

COLLABORATIVE VALUE ARCHITECTURES: UNCOVERING APPROACHES FOR PRODUCT-SERVICE SYSTEM DELIVERY

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ABSTRACT

Purpose: This study examines the value architectures that product manufacturers and dealers adopt to deliver solutions to customers.

Design/Methodology/Approach: We used a qualitative research approach consisting of exploratory case studies and an in-depth single-case study to uncover relevant value architecture for delivering solutions to customers.

Findings: The findings revealed that changes in customer activities open up opportunities for moving toward a solution business. Product manufacturers and/or dealers favour collaborative value architectures for customer solutions. In detail, we identified three value architectures for delivering solutions to customers: (i) integration-oriented, (ii) usage-oriented, and (iii) close-the-loop-oriented architectures.

Originality/Value:

Each architecture responds to changing customer activities, corresponds with certain solution offerings (e.g., product, service, and software components), and requires specific allocation of value creation activities along the solution process between product manufacturers and their dealers. Interestingly, these manufacturers and dealers have not yet converged on a single solution-oriented value architecture but embrace multiple versions of these architectures. These findings extend the previous literature about solution business and offer new insights for academics and professionals into the neglected field of providing solutions with partners in an ecosystem.

KEYWORDS: PSS, value architectures, solution business, dealer network, servitization

1. INTRODUCTION

Product manufacturers struggle to adopt service-oriented business models, and returns on investment are mixed. Sustainability, productivity, and digitalisation not only cause customers to change their solution requirements but also demand the continuous adaption of product manufacturers' value architectures (Adner, 2021).

Literature on product manufacturers evolving into solution providers identifies two gaps. First, most studies adopt a provider-centric view, overlooking customer activities as triggers for product-service systems (PSS) delivery. Despite emphasising customer centricity, few studies use customer data to understand how their activities influence solution delivery (e.g., Petri & Jacob, 2016). Second, existing theories often assume direct solution delivery from the product manufacturers to end customers, neglecting the role of business ecosystems (e.g., (Frandsen et al., 2022; Gebauer et al., 2013).

This study examines the value architectures that product manufacturers and dealers adopt to deliver solutions to customers. We applied a qualitative research approach consisting of exploratory case studies and an in-depth single-case study to uncover relevant value architectures for delivering customer solutions. The findings revealed that changes in customer activities open up opportunities for moving toward a solution business. Product manufacturers and dealers favour collaborative value architectures for delivering solutions to customers. These findings extend the previous literature on solution business and the delivery of product-service systems and offer new insights for academics and professionals into the neglected field of providing solutions with partners in an ecosystem. The remainder of this paper is organised as follows: The next section reviews the literature linking customer activities, solutions, and value architectures. Section 3 describes the research process and

methodology. Section 4 presents the results. The article concludes with a discussion of the study's implications, limitations, and future research opportunities.

2. THEORETICAL BACKGROUND

The presented study synthesises various partly overlapping solution literature streams, such as those focusing on servitization, hybrid offerings, and the solution business (e.g., Raddats et al., 2019; Tuli et al., 2007; Ulaga & Reinartz, 2011). These streams typically focus on three aspects: customer activities (the 'why'), solution offerings (the 'what'), and solution processes (the 'how').

Our research approaches solutions from a “value architecture” perspective. While value architecture has not been consistently detailed in solution contexts, it offers a fresh angle to enhance existing research and address identified gaps. The term value architecture describes “the rationale of how an organisation creates, delivers, and captures value” (Osterwalder & Pigneur, 2010, p. 14). It has been embedded in recent discussions on business models and business model innovations. Business models are argued to consist of various key components, with value proposition, value creation (delivery), and value capture being the three most concise key components (Teece, 2010). Accordingly, business model innovations result from novel changes to these key components of a firm's business model (Foss & Saebi, 2018). The value creation (or delivery) process is one of these key elements and describes how companies meet customer requirements and achieve the desired customer experience (Lepak et al., 2007).

