020, 762). Put differently, emphasising efficiency improvements can hinder the manufacturers' ability to innovate and react swiftly to changes (Benner and Tushman 2002; Cole and Matsumiya 2008). Reinforcing that exploitative QM curtails more exploratory behaviours (Benner and Tushman 2002), Benner (2009) further stresses that exploitative QM constrains both adaptability and responsiveness. In the same vein, Fernandes, Lourenço, and Silva (2014) find that QM focused on measuring results implies less organisational innovation, and process-focused QM is less conducive to management innovation.

These findings suggest an inherent tension between exploitative QM, designed to achieve consistency, standardisation, and control, and DCs that demand flexibility, adaptability, and innovativeness. When exploitative QM targets improving standardisation and strengthening existing organisational routines (Benner and Tushman 2003), it produces rigidities that impede flexibility and innovativeness. Therefore, the extent to which exploitative QM benefits firms depends on how congruent these initiatives are with their other activities (Zatzick, Moliterno, and Fang 2012). Therefore, we argue that exploitative QM moderates negatively the two relationships substantiated in postulates 1 and 2, hence the following two postulates:

Postulate 3: Emphasis on exploitative quality management weakens the relationship between manufacturers' dynamic capabilities and their service resources.

Postulate 4: Emphasis on exploitative quality management weakens the relationship between manufacturers dynamic capabilities and their customer solution capabilities.

3.2. Empirical insights

Gaining empirical insights into our four postulates requires extending our inquiry beyond our main research question to clarify its sub-sets derived from the postulates: *Do DCs positively impact manufacturers' service resources and customer solution capabilities?* and *Do exploitative QM attenuate DCs' positive impact on manufacturers' service resources and customer solution capabilities?* We draw on data about German manufacturers offering services to compete in their respective markets. This setting suits investigating the impact of within-firm processes on service-focused resources and capabilities. The study relies on surveys as data about these firms' practices were not readily or publicly available. It has an abductive aim such that the empirical insights serve to shed light on the theoretically derived postulates. They are not provided to formally test them but to add further clarity.

3.2.1. Sample

Using a random sampling strategy, the sample comprised 300 randomly selected firms in Germany's machine manufacturing and plant engineering sectors. Our data collection process involved an initial mail-based approach, followed by follow-up phone calls to enhance response rates. The mail-based survey targeted senior managers, such as heads of service departments or managing directors. A telephone call followed the mailed invitation, to ensure informant suitability and encourage participation. The 60 usable questionnaires[1] (each from a separate firm) represent an adequate response rate of 20%[2]. These came approximately 70% from heads of service operations, and 30% from general managers or other

Table 1. Sample and firm characteristics.

Sample size	300 randomly selected firms in Germany's manufacturing & plant engineering sectors
Response rate	20% (60 firms)
Key-respondents	70% head of service operations
	30% general manager or appropriate senior manager
Firm characteristics	average (median) firm size 720 (160) employees
	average (median) sales volume 165 mil EURO (30 mil EURO)
	average service operations as proportion of total sales generated: 20%

Table 2. Measurement model results.

Construct	Indicator						
Reflective Measures		Loading	CR	AVE	Cronbach's α	Mean	SD
Sensing	Better understand environment	.901***	.903	.757	.839	.902	.030
	Improve decision input quality	.896***				.789	.060
	Learn from failures	.811***				.894	.030
Seizing	Specify customer solution concepts	.763***	.844	.643	.723	.773	.048
	Better integrate feedback in decisions	.825***				.737	.066
	Shorten innovation cycle	.817***				.810	.088
Reconfiguring	Make use of market opportunities	.838***	.889	.728	.813	.840	.069
	Fast adoption of service offerings	.895***				.675	.026
	Successful placement of new services	.825***				.897	.080
Exploitative quality management	Focus on process automation	.846***	.817	.600	.666	.824	.112
	Focus on capacity utilisation	.692***				.661	.168
	Focus on professionalisation	.777***				.764	.159
Customer solution capabilities	Increase customers' process efficiency	.861***	.888	.727	.815	.860	.054
	Contribute to customers' business objectives	.787***				.792	.089
	Improve customers' business processes	.906***				.898	.034
Formative measures		Outer Weight	VIF	[Loading]		Mean	SD
Service resources	Skilled service employees	.549***	1.425	[.804***]		.547	.185
	Service and solution-oriented knowledge base	.355*	1.150	[.563***]		.326	.195
	Technology infrastructure that complements the installed base	.371**	1.042	[.371**]		.348	.164
	Service quality reputation	.647**	1.299	[.647***]		.318	.156

Notes: A bootstrapping routine (Hair et al. 2017) and a no sign change option revealed the significance levels. AVE = average variance extracted; CR = composite reliability; SD = standard deviation; VIF = variance inflation factor.
All loadings exceed the commonly used threshold of .70; except two that range from .623 to .692 but exceed the acceptable threshold of .60 (e.g. Hadid 2019; Hulland 1999); all Cronbach's alphas exceed the commonly used threshold of .70; except two that are .666 or .679 but exceed the acceptable threshold of .60 (Hair et al. 2006).
***$p < .01$, **$p < .05$, *$p < .10$.

appropriate senior managers. Among the 60 firms with usable survey responses, the average (median) firm size was 720 (160) employees, with an average (median) sales volume of approximately €165 million (€30 million). Service operations averaged some 20% of their total sales generation. Comparing data from the German Association of Machine Producers bares a general consistency in these characteristics with the wider population of machine manufacturing and plant engineering firms, indicating that our self-reported data are useful for our study. Table 1 summarises details of our sample and offers summary characteristics of firms included in our analyses. Thus, the sixty-strong final sample is appropriate for probing the postulates.

3.2.2. Measurement specification and survey instrument

Since measurement models were unavailable for most of the constructs embedded in the postulates, an a priori technique draws on Diamantopoulos and Winklhofer (2001) approach to index construction and qualitative decision rules to specify measurement models for each. Accordingly, we first clarified the constructs' theoretical definition. Second, we determined whether the measurement mode of each construct should be reflective or formative (i.e. whether it was theoretically more appropriate to measure reflections of the underlying concept or to measure components of it that contributed to the concept). Third, we operationalised the ensuing measurement models by specifying suitable effect indicators for reflective models and composite indicators for formative models, as applicable for the different constructs in this study. Additionally, discussions with 15 senior managers in manufacturing firms undertaking servitization guided the development and refinement of our models. These discussions started with the postulates' nomological content to determine whether the constructs and their relationships seemed managerially relevant. They also included reviewing the proposed definitions. This process indicated that the postulates were relevant.

Where measurement models were available for constructs, the indicators were adapted as necessary; otherwise, various related models in prior literature yielded a list of potentially suitable indicators. The same 15 managers then provided feedback about the relevance and clarity of the indicators, to ensure the meanings reflected the constructs. Using this, we refined the wording for the proposed indicators, and selected those indicators the managers considered most appropriately measured the constructs. We detail the measurement models (and their results, reported below) in Table 2.

3.2.2.1. Dynamic capabilities. Following Wilden et al. (2013), DCs were conceptualised as a Type-II, multidimensional, second-order index (reflective–formative type; Diamantopoulos and Winklhofer 2001). The formative mode is appropriate for two reasons. First, sensing, seizing, and reconfiguring microfoundations constitute and define the overall DC construct (Teece 2007). The formative measurement model thus is a composite of the three, and changes in any will alter the value of the overall DCs construct (Barreto 2010). Second, the three components capture different processes.

We developed the measurement models for sensing, seizing and reconfiguring informed by works including Fischer et al. (2010) and Kindström and Kowalkowski (2009), and adapted them to the study context as informed by the 15 managers. Because the set of activities that might refer to each microfoundation is infeasibly vast, we adopted a reflective measurement mode. Specifically, a three-indicator reflective measurement model that assessed the manufacturers' sensing microfoundation tapped the processes they used to understand relevant aspects of its service environment, including learning inputs for service-related decision-making. The seizing microfoundation featured another three-indicator reflective measurement model that gauged processes like the capacity to specify innovative solutions for customers and integrate feedback in decision-making. Finally, the measure of the reconfiguring microfoundation drew on a reflective model with three indicators, including its ability to adopt services quickly to meet changing customer demands and make use of opportunities. Respondents rated statements reflecting the three DC microfoundations on a five-point interval scale, anchored at 1 ('does not apply') and 5 ('applies fully').

3.2.2.2. Exploitative quality management. No appropriate, previously used measurement model suited our context. Consistent with descriptions above of exploitative QM, we developed a measurement model of practices that improve the performance of existing organisational processes, by refining production and operations to enhance efficiency. Prior literature and discussions with the 15 managers confirmed automation and optimisation initiatives were relevant. Because extensive improvement activities could serve to upgrade production and operations processes, the reflective measurement used the same five-point interval scale as above to determine how much QM focused on process automation, professionalism and improvement, or capacity optimisation.