3. RESEARCH METHODOLOGY

The empirical setting was structured around three criteria: (i) a business-to-business context, (ii) industries impacted by increasing digitalisation, productivity, and sustainability demands, and (iii) product manufacturers using dealers for sales. Adopting an inductive qualitative approach, the research comprised two stages: multiple exploratory case studies and a detailed single-case study. This approach, chosen for its conceptual relevance rather than representativeness, was deemed appropriate for examining complex value architectures in solution delivery (Yin, 2003).

The exploratory case study involved in-depth interviews with 35 key decision-makers across various industries, including, among others, agricultural equipment and automotive parts. These interviews, encompassing various industries, company sizes, and product complexities, informed six exploratory case studies on value architectures. We ensured representation from various stakeholders, including product manufacturers, dealers, and solution customers. A particular value architecture was included in the study's results based on its mention by multiple informants, observation across cases, and ability to provide insightful conclusions.

We verified our emerging value architectures through a single-case study in the European construction industry, focusing on a construction device manufacturer, its dealers, and customers. Conducted in three phases from November 2021 to November 2023, the study included, in the first phase, interviews with construction company representatives and field visits to gather strategic and operational insights. The second phase targeted dealers, exploring their responses to solution initiatives. The third phase, which was partly in parallel to phases 1 and 2, involved participation in project meetings, workshops, and access to company archives, offering a comprehensive view of the manufacturer's solution strategies. Data collection across these phases was extensive, utilising interviews, workshops, company documents, and industry publications. This multi-source approach, along with data triangulation, ensured the validity and reliability of the findings. Content analysis, including within- and cross-case analyses and pattern-matching, was employed to ensure the robustness of the data analysis (Beverland & Lindgreen, 2010).

4. FINDINGS

Our findings revealed three solution-oriented value architectures: (i) integration-oriented, (ii) usage-oriented, and (iii) close-the-loop-oriented value architectures. Each value architecture is a specific response to changes in customer activities (“why?”), consists of certain solution offerings (“what?”), Moreover, requires a specific allocation of activities between manufacturers and their dealers during

the solution process (“how?”). We noted a transition from traditional product-centric models to dynamic, solution-oriented architectures across industries. This reflects changing customer needs influenced by productivity, sustainability, and digitalisation demands, leading to diverse solutions and activities within the three identified architectures. This evolution departs from uniform customer needs, signifying a significant value creation and delivery shift.

4.1 Initial product-oriented value architecture

Our research shows that industries were previously entrenched in a stable, product-centric value architecture, focusing on straightforward product purchases and replacements. Dealers facilitated awareness of product updates and availability, while manufacturers informed dealers about new developments and supplied products. This architecture aims at satisfying customer demands for easy purchases, value for money, and support for significant malfunctions, with offerings primarily comprising products and essential services for seamless transactions. The process predominantly concentrated on awareness, with customisation and post-sale support receiving less attention. Activities across different dealer sizes remained consistent, emphasising product awareness, availability, delivery, and replacement, supported by Construction Devices Inc.'s provision of products, parts, and dealer training for reselling to construction companies.

4.2 Solution-oriented value architectures

Our findings indicate early efforts to refine the traditional product-focused value architecture, highlighted by an industry participant's remark: *“We invested in software applications to help dealers to better match their dealer offering with the customer requirements”* (head of service). This investment aims to enhance the alignment of dealer offerings with customer needs. However, adapting to the growing demands for productivity, digitalisation, and sustainability proves challenging. Another participant exemplifies the rapid evolution of customer activities in response to these pressures: *“Our projects are getting larger, more complex, and at the same time, we work under higher cost pressures...with fewer personnel...and new regulations regarding safety and sustainability are also coming into play. We have no other option but to consistently digitise all customer processes to become more productive ultimately.”* (Industry expert) These insights reveal a shift towards examining the reasons customers seek solutions.

Regarding the solution offerings (“what?”), one participant highlighted the following modifications: *“Since products have become a commodity, we need to bundle products with service and software offerings to differentiate ourselves from competitors”* (product manager). Another participant added, *“We can only escape stagnant product prices by offering our customers solutions...that solve customer problems...by enriching our products with services and software applications”* (senior manager).