3.2.2.3. Customer solution capabilities. Swink and Hegarty (1998) and Peng, Schroeder, and Shah (2008) emphasise that an operations strategy view of capabilities, as applied to servitizing manufacturers, 'focuses on the outcome a capability is supposed to enable, rather than on the 'means' or pathways to achieve that outcome' (Trentin, Forza, and Perin 2015, 254). Ultimately, all outcomes produced through customer solution capabilities target improved customer firms' operations (Storbacka 2011). A reflective measurement model is thus appropriate. Given prior studies (e.g. Auguste, Harmon, and Pandit 2006; Ulaga and Reinartz 2011), the discussion with the 15 senior managers revealed three particularly suitable indicators: increases in customer firms' process efficiency, contributions advancing customer firms towards their business objectives, and improvements to customers' business processes. This measurement model also is consistent with Öhman, Finne, and Holmström's (2015) elements and incorporates aspects of Raddats, Burton, and Ashman (2015). Again, each indicator was measured on the same five-point interval scale.

3.2.2.4. Service resources. No universal measurement model captures service resources for manufacturers, nor does any previously employed model clearly fit our context. Considering previous servitization insights (e.g. Ulaga and Reinartz 2011), the discussions with the 15 senior managers suggested a suitable model would include four elements: skilled employees with specific solution-focused competencies; service- and solution-oriented knowledge bases; a supportive technology infrastructure complementing the installed base; and a reputation for service quality. This measurement encapsulates aspects used by Raddats, Burton, and Ashman (2015) and Ulaga and Reinartz (2011). To discernibly impact performance (Barney 1991), resources must also be more effective than those of competitors. Competitors' abilities can vary for each element. Because the four elements were deemed relevant by the 15 managers as well as discussed in literature, but are not interchangeable, we chose a formative measurement model for this construct's measurement model. Our formative measurement model sought judgments on the firm's strength in each relative to competitors, on a five-point interval scale from 1 ('much weaker') 5 ('much stronger').

3.3. Measurement assessment

To assess the reflective measurement models, we established the model loadings, average variance extracted, composite reliability, and Cronbach's alpha (Table 2 summarises the measurement model results). The empirically established constructs are all reliable and valid. Heterotrait–monotrait ratios of correlations (HTMT; Henseler, Ringle, and Sarstedt 2015) all fell below the critical values (.90), also showing discriminant validity.

Assessment of the formative measurement models drew on the significance of the outer weights and indicators' collinearity (Hair et al. 2017). Indicators for both formatively measured constructs are all positive and significant (with indicator weights falling between .355 and .559); collinearity, determined by the variance inflation factor, is below the critical value of 5 (falling between 1.042 and 2.263 for the indicators).

Finally, confirmatory tetrad analysis supports the applied measurement modes (Gudergan et al. 2008). Therefore, all measurement models are suitable for probing the four postulates.

3.4. Data characteristics

From a crude assessment (comparing early with late respondents, according to Mann-Whitney U-tests for all included indicators), non-response bias was not a concern. Nor was common method bias, based on Harman's single-factor test (entering the study variables into a principal component analysis). Finally, the distribution of the data by Mardia's multivariate skew and kurtosis measures indicated a violation of the multivariate normality assumption.

3.5. Analytical approach

Analyses of the data drew on partial least squares structural equation modelling (PLS-SEM) using the SmartPLS 3 software (with default settings) (Ringle, Wende, and Becker 2015). This estimation approach is commonly used in similar studies (e.g. Akter, Fosso Wamba, and Dewan 2017; Hadid 2019; Leyer, Reus, and Moormann 2021). PLS-SEM is a soft modelling approach that has less restrictive assumptions, yields fewer identification problems, and does not require normally distributed data (Hair et al. 2017, Hair et al. 2023). It, therefore, fits perfectly with the abductive nature of this research (Richter et al. 2022).

Because we use cross-sectional data, cause-effect inferences based on the empirical results warrant caution. Thus, the following results should not necessarily be interpreted as evidence of underlying causal relationships but as supporting a prior causal scheme established through the theoretically substantiated postulates presented earlier. As mentioned above, they shed further light into the postulates outlined in a preceding section in this paper but are not presented to test them formally. Instead, the results represent empirical insights for our abductive approach and allow us to refine our theorising and articulate propositions based on a synthesis of theoretically derived postulates and empirical insights. Figure 3 illustrates the research model estimated employing PLS-SEM. The model includes all relationships that are assessed empirically, including those that are postulated and those that are not postulated but included in the estimations for analytical reasons.

3.6. Empirical insights

The following describes the results concerning the postulated relationships. Most estimated relationships were significant (Table 3 summarises the estimation results), providing support for all but one postulate (Postulate 4) (Table 4 offers a summary for the postulates). The average R^2-value (.376) was acceptable. The evaluation of the structural model results also considered predictive relevance and effect sizes (Hair et al. 2017). The Q^2 statistics were positive, indicating predictive relevance. The f^2 effect sizes revealed a rank order similar to that in the PLS path coefficients. For all effects, to ensure sufficient statistical power for the estimations, the

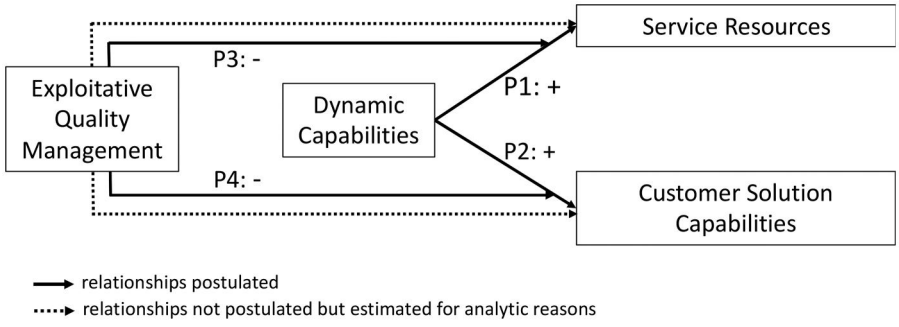

Figure 3. Research model.

Table 3. Estimation results.

Postulated Relationships		Path Coefficient	Bias Corrected 95% Confidence Interval	f^2
Dynamic capabilities → Service resources (compare Postulate 1)		.550***	[.341; .758]	.566
Dynamic capabilities → Customer solution capabilities (compare Postulate 2)		.481***	[.215; .694]	.253
Exploitative quality management × Dynamic capabilities → Service resources (compare Postulate 3)		−.265***	[−.362; −.016]	.144
Exploitative quality management × Dynamic capabilities → Customer solution capabilities (compare Postulate 4)		−.008$^{n.s.}$	[−.228; .402]	.000
Exploitative quality management → Customer solution capabilities		−.063$^{n.s.}$	[−.418; .230]	.004
Exploitative quality management → Service resources		.448***	[.098; .651]	.324
Explanation and Prediction	R^2	Bias Corrected 95% Confidence Interval	*p*	Q^2
Customer solution capabilities	0.213	[0.170; 0.635]	0.046	0.093
Service resources	0.539	[0.473; 0.783]	0.000	0.175

Notes: A bootstrapping routine (Hair et al. 2017) and the no sign change option determined the significance of the path coefficients.
Although the effects of exploitative quality management on customer solution capabilities and of exploitative quality management on service resources were not postulated, they are included for estimation purposes and, consequently, reported here.
***$p < .01$, **$p < .05$, *$p < .10$.

Table 4. Summary of the study's postulates.

Reference	Postulates	Theoretically derived postulate consistent with empirical insights
P1	Manufacturers' dynamic capabilities positively impact their service resources.	Yes
P2	Manufacturers' dynamic capabilities positively impact their customer solution capabilities.	Yes
P3	Emphasis on exploitative quality management weakens the relationship between manufacturers' dynamic capabilities and their service resources.	Yes
P4	Emphasis on exploitative quality management weakens the relationship between manufacturers' dynamic capabilities and their customer solution capabilities.	*insufficient statistical power*

minimum required effect size—given the model structure and sample size—was .135. This value was below the lowest, significant effect size in the estimations (.144), for which the corresponding statistical power was .824. Thus, sample size did not constrain interpretation of the estimations, except the non-significant effect, where statistical power was also insufficient to assess the estimated effects. Overall, the structural model is appropriate for examining the proposed relationships, except Postulate 4.