The corresponding move toward solution offerings initiates a new allocation of activities between product manufacturers and dealers along the solution process (“how?”). Our findings suggest that product manufacturers and dealers favour collaborative allocation of solution delivery activities rather than trying to deliver the solutions themselves. For example, a participant from a product manufacturer highlighted the importance of collaborating with dealers: *“Of course, it would be easier to deliver solutions just by ourselves. But at what costs? That would mean impeding decade-long relationships with our dealers. We need to figure out how to work with dealers in the solution business...because we cannot afford to lose them as partners.”* (Key executive) Another participant stated, *“Selling and delivering solutions ourselves is not an option for us.... Dealers have had a central role for a long time... Their position is simply too strong to bypass them”* (branch manager). Similarly, participants from among dealers and customers argued the following: *“Of course, we need the competencies of product manufacturers to deliver solutions effectively”* (innovation manager) and *“We require both the manufacturer and its dealers to convince us about solutions and to deliver solutions effectively”* (purchase director). This means that solution-oriented value architectures require synchronised collaborative allocation of activities among product manufacturers and their dealers.

Interestingly, such changes in customer activities, solution offerings, and solution processes lead to three solution-oriented value architectures: (1) integration-oriented, (2) usage-oriented, and (3) close-

the-loop-oriented value architectures. Shifting from a purely product-oriented value architecture, these three architectures presented distinct points on a continuum of solution-oriented value architectures. This continuum corresponds with an increasing scope of addressable customer activities for solution providers, an increasing scope of solution offerings, and an increasing coverage of solution processes. Accordingly, each value architecture can be described by our three key aspects and/or questions: (1) changes in customer activities (“Why do customers demand solutions?”), (2) solution offerings (“What product, service, and software elements should be included in the solution offering?”), Moreover, (3) the solution process (“How should product manufacturers and dealers allocate their activities to deliver solutions?”). The following sections explain these key aspects of each value architecture. Space considerations permit us to focus only on the key insights of each value architecture. Table 1 in the appendix illustrates the three value architectures in more detail.

4.2.1 Integration-Oriented Value Architecture

The first solution-oriented value architecture is characterised by a strong integration orientation.

Customer activities: The integration-oriented value architecture caters to customer needs for seamless solution integration into their operations, leveraging the opportunity to deepen understanding of solutions as customers extend and reconfigure their activities. This approach enables solution providers, including manufacturers and dealers, to enhance their core product offerings with additional services and software, aligning closely with customers' actual requirements and daily operations. For example, participants from the construction industries reported rapid changes in construction activities. One participant explained, *“While construction companies previously just looked for high-quality tools at reasonable prices, they now first want to achieve seamless integration of these tools into their own activities”* (product manager). The seamless integration of such construction devices was argued to be the result of *“construction companies looking for more support in administrating, maintaining, and using our devices”* (sales manager).

Solution offerings: Changes in customer requirements initially result in a modest bundle of products, services, and software focused on enhancing customer understanding through education, advice, and consulting. Therefore, solution providers must adapt to customers' evolving information-seeking behaviours by supplementing personal interactions with diverse digital channels and formats for education and consultation.

Solution process: This value architecture focuses on the initial stages of the solution process—awareness, customisation, and integration. Product manufacturers enhance dealers' ability to raise customer awareness and use digital formats like videos, online meetings, and webinars for customer education and consulting. Meanwhile, dealers prioritise personal interactions, supplemented by online communication methods, to educate and advise customers on solutions.

At the same time, product manufacturers and dealers embrace the following activities to improve matching their customer requirements with their solution offerings and integrate them into the customer's operations. First, since dealers were found to struggle to achieve such matches by themselves, they asked product manufacturers for more support. As one participant reported, *“To support the dealer in consulting customers on product accessories...there is, for example, an accessories app. The dealer can enter variables there and receive a prefiltered catalogue with relevant accessories and necessary services”* (head of service). Manufacturers provide dealers with solution configurators to customise product, service, and software combinations for specific customer needs. They also guide customers directly to the most suitable dealers for their requirements and establish dealer programs to evaluate and enhance dealers' solution-providing capabilities. One participant stated: *“We have therefore launched the Expert Partner Program. For a fee, we train the dealers' employees so that they can provide appropriate advice and make adjustments to our products. In return, the Expert Partners receive better warranty reimbursement rates and better margins.”* (Managing director)

After matching the customer requirements with the solution offerings, product manufacturers and dealers need to ensure the proper integration of the solutions into customers' daily operations. Again, this is far from easy and requires product manufacturers to take a more active role. A frequently

mentioned example was product manufacturers advising dealers and customers in making the necessary legal agreements and setting up a suitable information technology (IT) infrastructure to integrate the solutions smoothly into the customer context. As one participant explained, *“There has been a surge in customer inquiries... to directly connect distributors’ [product and service] catalogues through various interfaces to customers’ IT infrastructure”* (senior manager).

Consequently, product manufacturers have been found to establish activities to offer customers a seamless procurement and integration experience. To do so, product manufacturers liaise with dealers. They offer a “general” integration approach to customers, in which they orchestrate solution integration by managing dealers’ fulfilment activities. Product manufacturers and dealers are trying to enhance the integration of the solutions by shifting toward digital (remote) services. One participant stated: *“Looking a few years ahead, there will no longer be service employees installing and integrating our products at the customer sites... Instead, we will shift toward digital services, assisting customers in integrating our products into their operations easily... This will enhance our efficiency without completely replacing our existing installation services.”* (Vice president of sales)

4.2.2 Usage-oriented value architecture

The second solution-oriented value architecture—the usage-oriented value architecture—builds on the integration-oriented value architecture and adds distinct customer activities, offerings, and processes.

Customer activities: The usage-oriented value architecture emerges as customers increasingly look for efficient deployment of solutions to improve their daily product usage. For example, one participant highlighted, *“Nowadays, our customers increasingly demand better efficiency and high productivity”* (project manager). Another participant stated, *“Construction companies want to become productive...want to efficiently use our construction devices”* (branch manager). Another participant further underlined this argumentation: *“We increasingly made our products smart and connected...recording actual device usage hours...to maintain products on usage hours rather than regular maintenance intervals”* (project manager). This participant further extended the argument: *“[I]nstead of reacting to product failures, our product connectivity helps us to record the product status ... and to prevent possible product failures”*.

Solution offerings: Such changes in customer activities due to the newly emerging requirements open new opportunities for solution offerings. One participant explained, *“Mere product innovations are no longer enough. Hence, we now offer software and services...to support customers during product usage”* (Project Manager). Similarly, another participant concluded: *“Even as products remain the core of our business and the core of our customer relationship, we are venturing into digital service and software applications to support the entire product usage, from operating single products to planning, managing, and maintaining entire product fleets for our customers.”* (Business development specialist) Solution offerings consist of smart connected products, services to support product usage, and software elements to manage the maintenance of single products and even the entire fleet of products.

Solution process: Regarding the solution process, the usage-oriented value architecture goes beyond the customisation and integration phase and extends the allocation of product manufacturers’ and their dealers’ activities during the entire deployment phase. The deployment phase is many times longer than the customisation and integration phase and covers many different touchpoints along the customer’s journey. One participant described these various touchpoints and the corresponding offerings as follows: *“To support customers in product usage, we focused on the following main elements: (1) offering parts identification catalogues to make it easier for consumers to identify proper parts and (2) offering diagnostic software to make it easier for them to identify and/or predict possible product failures.”* (Product manager) Another participant supported this argumentation: *“We have rolled out a new software application for our dealers... The application assists dealers through a step-by-step guide during product maintenance.... Even customers can use it... The application is a game changer... [It] creates a leap in service quality and customer satisfaction.”* (Branch manager)

Product manufacturers and dealers must immerse themselves in new activities through the deployment phases to align such offerings with the solution process. Such new responsibilities might even initiate certain adaptations in how product manufacturers and dealers work together. One participant stated, *“To support customers along the deployment phase, we discuss new collaboration models with our dealers new collaboration models... We considered franchise models with a couple of hundred of our existing dealers to standardise dealer services throughout the usage phase”* (project manager). This participant added, *“We do not want to move to a single-dealer approach of taking care of the entire deployment phase as long as a couple of hundred dealers still sell our products to many customers.”* The franchise model benefits many dealers from the solution offerings, making customers’ product usage more efficient.