DCs exhibited positive relationships with the firm's service resources (ß = .550, p = .000) and customer solution capabilities (ß = .481, p = .000), supporting postulates 1 and 2 respectively. Whereas exploitative QM attenuated the positive relationship between DCs and service resources (ß = −.265, p = .002), we cannot establish whether it affects the relationship of DCs with customer solution capabilities (ß = −.008, p = .628). This supports Postulate 3 but not Postulate 4.

3.7. Discussion and propositions

Considering the prior theoretical reasoning (e.g. Gebauer, Fleisch, and Friedli 2005; Lightfoot and Gebauer 2011) encapsulated in postulates 1 and 2 in light of our empirical insights, we confirm that DCs positively impact manufacturers' service resources and customer solution capabilities, highlighting their role in enabling transformation efforts among manufacturers that develop a service business. In doing so, it advances the servitization literature by offering quantitative support that sensing, seizing, and reconfiguring underpin manufacturers' efforts towards servitization. We thereby corroborate and extend Fischer et al. (2010) qualitative case-based findings by demonstrating DCs' general applicability to servitization.

Moreover, by adducing theoretical arguments outlined in Postulate 3 and empirical insights that exploitative QM attenuates DCs' positive impact on a firm's service resources, we start investigating the tensions manufacturers face when navigating the servitization journey. In doing so, we connect to existing works that emphasise efficiency and flexibility performance trade-offs between lean and agile manufacturing firms in the automotive industry (Ding, Ferràs Hernández, and Agell Jané 2023; Qamar et al. 2020), alignment in terms of manufacturing structure, service structure, and the coupling between them (Peillon, Pellegrin, and Burlat 2015), internal inconsistencies between servitization strategy and internal organisational arrangements (Alghisi and Saccani 2015), socio-technical pivots on manufacturers' journey to service-oriented business models (Kurtz, Meyer, and Roth 2023), control versus learning approaches in TQM-driven organisations (Liao, Soltani, and Wilkinson 2023), and how internal context factors impact a manufacturer's strategic transformation towards competing through services (Dmitrijeva et al. 2020). In linking to these works, our conjectures cannot account for a manufacturer's level of servitization.

Because exploitative QM fosters 'stability and consistency in the production process' (Shen and Chen 2020, 762), manufacturers benefit from adjusting their management approach (Soltani et al. 2012) and managerial mindsets (Liao, Soltani, and Wilkinson 2023) when moving towards a servitized business. For instance, exploitatively-minded manufacturers are likely to sense narrowly and internally, whereas servitization requires sensing that scans the external environment and widely.

In revisiting Postulate 4 in light of our empirical insights, we note an important difference between service resources and customer solution capabilities. Service resources, as evidenced in our conceptualisation and operationalisation, have more tangible features, which render them more measurable (Madhavaram and Hunt 2008). This is not so to the same extent for customer solution capabilities. They are intangible and, in many ways, ambiguous. They comprise tacit knowledge and routines (Ambrosini and Bowman 2001) and are assembled in idiosyncratic ways (Eggers and Kaplan 2013). Depending on who is involved, they may also be performed inconsistently. These customer solution capabilities are also dyadic: their value is co-determined by customers even if manufacturers exercise them. They involve both transmission and receipt (Grant 1996). This reinforces the importance of adopting a DC view, which underscores that customers and manufacturers must learn from each other and collaborate so the solution offered by the latter benefits the former.

It also complements the work by Wilden et al. (2019) who apply service-dominant logic thinking (e.g. Lusch and Vargo 2006; Skålén et al. 2015; Wieland, Hartmann, and Vargo 2017) to explain the interplay of cocreation and DCs. Central to this line of thinking is a shift from a firm-centric (product-focused) production of outputs to activities and processes involving the firm, suppliers, and customers as resource integrators who participate in value-creation processes (Wieland, Hartmann, and Vargo 2017). However, critically this allows us to propose a more sophisticated explanation of why exploitative QM targeting efficiency with its process control and measurement-based automation and optimisation practices (Haridy et al. 2024), can only be leveraged on clear, internally

focused resources, not more fluent, ambiguous, externally (customer-centred, pull-based) focused capabilities (Ayala et al. 2017). Hence, we put forward our first proposition:

Proposition 1: Manufacturers' exploitative quality management weakens the positive impact of its dynamic capabilities on their service resources but not that on their customer solution capabilities.

Outside the four postulates, a further contribution to the literature concerns the empirical finding that, directly, exploitative QM helps develop the manufacturers' service resources, but does not affect their customer solution capabilities. As mentioned, the development of customer solution capabilities may occur in conjunction with the manufacturers' customers and concerns more intangible elements that manufacturers are less familiar with, whereas service resources comprise more tangible elements and, as an add-on to what they already do, are less different from their current operations. Accordingly, we conjecture that manufacturers develop more quickly understanding about service resources than about customer solution capabilities. This echoes arguments that the transition towards servitization has a temporal component (e.g. Baines et al. 2020). Manufacturers change from the provision of basic services to advanced services (West, Gaiardelli, and Saccani 2022), and they are characterised by a certain degree of servitization (Calabrese et al. 2019). Accordingly, and building on West, Gaiardelli, and Saccani (2022, p 96), we can reason that, as manufacturers develop advanced service resources, they establish standardised building blocks (e.g. employees with specific solution-focused competencies; service- and solution-oriented knowledge components; technology modules to support the installed base). This standardisation is likely to be positively supported through the manufacturers' exploitative QM. A focus on process automation and capacity utilisation supports the development of standardised building blocks that make up the manufacturers' service resources. This corroborates Coreynen et al. (2020) argument that exploitative firms can also be oriented towards servitization, but it broadens their findings as their study is solely related to digital servitization and it brings a more complete understanding by decomposing servitization. This nuancing extends the literature by explaining why it is essential to give credence to the differences in the nature of these resources and operational capabilities. Accordingly, we suggest a second proposition:

Proposition 2: Manufacturers' exploitative quality management supports their service resources but not their customer solution capabilities.

4. Conclusions

This study applies the DC view and its conceptualisation of microfoundations to provide a more comprehensive theoretical and empirical treatment of manufacturing firms that seek to transform towards servitization (Kindström, Kowalkowski, and Sandberg 2013; Valtakoski 2017). In doing so, this study complements prior studies that clarify the ways firms ought to structure and design their servitized business (e.g. Salonen, Saglam, and Hacklin 2017; Zhang and Banerji 2017) by illuminating in more detail how manufacturers can *transform towards* such a business in the first instance. Our study provides a distinct contribution from prior works that have started clarifying how manufacturers ought to organise their servitized business once operating. It differs from them by focusing on the process of transitioning (or transforming) towards servitization; it focuses on the development of the service business rather than its manufacturing operation. In doing so, we add theoretical understanding to some of the descriptive works that look at the servitization transformation process (e.g. Baines et al. 2020).

4.1. Implications for theory

While we know that DCs can provide a basis for manufacturers to transition to a service-based business (Gebauer, Fleisch, and Friedli 2005; Lightfoot and Gebauer 2011), not all servitization attempts achieve what they set out to do (Lütjen, Tietze, and Schultz 2017; Vendrell-Herrero et al. 2022). What is missing from the literature is a nuanced understanding of what constraints a manufacturer from effectively using its DCs in such transformative endeavours. Hence our focus. Answering calls to expand the DC approach to servitization (Kindström, Kowalkowski, and Sandberg 2013; Rabetino et al. 2018), our abductive study substantiates that DCs positively impact manufacturers' service resources and customer solution capabilities, highlighting their role in enabling transformation efforts among manufacturers that seek to develop a service-based business.

Moreover, by presenting theoretical arguments and empirical insights that exploitative QM attenuates DCs' positive impact on a firm's service resources, we start investigating the tensions manufacturers face when navigating the servitization journey. Specifically, we shed new light on the practices that may inhibit, but also support efforts towards servitization, showing that exploitative QM can indirectly hamper the development of the manufacturers' service resources as it weakens the DCs-enabled servitization, but directly support their service resources by fostering standardisation. Thus, we contribute to the servitization failure literature (answering calls by Valtakoski 2017) by highlighting the importance of such a boundary condition. Emphasising exploitative QM as a boundary condition enriches our understanding of the DCs enabling servitization by foreshadowing when they may not work effectively (Makadok, Burton, and Barney 2018). Because exploitative QM fosters 'stability and consistency in the production process' (Shen and Chen 2020, 762), manufacturers benefit from adjustments to their management approach (Soltani et al. 2012) and managerial mindsets (Liao, Soltani, and Wilkinson 2023) when moving towards a servitized business, representing a cultural challenge for servitizing manufacturers (Khanra et al. 2021). Altogether these findings further unravel the importance of the DC view in a more sophisticated comprehension of how manufacturers develop a service business when transforming

towards servitization (Valtakoski 2017). Moreover, whereas Kohtamäki, Einola, and Rabetino (2020) discuss paradoxes in manufacturers' operations that have servitized, we add to this line of thought by unpacking the paradox that characterises exploitative QM and DCs when manufacturers seek to develop their service business in the first instance, aligning with the implications of the study by El Manzani et al. (2024) that tailored QM initiatives are required to optimise organisational innovations such as DC-enabled servitization.