Product manufacturers and dealers take responsibility for activities related to efficiently deploying the solution. Manufacturers immerse themselves in digital activities to support customers directly during the deployment phase to enable dealers to support customers. Dealers have started providing services as part of the solution deployment, which requires high customer proximity (e.g., maintaining, repairing, and exchanging customer products). One participant highlighted, *“Nowadays, construction companies [customers] demand better efficiency... We integrated software applications for optimising construction sites in our solution offerings... We support customers in the software deployment through automatised software updates and upgrades”* (product manager). Another participant added, *“We [product manufacturer] try to control the customer relationship through the deployment phase...while at the same time, we selected a single dedicated dealer per region to provide the necessary logistic activities throughout the deployment phase”* (project manager). More specifically, product manufacturers attempt to control the pricing of the solution offering through the customer relationship during the deployment phase. As one participant explained: *“Customers want to have reasonable prices for any service or software offered during the product usage phase. We communicate customers’ price expectations to the dealers, facilitate price negotiations between dealers and customers... [to ensure] our customers that dealers can match their price expectations for the required service and software offerings.”* (Key executive)

4.2.3 Closing-the-loop-oriented value architecture

The closing-the-loop-oriented value architecture builds upon the prior two, introducing unique customer activities, solution offerings, and processes. It bridges the post-deployment and awareness phases, emphasising circularity and sustainability in customer solution requirements.

Customer activities: The close-the-loop-oriented value architecture emerges as customers increasingly seek support beyond efficient product usage. Thus, more adjacent customer activities that go beyond product usage are increasingly addressable by solution providers. One participant argued: *“Of course, selling agricultural machines and solutions for the efficient deployment of these machines to agricultural businesses remains our primary revenue source...[but] new requirements to make agricultural businesses more productive and sustainable...[motivates us] to venture into adjacent customer activities... For example, we introduced a digital service to correctly dose the fertilisation with our agricultural machines to avoid overfertilisation and still maintain a high crop yield... even though we are not in the fertiliser business.”* (Chief executive officer)

Solution offerings: As the previous statement suggests, the solution offering includes more service and software offerings. One participant concluded, *“Of course, robotic equipment remains the core of our business... [Nevertheless] we have developed additional digital services and software applications to venture into the more strategic business activities of our customers...to optimise the entire production process”* (business development specialist). This extension in the service and software offering is further supported by the following participant statement: *“Our new software application for dealers...[assists] them stepwise during the product maintenance... Better product maintenance extends the product life...making it possible to provide products, after a first and a second life...with a high residual product value”* (product manager).

However, compared to the integration- and usage-oriented value architectures, the close-the-loop-oriented value architecture extends the product offering from a product to a system perspective. A

pure product perspective is insufficient to make customers' businesses more productive, safer, and/or sustainable. Both product manufacturers and dealers must think about the entire system surrounding the product. One participant noted that *"as customers demand more sustainability, we can no longer just focus on our own water heating systems... We have to look into the entire heating system to figure out how to minimise the carbon dioxide emission"* (vice president of sales). Similarly, another participant stated: *"As local dealers...we do not just sell and install heat pumps... Instead, we advise customers on the entire energy solutions for their houses...including solar panels and inverters to operate the heat pump with renewable energy...as well as necessary actions to improve the thermal insulation."* (Senior manager) As such statements suggest, the solution offerings include smart and connected systems rather than single products and services and software offerings that support entire systems and address more strategic adjacent customer activities.

Solution process: Such solution offerings go far beyond previous dealer activities for managing the solution process. One participant substantiated this: *"As our customers seek more advice on sustainability issues, our dealers are not really ready for it"* (key executive). Product manufacturers and dealers start joint initiatives to set up the necessary activities for implementing the close-the-loop-oriented architecture. Product manufacturers, for example, reported initiatives to better advise customers in achieving their sustainability goals by supporting documenting sustainability improvements and generating detailed sustainability reports. These reports can include diverse data, from tool usage hours to safety feature activations, to provide insights into product longevity and safety compliance. One participant explained the sustainability aspects as follows: *"Sustainability...evolved beyond mere buzzwords to become a fundamental requirement... With our solution offering, we can not only provide insights on product usage but also generate comprehensive sustainability reports...indicat[ing] when products need to be replaced after a certain number of usage hours."* (Service executive)

In this value architecture, product manufacturers and dealers collaborate to leverage product utilisation data to minimise the number of products customers need to ensure efficient product usage and maximise product duration. This contributes to customers' sustainability objectives. Through the data on customers' product usage, product manufacturers can learn much about the actual customer requirements, leading to a smooth feedback loop between the phases for post-deployment support and defining customer requirements. Closing this feedback loop allows product manufacturers, together with dealers, to make the customer's awareness easier.

Product manufacturers take the lead in the post-deployment phase and try to enable dealers to follow the close-the-loop logic. One participant explained this enablement through their company's sharing platform for products (power tools): *"We have developed for our dealers a customisable sharing platform for power tools... Of course, dealers already offer rental services [rental shop] for power tools to customers... Our platform functions like a "shop-in-the-shop" approach... Allowing dealers to harness synergies between their rental shops empowers dealers to offer more sustainable alternatives on renting out instead of selling power tools...helping customers minimise their own power tool inventory."* (Marketing manager)

In this value architecture, product manufacturers and their dealers adopt a holistic perspective to guarantee a consistent customer experience at every touchpoint along the entire solution process—from the customer awareness phase to the post-deployment phase.

Our findings indicate a widespread shift across industries from traditional product-oriented value architectures to more diverse, solution-oriented ones. Instead of converging on a singular solution-oriented framework, industries are adopting multiple, distinct value architectures, including integration-oriented, usage-oriented, and close-the-loop-oriented models. These variations are tailored to align with changes in customer activities, solution offerings, and the distribution of activities throughout the solution process. Driving this transition are emerging demands for productivity, sustainability, and digitalisation, which not only alter customer activities but also contribute to a more varied customer base. This shift from previously uniform customer requirements characteristic of product-oriented models to a more diverse set of needs facilitates the development

of distinct solution offerings and the reallocation of activities along the solution process, culminating in forming three distinct value architectures.

5. DISCUSSION

5.1 Theoretical and managerial implications

Our study directly responds to the recent call for a better understanding of the implementation aspects of moving from selling products to providing solutions. Our findings contribute to the existing literature in four ways. The first contribution is closing an empirical gap, while the other three advance existing theories.

First, most studies have focused on product manufacturers directly providing solutions to customers (e.g., Tuli et al., 2007), overlooking the role of dealers as intermediaries in business ecosystems (e.g., Frandsen et al., 2022). Our research addresses this gap by exploring how product companies deliver solutions through dealers, aligning with recent calls to examine solutions from an ecosystem perspective (Frandsen et al., 2022). This approach allows for a detailed examination of value architectures within a simpler ecosystem of product companies, dealers, and customers, offering insights into the coordination of activities and the potential for multiple value architectures in more complex ecosystems.

Second, our findings underscore the shift from products to solutions, expanding the solution literature, which traditionally focuses on product companies enhancing their offerings with services and software (e.g., Hakanen et al., 2017; Shepherd & Ahmed, 2000; Windahl & Lakemond, 2010). This literature often takes a supplier-centric view, presuming providers understand the value customers seek (Storbacka, 2011; Windler et al., 2017), which may lead to mismatches between solutions and actual customer needs, affecting monetisation and solution quality (e.g., Macdonald et al., 2016). Our study broadens this perspective by examining shifts in customer activities (Petri & Jacob, 2016), aligning with the emphasis on customer orientation and centrality as drivers for moving towards solutions (Brady et al., 2005; Galbraith, 2002; Matthyssens & Vandenbempt, 2008). This approach complements Tuli et al.'s (2007) framework of relational processes for enhancing solution effectiveness through alignment with evolving customer needs and activities. We highlight that customer needs and activities are dynamic, driven by the extension and reconfiguration of these activities (Sawhney et al., 2004), influenced by emerging demands for productivity, sustainability, and digitalisation. These demands extend the range of activities customers seek support for and prompt customers to reconfigure their activities, potentially narrowing their core competencies and becoming more receptive to external solutions.