4.2. Managerial implications

When manufacturing firms seek to transition towards servitization, the role of DCs becomes crucial. Managers must adeptly leverage the processes of sensing, seizing, and reconfiguring to drive this transformation effectively. The present research underscores the importance of instituting robust mechanisms for sensing, which entails continuously monitoring market trends, customer needs, and technological advancements. Managers could, in this regard, consider adopting AI as advancements in the field means that such activities have become more straightforward (Abou-Foul, Ruiz-Alba, and López-Tenorio 2023). This proactive stance allows for the timely identification of opportunities and threats, essential for servitization. Additionally, assessing internal capabilities and resources is equally important to ensure alignment with the evolving service-oriented business model.

In the context of seizing, rapid and innovative decision-making processes are vital. Cultivating a culture that encourages agility and responsiveness enables swift action on the insights gained from sensing processes. Managers should strategically allocate resources to seize new opportunities, which might involve investing in new technologies, in training staff or recruiting new staff for service delivery. Reconfiguring organisational structures and systems to support servitization is another critical managerial implication. This could involve creating dedicated service units, integrating service functions across various departments, and establishing processes to support the new service-oriented operations. Implementing new IT systems for service management or redesigning workflows to enhance service delivery are examples of such reconfigurations.

Balancing exploitative QM with DCs is a nuanced challenge for managers. While commonly employed operational exploitative QM can directly bolster service resources by fostering standardisation and consistency, it can also pose challenges by potentially stifling the transformative efforts required for servitization. The emphasis on stability and efficiency might negatively condition the benefits of DCs, which demand flexibility and innovation. To navigate this, managers must strike a balance between improving efficiencies in existing operations and fostering the flexibility, adaptability, and innovativeness needed for servitization. They need to be attentive to both and understand properly the underlying assumptions of both logics. This would allow them to consider how the tensions can be alleviated, notably by bringing people together to generate a common understanding (Klag and Langley 2023). This can be facilitated by encouraging people with different values and assumptions to share their concerns and debate (Lewis, Andriopoulos, and Smith 2014). Achieving this balance often requires a cultural shift within the organisation. Managers need to promote a mindset that values both efficiency and innovation, encouraging teams to embrace new ways of thinking and working. They also need to make sure that coordination is effective in their organisations as to ensure an integration of logics. Indeed, the transition towards servitization also requires a shift in the dominant business logic from product-centric to service-centric thinking. Managers should champion this shift, aligning organisational goals and strategies with a service-oriented vision. Encouraging a culture of continuous learning and adaptation is vital in this shift. Managers should foster environments where lessons from past experiences are systematically captured and applied to future initiatives. Encouraging collaboration and communications across all organisational units will allow for developing a unique and clearly understood logic. Involving everyone in the organisation and ensuring they understand the business imperative will make people more accepting of the transition, and re-joining our previous point will also foster strategic ability (Doz 2020). Communications about knowledge transfer and problems associated to the transition from one logic to another will be notably paramount to engaging in continuous improvement and learning.

This also signals that adopting leadership styles that support both exploitation and strategic change is crucial. This might involve transformational leadership to inspire change and transactional leadership to ensure operational efficiencies. Leaders need to share their vision and the underlying logic effectively. Effective change management practices are essential to guide the manufacturer through the transformation process, including clear communication, stakeholder engagement, and addressing resistance to change. These are key levers to make the transition to a service business successful and ensure that there is no systematic resistance from employees who may feel that their deeply held assumptions about the role of manufacturers are violated.

Lastly, managers must cultivate mindsets that prioritise flexibility and innovation. This is critical given that competition is not static, and competitive advantage is underpinned by the ability to innovate (Teece 2023). This involves encouraging risk-taking, experimentation, and embracing failure as a learning opportunity. Developing strategic flexibility allows manufacturers to pivot quickly in response to changing market conditions and customer needs, ensuring long-term competitiveness in a service-oriented market.

In summary, DCs are key enablers to servitization and transitioning towards servitization demands a comprehensive approach where managers strategically leverage DCs, balance operational exploitative QM, and foster a cultural shift towards service-oriented thinking. By focusing on these areas, managers can navigate the complexities of servitization and drive successful transformation efforts, even as boosting cost efficiencies remains crucial (Gif et al. 2016). In the era of AI, we can also suggest that managers exploit AI

capabilities as they may allow for better decision-making and facilitate operational processes altogether.

4.3. Limitations and avenues for further research

While providing noteworthy empirical insights, the research design carries three limitations. First, the sample size produced insufficient statistical power to explore whether exploitative QM conditions DCs' impact on customer solution capabilities. While the directionality found in our data analysis is consistent with our preliminary theorising, further studies could draw on a larger sample. Secondly, a single respondent provided data per firm. Although the self-reported data are suitable here, further studies could use data from different sources such as multiple respondents per firm and, if accessible, complementary, non-survey data. Third, our study firms are based in one highly industrial country and results may be different in a different context (i.e. different countries or different industries). Then, to advance insights into how to balance the potentially competing logics and practices within servitizing manufacturers, future research could examine both exploitative and explorative QM efforts that possibly characterise firms' manufacturing operations or the organisation more widely, examining how explorative and exploitative DCs and notably sensing and seizing opportunities support servitization efforts and transform the firms and develop the appropriate customer solution oriented knowledge base.

Then, as is the case for any firm, the servitization impact of DC deployment in manufacturing firms likely is conditioned by their service-dominant orientation (Wilden and Gudergan 2017) or service orientation (Kohtamaki et al. 2015). Hence, although our findings already allow speaking to these aspects, further research can explore to what extent manufacturers' organisational capacity to engage and involve their customers, in addition to certain QM efforts, may condition the success of their transformation efforts towards servitization, and whether certain configurations of these organisational practices and DCs distinguish between more or less successful transformations at different stages or levels of their transition towards a servitized business (Gelhard, von Delft, and Gudergan 2016). Moreover, research could be important in investigating whether the transition towards servitization and the need to adopt an exploratory logic is more challenging in some contexts than others (e.g. firms with no embedded organisational learning culture or top-down leadership style) and whether the external environment and notably the intensity of competition or level of customer sophistication matters (Dmitrijeva et al. 2020). Finally, manufacturers' position in their value chain (Gebauer, Paiola, and Edvardsson 2010) and the specific stages of an industry's lifecycle (Cusumano, Kahl, and Suarez 2015) which may differ in different countries affect the type of industrial service they seek to offer and, accordingly, may condition their servitization. Furthermore, according to Kowalkowski, Kindström, and Witell (2011), internal context may also matter, as it may also be dependent on whether the service business is entirely internalised or not. Therefore, the particular type of industrial service manufacturers aim to provide themselves internally or in collaboration with external business through their servitization may further condition the extent to which QM weakens or strengthens their transformation efforts. Therefore, further research can consider accounting for such contingencies to understand better how manufacturers transform towards a servitized business.

Notes

1. Our sample size corresponds with other studies published in this journal that have employed partial least squares structural equation modelling (PLS-SEM) (e.g. Dwaikat et al. (2018) relied on a sample of 52 firms) and our interpretations account for the necessary analysis of statistical power (e.g. Hair et al. 2017; Laguir, Stekelorum, and El Baz; Rampasso et al. 2019).
2. This response rate is acceptable and reported response rates for PLS-SEM studies published in this journal include, for example, 19.1% (Rampasso et al. 2019), 11.6% (Laguir, Stekelorum, and El Baz 2021), and 11.3% (Hadid 2019).

Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

Abou-Foul, M., J. L. Ruiz-Alba, and P. J. López-Tenorio. 2023. "The Impact of Artificial Intelligence Capabilities on Servitization: The Moderating Role of Absorptive capacity-A Dynamic Capabilities Perspective." *Journal of Business Research* 157: 113609. https://doi.org/10.1016/j.jbusres.2022.113609.

Adler, P. S., B. Goldoftas, and D. I. Levine. 1999. "Flexibility versus Efficiency? A Case Study of Model Changeovers in the Toyota Production System." *Organization Science* 10 (1): 43–68. https://doi.org/10.1287/orsc.10.1.43.

Ahire, S. L., and P. Dreyfus. 2000. "The Impact of Design Management and Process Management on Quality: An Empirical Investigation." *Journal of Operations Management* 18 (5): 549–575. https://doi.org/10.1016/S0272-6963(00)00029-2.

Akter, S., S. Fosso Wamba, and S. Dewan. 2017. "Why PLSSEM is Suitable for Complex Modelling? An Empirical Illustration in Big Data Analytics Quality." *Production Planning & Control* 28 (11-12): 1011–1021. https://doi.org/10.1080/09537287.2016.1267411.

Alghisi, A., and N. Saccani. 2015. "Internal and External Alignment in the Servitization Journey – Overcoming the Challenges." *Production Planning & Control* 26 (14-15): 1219–1232. https://doi.org/10.1080/09537287.2015.1033496.

Allmendinger, G., and R. Lombreglia. 2005. "Four Strategies for the Age of Smart Services." *Harvard Business Review* 83 (10): 131–134, 136, 138 passim.

Ambrosini, V., and C. Bowman. 2001. "Tacit Knowledge: Some Suggestions for Operationalization." *Journal of Management Studies* 38 (6): 811–829. https://doi.org/10.1111/1467-6486.00260.

Auguste, B. G., E. P. Harmon, and V. Pandit. 2006. "The Right Service Strategies for Product Companies." *McKinsey Quarterly* 1: 41–51.

Ayala, N. F., C. A. Paslauski, A. Ghezzi, and A. G. Frank. 2017. "Knowledge Sharing Dynamics in Service Suppliers' Involvement for Servitization of Manufacturing Companies." *International Journal of Production Economics* 193: 538–553. https://doi.org/10.1016/j.ijpe.2017.08.019.

Baines, T., A. Z. Bigdeli, R. Sousa, and A. Schroeder. 2020. "Framing the Servitization Transformation Process: A Model to Understand and Facilitate the Servitization Journey." *International Journal of Production Economics* 221: 107463. https://doi.org/10.1016/j.ijpe.2019.07.036.

Baines, T., and V. G. Shi. 2015. "A Delphi Study to Explore the Adoption of Servitization in UK Companies." *Production Planning & Control* 26 (14-15): 1171–1187. https://doi.org/10.1080/09537287.2015.1033490.

Barney, J. 1991. "Firm Resources and Sustained Competitive Advantage." *Journal of Management* 17 (1): 99–120. https://doi.org/10.1177/014920639101700108.

Barreto, I. 2010. "Dynamic Capabilities: A Review of past Research and an Agenda for the Future." *Journal of Management* 36 (1): 256–280. https://doi.org/10.1177/0149206309350776.

Benner, M. 2009. "Dynamic or Static Capabilities? Process Management Practices and Response to Technological Change." *Journal of Product Innovation Management* 26 (5): 473–486. https://doi.org/10.1111/j.1540-5885.2009.00675.x.

Benner, M. J., and M. L. Tushman. 2002. "Process Management and Technological Innovation: A Longitudinal Study of the Photography and Paint Industries." *Administrative Science Quarterly* 47 (4): 676–707. https://doi.org/10.2307/3094913.

Benner, M. J., and M. L. Tushman. 2003. "Exploitation, Exploration and Process Management: The Productivity Dilemma Revisited." *The Academy of Management Review* 28 (2): 238–256. https://doi.org/10.2307/30040711.

Bettis, R. A., and C. K. Prahalad. 1995. "The Dominant Logic: Retrospective and Extension." *Strategic Management Journal* 16 (1): 5–14. https://doi.org/10.1002/smj.4250160104.

Biege, S., G. Lay, and D. Buschak. 2012. "Mapping Service Processes in Manufacturing Companies: industrial Service Blueprinting." *International Journal of Operations & Production Management* 32 (8): 932–957. https://doi.org/10.1108/01443571211253137.

Bititci, U. S., F. Ackermann, A. Ates, J. D. Davies, S. Gibb, J. MacBryde, D. Mackay, C. Maguire, R. van der Meer, and F. Shafti. 2011. "Managerial Processes: An Operations Management Perspective towards Dynamic Capabilities." *Production Planning & Control* 22 (2): 157–173. https://doi.org/10.1080/09537281003738860.

Brax, S. 2005. "A Manufacturer Becoming Service provider - Challenges and a Paradox." *Managing Service Quality: An International Journal* 15 (2): 142–155. https://doi.org/10.1108/09604520510585334.

Calabrese, A., N. L. Ghiron, L. Tiburzi, T. Baines, and A. Z. Bigdeli. 2019. "The Measurement of Degree of Servitization: literature Review and Recommendations." *Production Planning & Control* 30 (13): 1118–1135. https://doi.org/10.1080/09537287.2019.1592260.

Carme, M.-C., M. Mas-Machuca, E. Benedito, and A. Corominas. 2014. "A Review of Mathematical Programming Models for Strategic Capacity Planning in Manufacturing." *International Journal of Production Economics* 153 (7): 66–85. https://doi.org/10.1016/j.ijpe.2014.03.011.

Casson, M., and N. Wadeson. 2007. "Entrepreneurship and Macroeconomic Performance." *Strategic Entrepreneurship Journal* 1 (3-4): 239–262. https://doi.org/10.1002/sej.35.

Cepeda, G., and D. Vera. 2007. "Dynamic Capabilities and Operational Capabilities: A Knowledge Management Perspective." *Journal of Business Research* 60 (5): 426–437. https://doi.org/10.1016/j.jbusres.2007.01.013.

Cepeda-Carrion, G., J. G. Cegarra-Navarro, and V. Cillo. 2019. "Tips to Use Partial Least Squares Structural Equation Modelling (PLS-SEM) in Knowledge Management." *Journal of Knowledge Management* 23 (1): 67–89. https://doi.org/10.1108/JKM-05-2018-0322.

Cole, R. E., and T. Matsumiya. 2008. "When the Pursuit of Quality Risks Innovation." *The TQM Journal* 20 (2): 130–142. https://doi.org/10.1108/17542730810857363.

Coreynen, W., J. Vanderstraeten, A. van Witteloostuijn, N. Cannaerts, E. Loots, and H. Slabbinck. 2020. "What Drives Product-Service Integration? An Abductive Study of Decision-Makers' Motives and Value Strategies." *Journal of Business Research* 117: 189–200. https://doi.org/10.1016/j.jbusres.2020.05.058.

Cusumano, M. A., S. J. Kahl, and F. F. Suarez. 2015. "Services, Industry Evolution, and the Competitive Strategies of Product Firms." *Strategic Management Journal* 36 (4): 559–575. https://doi.org/10.1002/smj.2235.

Dahlgaard, J. J., L. Reyes, C. K. Chen, and S. M. Dahlgaard-Park. 2019. "Evolution and Future of Total Quality Management: management Control and Organisational Learning." *Total Quality Management & Business Excellence* 30 (sup1): S1–S16. https://doi.org/10.1080/14783363.2019.1665776.

Datta, P., and R. Roy. 2011. "Operations Strategy for the Effective Delivery of Integrated Industrial Product-Service Offerings: two Exploratory Defence Industry Case Studies." *International Journal of Operations & Production Management* 31 (5): 579–603. https://doi.org/10.1108/01443571111126337.

Davies, A., T. Brady, and M. Hobday. 2006. "Charting a Path towards Integrated Solutions." *MIT Sloan Management Review* 47 (3): 39–48.

Diamantopoulos, A., and H. Winklhofer. 2001. "Index Construction with Formative Indicators: An Alternative to Scale Development." *Journal of Marketing Research* 38 (2): 269–277. https://doi.org/10.1509/jmkr.38.2.269.18845.

Ding, B., X. Ferràs Hernández, and N. Agell Jané. 2023. "Combining Lean and Agile Manufacturing Competitive Advantages through Industry 4.0 Technologies: An Integrative Approach." *Production Planning & Control* 34 (5): 442–458. https://doi.org/10.1080/09537287.2021.1934587.

Dmitrijeva, J., A. Schroeder, A. Ziaee Bigdeli, and T. Baines. 2020. "Context Matters: how Internal and External Factors Impact Servitization." *Production Planning & Control* 31 (13): 1077–1097. https://doi.org/10.1080/09537287.2019.1699195.

Douglas, T. J., and W. Q. Judge. Jr, 2001. "Total Quality Management Implementation and Competitive Advantage: The Role of Structural Control and Exploration." *Academy of Management Journal* 44 (1): 158–169. https://doi.org/10.2307/3069343.

Doz, Y. 2020. "Fostering Strategic Agility: How Individual Executives and Human Resource Practices Contribute." *Human Resource Management Review* 30 (1): 100693. https://doi.org/10.1016/j.hrmr.2019.100693.

Dubois, A., and L.-E. Gadde. 2002. "Systematic Combining: An Abductive Approach to Case Research." *Journal of Business Research* 55 (7): 553–560. https://doi.org/10.1016/S0148-2963(00)00195-8.