Our third contribution broadens the discussion on strategies for transitioning towards solution-oriented business models, challenging the notion that product companies can solely capitalise on the solution business due to its financial allure and closer customer relationships. Our research reveals that the lone efforts of product companies or dealers are insufficient for effective solution delivery (Sa Vinhas, 2023). Instead, successful strategies involve collaborative value architectures—integration-oriented, usage-oriented, and close-the-loop-oriented—between product companies and dealers. These architectures align customer activities with solution offerings and processes across a continuum from product-centric to solution-centric approaches. They necessitate a division of labour, where product manufacturers and dealers engage in different aspects of the customer journey and solution delivery, highlighting the importance of joint efforts in various process stages (Hakanen et al., 2017; Xia et al., 2017).

Our fourth contribution reveals that effective solution delivery necessitates adopting multiple value architectures, allowing product manufacturers to more thoroughly engage dealers and enhance control over the solution process for smoother customer experiences. This approach signifies a shift towards collaborative value architectures for strategic variability and adaptability in industrial markets, facilitating a broader market reach and customer segment satisfaction. While this strategy enhances customer alignment and satisfaction through diversified solution delivery methods, it introduces challenges in coordination and understanding diverse customer needs. Embracing multiple value architectures demonstrates a response to the dynamic industrial market demands, emphasising

the need for flexible engagement strategies across different customer segments. However, it raises considerations about resource allocation and achieving synergies between these architectures, questioning the sustainability of such a model and whether it represents a transient or enduring approach to solution delivery.

Adopting multiple value architectures prompts questions about how companies can manage resources efficiently and create synergies across architectures, balancing cost reduction with solution delivery repeatability and modularity (Davies & Brady, 2000). It also remains open whether embracing multiple value architectures is just a temporary or permanent state of delivering solutions to different customer segments.

Our findings support managers in their attempts to deliver solutions to customers. Only when managers understand the extension and reconfiguration of customer activities will they be able to seize the scope of the solution offering. More specifically, managers need to gain insights into how digitalisation, productivity, and sustainability requirements change customer activities and make these customer activities addressable for solution providers. Consequently, to gain deep knowledge about customer challenges, preferences, and needs, managers should frequently map customer activities by looking at the entire customer journey and zooming in on single customer activities within this customer journey, as well as by working together with typical and rather untypical customers.

Managers should be aware that delivering solutions requires managing multiple value architectures. Selling products through dealers to customers typically works with a single value architecture in which product manufacturers, in turn, sell the products to dealers and provide the necessary product information to dealers. Dealers, in turn, inform customers about products and sell these products to customers. To deliver solutions, managers must embrace multiple value architectures, namely integration-oriented, usage-oriented, and close-the-loop-oriented value architectures. Managers should pay attention to possible tensions regarding harnessing synergies between these architectures. Managers should recognise that delivering more comprehensive solutions requires stepwise progress from integration-oriented, usage-oriented, to close-the-loop-oriented value architectures. Overall, managers need to recognise that delivering solutions requires the collaborative allocation of activities between product manufacturers and dealers. They cannot capture the solution business by themselves; they need to work together.

5.2 Limitations and further research

Our research, while insightful, has limitations and opens avenues for further investigation. First, future studies should refine our observations on evolving customer activities by examining specific customer types or segments to better understand what expands solution providers' reach. Second, our findings, based on studies from 2021 to 2023, offer a snapshot of how customer activities, solution offerings, and processes converge in solution delivery. Future research should adopt longitudinal approaches to explore how companies adapt their solution delivery strategies over time, including integrating services and software. This would clarify whether the trend towards multiple value architectures represents a transient phase or a lasting shift.