Dwaikat, N. Y., A. H. Money, H. M. Behashti, and E. Salehi-Sangari. 2018. "How Does Information Sharing Affect First-Tier Suppliers' Flexibility? Evidence from the Automotive Industry in Sweden." *Production Planning & Control* 29 (4): 289–300. https://doi.org/10.1080/09537287.2017.1420261.

Eggers, J. P., and S. Kaplan. 2013. "Cognition and Capabilities: A Multi-Level Perspective." *Academy of Management Annals* 7 (1): 295–340. https://doi.org/10.5465/19416520.2013.769318.

Eisenhardt, K. M., and J. A. Martin. 2000. "Dynamic Capabilities: What Are They?" *Strategic Management Journal* 21 (10-11): 1105–1121. https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E.

Eisenhardt, K. M., and M. E. Graebner. 2007. "Theory Building from Cases: Opportunities and Challenges." *Academy of Management Journal* 50 (1): 25–32. https://doi.org/10.5465/amj.2007.24160888.

Eisenhardt, K. M., N. R. Furr, and C. B. Bingham. 2010. "CROSSROADS—Microfoundations of Performance: balancing Efficiency and Flexibility in Dynamic Environments." *Organization Science* 21 (6): 1263–1273. https://doi.org/10.1287/orsc.1100.0564.

El Manzani, Y., M. El Idrissi, R. Chouchane, M. Sony, and J. Antony. 2024. "A Meta-Analysis of the Relationship between Quality Management and Innovation in Small and Medium-Sized Enterprises." *Production Planning & Control:* 1–20. https://doi.org/10.1080/09537287.2024.2321284.

Fernandes, A. A., L. A. Lourenço, and M. J. Silva. 2014. "Influence of Quality Management on the Innovative Performance." *Review of Business Management* 16 (53): 575–593.

Fischer, T., H. Gebauer, M. Gregory, G.-J. Ren, and E. Fleisch. 2010. "Exploitation or Exploration in Service Business Development?" *Journal of Service Management* 21 (5): 591–624. https://doi.org/10.1108/09564231011079066.

Fosso Wamba, S., and M. M. Queiroz. 2022. "Industry 4.0 and the Supply Chain Digitalisation: A Blockchain Diffusion Perspective." *Production Planning & Control* 33 (2-3): 193–210. https://doi.org/10.1080/09537287.2020.1810756.

Foster, S. T. 2006. "One Size Does Not Fit All." *Quality Progress* 39 (7): 54–61.

Galbraith, J. 2002. "Organizing to Deliver Solutions." *Organizational Dynamics* 31 (2): 194–207. https://doi.org/10.1016/S0090-2616(02)00101-8.

Gebauer, H., E. Fleisch, and T. Friedli. 2005. "Overcoming the Service Paradox in Manufacturing Companies." *European Management Journal* 23 (1): 14–26. https://doi.org/10.1016/j.emj.2004.12.006.

Gebauer, H., G. J. Ren, A. Valtakoski, and J. Reynoso. 2012. "Service-Driven Manufacturing: Provision, Evolution and Financial Impact of Services in Industrial Firms." *Journal of Service Management* 23 (1): 120–136. https://doi.org/10.1108/09564231211209005.

Gebauer, H., M. Paiola, and B. Edvardsson. 2010. "Service Business Development in Small and Medium Capital Goods Manufacturing Companies." *Managing Service Quality: An International Journal* 20 (2): 123–139. https://doi.org/10.1108/09604521011027561.

Gebauer, H., M. Paiola, and B. Edvardsson. 2012. "A Capability Perspective on Service Business Development in Small and Medium-Sized Suppliers." *Scandinavian Journal of Management* 28 (4): 321–339. https://doi.org/10.1016/j.scaman.2012.07.001.

Gelhard, C., S. von Delft, and S. Gudergan. 2016. "Heterogeneity in Dynamic Capability Configurations: Equifinality and Strategic Performance." *Journal of Business Research* 69 (11): 5272–5279. https://doi.org/10.1016/j.jbusres.2016.04.124.

Gif, C. A., M. D. Rodriguez, B. Gangula, A. V. Roth, and T. Hanley. 2016. "*2016 Global Manufacturing Competitiveness Index*." Council on Competitiveness and Deloitte Touche Tohmatsu Limited (DTTL): 17.

Goswami, M., and Y. Daultani. 2023. "Product Quality Optimization vs Production Capacity Optimization: An Analytical Perspective." *International Journal of Quality & Reliability Management* 40 (3): 801–819. forthcoming. https://doi.org/10.1108/IJQRM-10-2021-0364.

Grant, R. M. 1996. "Toward a Knowledge-Based Theory of the Firm." *Strategic Management Journal* 17 (S2): 109–122. https://doi.org/10.1002/smj.4250171110.

Gudergan, S. P., C. M. Ringle, S. Wende, and A. Will. 2008. "Confirmatory Tetrad Analysis in PLS Path Modeling." *Journal of Business Research* 61 (12): 1238–1249. https://doi.org/10.1016/j.jbusres.2008.01.012.

Hadid, W. 2019. "Lean Service, Business Strategy and ABC and Their Impact on Firm Performance." *Production Planning & Control* 30 (14): 1203–1217. https://doi.org/10.1080/09537287.2019.1599146.

Hair, J. F., G. T. M. Hult, C. M. Ringle, and M. Sarstedt. 2017. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 2nd ed. Thousand Oaks, CA: Sage.

Hair, J. F., M. Sarstedt, C. M. Ringle, and S. P. Gudergan. 2023. *Advanced Issues in Partial Least Squares Structural Equation Modeling*, 2nd ed. Thousand Oaks, CA: Sage.

Hair, J. F., W. C. Black, B. J. Babin, R. E. Anderson, and R. L. Tatham. 2006. *Multivariate Data Analysis*. Upper Saddle River, NJ: Pearson Prentice Hall.

Haridy, S., U. Ojiako, A. Maged, M. Al Remeithi, H. Bashir, and M. Shamsuzzaman. 2024. "Quality Process Control and Resourcing in Manufacturing Firms." *Production Planning & Control* 35 (14): 1821–1843. https://doi.org/10.1080/09537287.2023.2214109.

Helfat, C. E., S. Finkelstein, W. Mitchell, M. Peteraf, H. Singh, D. J. Teece, and S. G. Winter. 2007. *Dynamic Capabilities: Understanding Strategic Change in Organizations*. Malden, MA: Blackwell Publishing.

Henseler, J., C. M. Ringle, and M. Sarstedt. 2015. "A New Criterion for Assessing Discriminant Validity in Variance-Based Structural Equation Modeling." *Journal of the Academy of Marketing Science* 43 (1): 115–135. https://doi.org/10.1007/s11747-014-0403-8.

Holgado, M., and M. Macchi. 2023. "A Value-Driven Method for the Design of Performance-Based Services for Manufacturing Equipment." *Production Planning & Control* 34 (14): 1316–1332. https://doi.org/10.1080/09537287.2021.2008129.

Huikkola, T., R. Rabetino, M. Kohtamäki, and H. Gebauer. 2020. "Firm Boundaries in Servitization: Interplay and Repositioning Practices." *Industrial Marketing Management* 90: 90–105. https://doi.org/10.1016/j.indmarman.2020.06.014.

Hulland, J. 1999. "Use of Partial Least Squares (PLS) in Strategic Management Research: A Review of Recent Studies." *Strategic Management Journal* 20 (2): 195–204. https://doi.org/10.1002/(SICI)1097-0266(199902)20:2<195::AID-SMJ13>3.0.CO;2-7.

Jaakkola, E., and A. Hallin. 2018. "Organizational Structures for New Service Development." *Journal of Product Innovation Management* 35 (2): 280–297. https://doi.org/10.1111/jpim.12399.

Khanra, S., A. Dhir, V. Parida, and M. Kohtamäki. 2021. "Servitization Research: A Review and Bibliometric Analysis of past Achievements and Future Promises." *Journal of Business Research* 131: 151–166. https://doi.org/10.1016/j.jbusres.2021.03.056.

Kindström, D., and C. Kowalkowski. 2009. "Development of Industrial Service Offerings: process Framework." *Journal of Service Management* 20 (2): 156–172. https://doi.org/10.1108/09564230910952753.

Kindström, D., and C. Kowalkowski. 2014. "Service Innovation in Product-Centric Firms: A Multidimensional Business Model Perspective." *Journal of Business & Industrial Marketing* 29 (2): 96–111. https://doi.org/10.1108/JBIM-08-2013-0165.

Kindström, D., C. Kowalkowski, and E. Sandberg. 2013. "Enabling Service Innovation: A Dynamic Capabilities Approach." *Journal of Business Research* 66 (8): 1063–1073. https://doi.org/10.1016/j.jbusres.2012.03.003.