Third, our three value architectures are not meant to be exhaustive. Identifying additional value architectures and exploring their possible combinations could enhance understanding. Fourth, a capability perspective could reveal the operational and dynamic capabilities required for aligning customer activities, solution offerings, and solution processes within value architectures as customer activities evolve. Fifth, while we focused on the relationship between manufacturers and dealers, comprehensive solutions involving multiple product, service, and software components may necessitate broader partnerships. Future studies should extend beyond the manufacturer-dealer dynamic to include a wider range of partners in developing value architectures for comprehensive solutions (Frandsen et al., 2022). Although these limitations and future research opportunities must be considered when considering the implications, the findings provide useful new insights for academics and practitioners alike.

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APPENDICES

Table 1: Overview of solution-oriented value architectures

Integration-oriented value architecture	Usage-oriented value architecture	Close-the-loop-oriented value architecture
Customer activities: Why should customers demand solutions?		
Customers demand the seamless integration of solutions into their daily operation	Customers demand efficient product usage in their daily operation	- Customers want to strengthen their likelihood of success in a rapidly changing business environment - Customers want to become more sustainable - Customers want to increase their productivity further - Customers want to leverage digitalisation opportunities
Solution offerings: What product, service, and software elements should be included in the solution offering?		
Product, service, and software offerings that allow for simple integration into the customer's daily operations	Smart, connected products, services, and software offerings that allow for, first, simple integration into the customer's daily operations and, second, efficient continuous deployments of the solution through customers	- Entire systems rather than single products - Software and digital services that support more adjacent customer activities
Solution process: How should product manufacturers and dealers allocate their activities to deliver solutions?		
<i>(1) Awareness creation and customer requirement phase</i>		
Manufacturers	Manufacturers	Manufacturers
- Strengthening dealers' skills for promoting solutions - Establishing digital solutions for information campaigns	- Educating dealers about pains and gains during product usage - Strengthening dealers' skills in promoting solutions - Establishing digital solution information campaigns about efficient product usage	- Providing information and education about embedding products into entire systems - Establishing digital awareness campaigns to inform customers about system solutions

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Dealers

- Informing customers about possible solution benefits
- Promoting solutions to customers

Manufacturers

- Offering dealers software applications to obtain customer requirements to match them with solution offerings

Dealers

- Assisting customers in matching requirements and solution offerings
- Supporting customers during solution integration

Dealers

- Facilitating knowledge exchanges with customers about product usage
 - Creating customer awareness about possible improvements during product usage
- (2) Customization and integration phase*

Manufacturers

- Offering dealers software to obtain customer requirements during product usage to match them with solution offerings

Dealers

- Advising customers to integrate the products – embedding smart, connected products into the customer operation

(3) Deployment phase

Manufacturers

- Providing some second-level support in case of any malfunction during solution deployment
- Assisting dealers in offering some ad-hoc support during solution deployment

Dealers

- Providing some ad-hoc support to avoid any difficulties during solution deployment

Manufacturers

- Enabling dealers to provide services throughout the deployment phase
- Providing digital services to assist customers and dealers throughout the deployment phase

Dealers

- Providing services to customers throughout the solution deployment phase
- Supporting customers to ensure efficient product usage

(4) Post-deployment phase

Manufacturers

- Enabling dealers to simplify frequent product purchases

Dealers

- Offering customers simple ways to purchase products frequently

Manufacturers

- Developing software applications to lock in customers
- Educating dealers on retaining customers

Dealers

- Setting up reward programs to make it easier to retain customers after the first solution deployment

Dealers

- Promoting entire system solutions

Manufacturers

- Advising dealers on additional system knowledge, extending the product focus
- Providing dealers with software to configure, customise, and integrate system-wide solutions

Dealers

- Configuring, customising, and integrating solutions surrounding entire systems

Manufacturers

- Providing services for adjacent customer activities that go beyond product usage (operation)
- Orchestrating dealers in contributing to solution delivery

Dealers

- Servicing systems throughout the solution deployment phase
- Assisting customers in becoming more productive and sustainable

Manufacturers

- Supporting and coordinating dealers to establish solution elements
- Assisting dealers in validating the solution benefits and communicating these benefits to customers

Dealers

- Offering customers repetitive solution elements and/or recurring revenue schemes to establish a continuous relationship