Kindström, Daniel. 2010. "Towards a Service-Based Business Model—Key Aspects for Future Competitive Advantage." *European Management Journal* 28 (6): 479–490. https://doi.org/10.1016/j.emj.2010.07.002.

Klag, M., and A. Langley. 2023. "When Everything Interacts with Everything Else: Intervening in Messes." *Academy of Management Perspectives* 37 (1): 37–54. https://doi.org/10.5465/amp.2020.0159.

Kohtamäki, M., S. Einola, and R. Rabetino. 2020. "Exploring Servitization through the Paradox Lens: Coping Practices in Servitization." *International Journal of Production Economics* 226: 107619. https://doi.org/10.1016/j.ijpe.2020.107619.

Kohtamaki, M., H. Hakala, J. Partanen, V. Parida, and J. Wincent. 2015. "The performance impact of industrial services and service orientation on manufacturing companies." *Journal of Service Theory and Practice* 25 (4): 463–485. https://doi.org/10.1108/JSTP-12-2013-0288.

Kowalkowski, C., D. Kindström, and L. Witell. 2011. "Internalisation or Externalisation? Examining Organisational Arrangements for Industrial Services." *Managing Service Quality: An International Journal* 21 (4): 373–391. https://doi.org/10.1108/09604521111146252.

Kowalkowski, C., D. Kindström, T. Brashear-Alejandro, S. Brege, and S. Biggemann. 2012. "Service Infusion as Agile Incrementalism in Action." *Journal of Business Research* 65 (6): 765–772. https://doi.org/10.1016/j.jbusres.2010.12.014.

Kreye, M. E., J. K. Roehrich, and M. A. Lewis. 2015. "Servitising Manufacturers: The Impact of Service Complexity and Contractual and Relational Capabilities." *Production Planning & Control* 26 (14-15): 1233–1246. https://doi.org/10.1080/09537287.2015.1033489.

Kurtz, J., P. Meyer, and A. Roth. 2023. "Decoding the Context of Servitization: socio-Technical Pivots on the Journey to Service-Oriented Business Models in Manufacturing Firms." *Production Planning & Control* 36 (3): 267–284. https://doi.org/10.1080/09537287.2023.2261880.

Laguir, I., R. Stekelorum, and J. El Baz. 2021. "Going Green? Investigating the Relationships between Proactive Environmental Strategy, GSCM Practices and Performances of Third-Party Logistics Providers (TPLs)." *Production Planning & Control* 32 (13): 1049–1062. https://doi.org/10.1080/09537287.2020.1784483.

Lavie, D. 2006. "Capability Reconfiguration: An Analysis of Incumbent Responses to Technological Change." *Academy of Management Review* 31 (1): 153–174. https://doi.org/10.5465/amr.2006.19379629.

Lewis, M. W., C. Andriopoulos, and W. K. Smith. 2014. "Paradoxical Leadership to Enable Strategic Agility." *California Management Review* 56 (3): 58–77. https://doi.org/10.1525/cmr.2014.56.3.58.

Leyer, M., M. Reus, and J. Moormann. 2021. "How Satisfied Are Employees with Lean Environments?" *Production Planning & Control* 32 (1): 52–62. https://doi.org/10.1080/09537287.2020.1711981.

Li, D., J. Lin, W. Cui, and Y. Qian. 2018. "The Trade-off between Knowledge Exploration and Exploitation in Technological Innovation." *Journal of Knowledge Management* 22 (4): 781–801. https://doi.org/10.1108/JKM-09-2016-0401.

Liao, Y.-Y., E. Soltani, and A. Wilkinson. 2023. "From Product to Service Quality: The Role of Managerial Mindsets." *Production Planning & Control* 34 (8): 705–726. https://doi.org/10.1080/09537287.2021.1957173.

Lightfoot, H. W., and H. Gebauer. 2011. "Exploring the Alignment between Service Strategy and Service Innovation." *Journal of Service Management* 22 (5): 664–683. https://doi.org/10.1108/095642311 11175004.

Lu, Y., X. Xu, and L. Wang. 2020. "Smart Manufacturing Process and System Automation–a Critical Review of the Standards and Envisioned Scenarios." *Journal of Manufacturing Systems* 56: 312–325. https://doi.org/10.1016/j.jmsy.2020.06.010.

Lusch, R. F., and S. L. Vargo. 2006. "Service-Dominant Logic: reactions, Reflections and Refinements." *Marketing Theory* 6 (3): 281–288. https://doi.org/10.1177/1470593106066781.

Lütjen, H., F. Tietze, and C. Schultz. 2017. "Service Transitions of Product-Centric Firms: An Explorative Study of Service Transition Stages and Barriers in Germany's Energy Market." *International Journal of Production Economics* 192: 106–119. https://doi.org/10.1016/j.ijpe.2017.03.021.

Madhavaram, S., and S. D. Hunt. 2008. "The Service-Dominant Logic and a Hierarchy of Operant Resources: developing Masterful Operant Resources and Implications for Marketing Strategy." *Journal of the Academy of Marketing Science* 36 (1): 67–82. https://doi.org/10.1007/s11747-007-0063-z.

Makadok, R., R. Burton, and J. Barney. 2018. "A Practical Guide for Making Theory Contributions in Strategic Management." *Strategic Management Journal* 39 (6): 1530–1545. https://doi.org/10.1002/smj.2789.

March, J. G. 1991. "Exploration and Exploitation in Organizational Learning." *Organization Science* 2 (1): 71–87. https://doi.org/10.1287/orsc.2.1.71.

Mele, C., M. Colurcio, and T. Russo-Spena. 2014. "Research Traditions of Innovation: Goods-Dominant Logic, the Resource-Based Approach, and Service-Dominant Logic." *Managing Service Quality* 24 (6): 612–642. https://doi.org/10.1108/MSQ-10-2013-0223.

Nair, A. 2006. "Meta-Analysis of the Relationship between Quality Management Practices and Firm Performance—Implications for Quality Management Theory Development." *Journal of Operations Management* 24 (6): 948–975. https://doi.org/10.1016/j.jom.2005.11.005.

Ning, Y., and S. Gao. 2021. "A Resilience Framework to Explorative Quality Management in Innovative Building Projects." *Journal of Engineering and Technology Management* 62: 101654. https://doi.org/10.1016/j.jengtecman.2021.101654.

Öhman, M., M. Finne, and J. Holmström. 2015. "Measuring Service Outcomes for Adaptive Preventive Maintenance." *International Journal of Production Economics* 170 (Part B): 457–467. https://doi.org/10.1016/j.ijpe.2015.06.020.

Oliva, R., and R. Kallenberg. 2003. "Managing the Transition from Products to Services." *International Journal of Service Industry Management* 14 (2): 160–172. https://doi.org/10.1108/09564230310474138.

Peillon, S., C. Pellegrin, and P. Burlat. 2015. "Exploring the Servitization Path: A Conceptual Framework and a Case Study from the Capital Goods Industry." *Production Planning & Control* 26 (14-15): 1264–1277. https://doi.org/10.1080/09537287.2015.1033492.

Peng, D. X., R. G. Schroeder, and R. Shah. 2008. "Linking Routines to Operations Capabilities: A New Perspective." *Journal of Operations Management* 26 (6): 730–748. https://doi.org/10.1016/j.jom.2007.11.001.

Qamar, A., M. A. Hall, D. Chicksand, and S. Collinson. 2020. "Quality and Flexibility Performance Trade-Offs between Lean and Agile Manufacturing Firms in the Automotive Industry." *Production Planning & Control* 31 (9): 723–738. https://doi.org/10.1080/09537287.2019.1681534.

Queiroz, S. A. B., G. H. S. Mendes, J. H. O. Silva, G. M. D. Ganga, P. A. Cauchick Miguel, and M. G. Oliveira. 2020. "Servitization and Performance: impacts on Small and Medium Enterprises." *Journal of Business & Industrial Marketing* 35 (7): 1237–1249. https://doi.org/10.1108/JBIM-06-2019-0277.

Rabetino, R., M. Kohtamäki, S. A. Brax, and J. Sihvonen. 2021. "The Tribes in the Field of Servitization: Discovering Latent Streams across 30 Years of Research." *Industrial Marketing Management* 95: 70–84. https://doi.org/10.1016/j.indmarman.2021.04.005.

Rabetino, R., W. Harmsen, M. Kohtamäki, and J. Sihvonen. 2018. "Structuring Servitization-Related Research." *International Journal of Operations & Production Management* 38 (2): 350–371. https://doi.org/10.1108/IJOPM-03-2017-0175.

Raddats, C., J. Burton, and R. Ashman. 2015. "Resource Configurations for Services Success in Manufacturing Companies." *Journal of Service Management* 26 (1): 97–116. https://doi.org/10.1108/JOSM-12-2012-0278.

Rahman, M., M. A. Hossain, F. Abdel Fattah, and S. Akter. 2020. "Optimizing Competitive Performance of Service Firms in Data-Rich Environment." *Journal of Service Theory and Practice* 30 (6): 681–706. https://doi.org/10.1108/JSTP-04-2020-0077.

Rampasso, I. S., R. Anholon, D. da Silva, R. E. C. Ordóñez, and O. L. G. Quelhas. 2019. "Maturity Analysis of Manufacturing Cells." *Production Planning & Control* 30 (15): 1250–1264. https://doi.org/10.1080/09537287.2019.1612108.

Randhawa, K., R. Wilden, and S. Gudergan. 2021. "How to Innovate toward an Ambidextrous Business Model? The Role of Dynamic Capabilities and Market Orientation." *Journal of Business Research* 130: 618–634. https://doi.org/10.1016/j.jbusres.2020.05.046.

Ratnadeep, P., and S. Anand. 2015. "Optimization of Layered Manufacturing Process for Reducing Form Errors with Minimal Support Structures." *Journal of Manufacturing Systems* 36 (2): 231–243. https://doi.org/10.1016/j.jmsy.2014.06.014.

Richter, N. F., S. Hauff, C. M. Ringle, and S. Gudergan. 2022. "The Use of Partial Least Squares Structural Equation Modeling and Complementary Methods in International Management Research." *Management International Review* 62 (4): 449–470. https://doi.org/10.1007/s11575-022-00475-0.

Ringle, C. M., S. Wende, and J.-M. Becker. 2015. *SmartPLS 3*. Bönningstedt: SmartPLS.

Salonen, A., O. Saglam, and F. Hacklin. 2017. "Servitization as Reinforcement, Not Transformation." *Journal of Service Management* 28 (4): 662–686. https://doi.org/10.1108/JOSM-05-2016-0121.

Samson, D., and M. Terziovski. 1999. "The Relationship between Total Quality Management Practices and Operational Performance." *Journal of Operations Management* 17 (4): 393–409. https://doi.org/10.1016/S0272-6963(98)00046-1.

Shah, R., and P. T. Ward. 2007. "Defining and Developing Measures of Lean Production." *Journal of Operations Management* 25 (4): 785–805. https://doi.org/10.1016/j.jom.2007.01.019.

Shen, B., and C. Chen. 2020. "Quality Management in Outsourced Global Fashion Supply Chains: An Exploratory Case Study." *Production Planning & Control* 31 (9): 757–769. https://doi.org/10.1080/09537287.2019.1683774.

Skålén, P., J. Gummerus, C. Von Koskull, and P. R. Magnusson. 2015. "Exploring Value Propositions and Service Innovation: A Service-Dominant Logic Study." *Journal of the Academy of Marketing Science* 43 (2): 137–158. https://doi.org/10.1007/s11747-013-0365-2.

Soltani, E., B. Barnes, J. Syed, and Y.-Y. Liao. 2012. "Does Management's Approach Impede Service Quality?" *Production Planning & Control* 23 (7): 523–540. https://doi.org/10.1080/09537287.2011.640041.

Sousa, R., and C. A. Voss. 2008. "Contingency Research in Operations Management Practices." *Journal of Operations Management* 26 (6): 697–713. https://doi.org/10.1016/j.jom.2008.06.001.

Storbacka, K. 2011. "A Solution Business Model: capabilities and Management Practices for Integrated Solutions." *Industrial Marketing Management* 40 (5): 699–711. https://doi.org/10.1016/j.indmarman.2011.05.003.

Storbacka, K., C. Windahl, S. Nenonen, and A. Salonen. 2013. "Solution Business Models: Transformation along Four Continua." *Industrial Marketing Management* 42 (5): 705–716. https://doi.org/10.1016/j.indmarman.2013.05.008.

Strandvik, T., M. Holmlund, and B. Edvardsson. 2012. "Customer Needings: A Challenge for the Seller Offering." *Journal of Business & Industrial Marketing* 27 (2): 132–141. https://doi.org/10.1108/08858621211196994.

Suddaby, R., D. Coraiola, C. Harvey, and W. Foster. 2020. "History and the Micro – Foundations of Dynamic Capabilities." *Strategic Management Journal* 41 (3): 530–556. https://doi.org/10.1002/smj.3058.

Swink, M., and W. H. Hegarty. 1998. "Core Manufacturing Capabilities and Their Links to Product Differentiation." *International Journal of Operations & Production Management* 18 (4): 374–396. https://doi.org/10.1108/01443579810199748.

Szulanski, G. 1996. "Exploring Internal Stickiness: Impediments to the Transfer of Best Practice within the Firm." *Strategic Management Journal* 17 (S2): 27–43. https://doi.org/10.1002/smj.4250171105.

Teece, D. J. 2007. "Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance." *Strategic Management Journal* 28 (13): 1319–1350. https://doi.org/10.1002/smj.640.

Teece, D. J. 2023. "Big Tech and Strategic Management: How Management Scholars Can Inform Competition Policy." *Academy of Management Perspectives* 37 (1): 1–15. https://doi.org/10.5465/amp.2022.0013.

Trentin, A., C. Forza, and E. Perin. 2015. "Embeddedness and Path Dependence of Organizational Capabilities for Mass Customization and Green Management: A Longitudinal Case Study in the Machinery Industry." *International Journal of Production Economics* 169 (11): 253–276. https://doi.org/10.1016/j.ijpe.2015.08.011.

Tuli, K. R., A. K. Kohli, and S. G. Bharadwaj. 2007. "Rethinking Customer Solutions: From Product Bundles to Relational Processes." *Journal of Marketing* 71 (3): 1–17. https://doi.org/10.1509/jmkg.71.3.001.

Ulaga, W., and W. J. Reinartz. 2011. "Hybrid Offerings: how Manufacturing Firms Combine Goods and Services Successfully." *Journal of Marketing* 75 (6): 5–23. https://doi.org/10.1509/jmkg.75.6.5.

Valtakoski, A. 2017. "Explaining Servitization Failure and Deservitization: A Knowledge-Based Perspective." *Industrial Marketing Management* 60: 138–150. https://doi.org/10.1016/j.indmarman.2016.04.009.

Vendrell-Herrero, F., Y. Vaillant, O. F. Bustinza, and E. Lafuente. 2022. "Product Lifespan: The Missing Link in Servitization." *Production Planning & Control* 33 (14): 1372–1388. https://doi.org/10.1080/09537287.2020.1867773.

West, S., P. Gaiardelli, and N. Saccani. 2022. Modern Industrial Services, Springer Texts in Business and Economics, Springer, number 978-3-030-80511-1, December.

Wieland, H., N. N. Hartmann, and S. L. Vargo. 2017. "Business Models as Service Strategy." *Journal of the Academy of Marketing Science* 45 (6): 925–943. https://doi.org/10.1007/s11747-017-0531-z.

Wilden, R., and S. Gudergan. 2017. "Service-Dominant Orientation, Dynamic Capabilities and Firm Performance." *Journal of Service Theory and Practice* 27 (4): 808–832. https://doi.org/10.1108/JSTP-04-2016-0077.

Wilden, R., S. Gudergan, M. A. Akaka, A. Averdung, and T. Teichert. 2019. "The Role of Cocreation and Dynamic Capabilities in Service Provision and Performance: A Configurational Study." *Industrial Marketing Management* 78: 43–57. https://doi.org/10.1016/j.indmarman.2018.06.008.

Wilden, R., S. P. Gudergan, B. B. Nielsen, and I. Lings. 2013. "Dynamic Capabilities and Performance: Strategy, Structure and Environment." *Long Range Planning* 46 (1-2): 72–96. https://doi.org/10.1016/j.lrp.2012.12.001.

Witell, L., and M. Löfgren. 2013. "From Service for Free to Service for Fee: business Model Innovation in Manufacturing Firms." *Journal of Service Management* 24 (5): 520–533. https://doi.org/10.1108/JOSM-04-2013-0103.

Zatzick, C. D., T. P. Moliterno, and T. Fang. 2012. "Strategic (MIS) FIT: The Implementation of TQM in Manufacturing Organizations." *Strategic Management Journal* 33 (11): 1321–1330. https://doi.org/10.1002/smj.1988.

Zhang, D., K. Linderman, and R. Schroeder. 2012. "The Moderating Role of Contextual Factors on Quality Management Practices." *Journal of Operations Management* 30 (1-2): 12–23. https://doi.org/10.1016/j.jom.2011.05.001.

Zhang, W., and S. Banerji. 2017. "Challenges of Servitization: A Systematic Literature Review." *Industrial Marketing Management* 65: 217–227. https://doi.org/10.1016/j.indmarman.2017.06.003.