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From selling machinery to hybrid offerings – organizational impact of digital servitization on manufacturing firms

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Abstract:
The transition towards services has been imperative for manufacturing firms for years. The change from a product-oriented to a more service-dominant business model affects the organizational structure of firms. However, literature provides limited insights into how manufacturing firms organize themselves in this transition. Even though digital technologies are critical for the transition, it is unclear how to orchestrate digital and traditional Information Technology (IT) resources in manufacturing firms accordingly. We analyze the case of a typical manufacturing firm that has adjusted its structure to reorganize for solution offerings based on product, service, and digital components. Our results describe a hybrid organizational structure that splits front- and back-end units. The back-end units are split along solution components. Digital IT resources are internalized and governed decentrally, with traditional IT resources being outsourced and steered centrally. Our findings contribute to digital servitization research by clarifying the overarching as well as the digital and traditional IT-related organization for manufacturing firms.

Keywords:
digital servitization; manufacturing firm; organizational structure; digital technologies; service-dominant logic.

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1. Introduction

Kaeser Compressors is a prominent example of a firm that shifted its business model from selling air compressors to selling compressed air as a service [1, 2]. Such a transition from a product-oriented to a more service-dominant business model is recognized as a strategic imperative for many manufacturing firms [3-6]. Scholars refer to this strategic transition as servitization [7].

Nowadays, digital technologies further facilitate servitization. Manufacturing firms employ digital technologies to link data of distributed products back to their value chain to implement new or to enhance existing services, e. g., via remote monitoring [4]. Scholars acknowledge the importance of digital technologies for servitization by introducing the term digital servitization [8]. Manufacturing firms that employ digital technologies can profit from multiple affordances to realize business objectives, e. g., achieving operational excellence in providing services, creating new offerings, or moving to new value propositions [4-6].

Typically, manufacturing firms start with their business model focused on products and additional product-oriented services [9, 10]. Digital technologies help manufacturing firms escape their products' potential commoditization trap by shifting the focus to higher-value products and services [10-12]. Thus, digital servitization of manufacturing firms' business models is often associated with a shift in the companies' strategies [13, 14].

Manufacturing firms need to reflect these strategic changes in their organizational structure [15-18]. Due to the increased focus on services, firms have to adapt their activities, processes, and capabilities [18, 19]. In the case of Kaeser, the firm established a new organizational unit to specialize in its additional service tasks and activities [1]. Generally, the reorganization for digital servitization needs to embrace two aspects, it should (1) enable a service transition starting from a product-oriented structure and (2) foster a firm's benefit from the use of digital technologies [5, 20]. However, literature is still sparse on how firms should adjust their organizational structure to encounter digital servitization [18, 21-24].

Regarding the first aspect, there are discussions about how to reorganize, looking at the offering and its components, and how to handle an organization's customer contact [16, 25]. In terms of structuring an organization around the offering, scholars discuss the separation of intra-organizational units according to product and service spheres [25, 26]. Another stream of research is about structuring an organization in customer-facing front-end units and back-end units [16, 27]. Still, literature lacks guidance on which organizational structures manufacturing firms should adopt [17, 24].

The second aspect in organizing for digital servitization refers to digital technologies and their arrangement within manufacturing firms. Through digital servitization, manufacturing firms adopt digital technologies and consequently adjust their value creation, value delivery, and value capturing [28, 29]. Hence, the adoption of digital technologies requires manufacturing firms to reflect the accompanying dynamics in their organizations, e.g., to enable novel ways of how to collaborate or to facilitate novel roles to manage digital technologies [28, 30]. Even though digital technologies and associated expert roles are critical in digital servitization, few contributions have been made about organizing digital and traditional IT resources, particularly for manufacturing firms [22, 23, 30].

This lack of research about organizational structures is predominantly an issue for manufacturing firms that undergo digital servitization of their business model. In this strategic transition, firms need to balance their previously product-oriented business model while establishing an additional focus on services [12, 31]. Practice confirms that the biggest share of manufacturing firms is undergoing this transition. Only a small share has completed its transition from a goods-dominant "product sales" business model to a service-dominant "as-a-service" business model [32]. Therefore, our paper aims at clarifying the organizational structures of manufacturing firms undergoing digital servitization of their

business model by answering two research questions. We first focus on the overarching and then on the IT-related organizational structure:

RQ1: How does the overarching organizational structure of manufacturing firms change when undergoing digital servitization?

RQ2: How do digital and traditional IT organizations of manufacturing firms change when undergoing digital servitization?

To answer these research questions, we consolidate current concepts about organizing for digital servitization in section 2, starting from an overarching firm-level perspective before focusing on digital and traditional IT aspects. We introduce our research methodology based on an in-depth case study (section 3). Section 4 summarizes the case firm's starting point before describing how it organizes for its digital servitization on an overarching level. The section also shows how the case company organizes digital and traditional IT (human) resources. In section 5, we discuss our insights considering existing research. Eventually, we summarize our contribution to digital servitization literature and derive limitations and future research avenues.

This paper contributes to digital servitization and IT research by (a) consolidating previously separate organizational perspectives into a tentative concept for a hybrid organizational structure for manufacturing firms, (b) describing a hybrid organizational structure based on the case of a common manufacturing firm, and (c) showing how to organize digital and traditional IT resources based on the same case. Although our findings are mostly descriptive in nature, they may be used for inductive analogy, that is case-to-case generalization [33]. Across the following sections, we focus primarily on digital and traditional IT resources in terms of human IT resources.

2. Conceptual background

2.1 Digital servitization

Over the past decades, product-oriented manufacturing firms have been looking for opportunities to stand out from competition [7, 34]. Servitization, as a transition towards services, offers the potential to differentiate [35]. Scholars find three reasons that motivate manufacturing firms to initiate a service transition: to improve their competitive positioning, to address evolving customer demands, or to optimize their economic situation [34, 36, 37].

Recently, manufacturing firms have started to employ digital technologies for the servitization of their business models [38-40]. Research understands digital servitization as a firm's transition to adopt new service offerings enabled by digital technologies [4], such as the connection to products, remote monitoring in real-time, or the analysis of machine data for future improvements [4, 5, 24].

Digital servitization research has mainly focused on four topics, including the concept of digital servitization, its effects on stakeholders, digital technologies used in the transition, and the role of digital technologies for the transition [4, 22].

2.2 Digital servitization business models and strategies

The concept of digital servitization outlines a strategic transition of manufacturing firms [13, 14]. Research finds that manufacturing firms add services to their offerings and adjust their value propositions towards customers [5, 22]. This strategic transition affects the overarching business model of manufacturing firms [6, 41].

Scholars differentiate digital servitization business models based on three dimensions: the focus of the offering (product sales vs. results provision), the degree of customization (standard vs. custom), and the level of digitalization [22]. The focus of the offering considers whether the value of an offering primarily stems from the associated product (product-oriented), from ensuring the usability of a product based on associated services (use-oriented), or from ensuring results based on employing products and services (result-oriented) [42]. The degree of customization considers whether an offering is standardized, based on modular components, or a custom solution [22]. The third dimension is the level of

digitalization that captures the role of digital technologies for the offering [22]. Digital technologies enable four levels: remote monitoring, remote optimization, remote control, or autonomy of a digitalized or smart product [43, 44].

Scholars find five business model archetypes in this previously mentioned three-dimensional space for digital servitization business models [22]. These five archetypes show the bandwidth of servitization strategies: There are "*Product-oriented Service Providers*" as manufacturing firms that sell products with product-oriented services, like repair, overhaul, or spare parts services [6]. "*Industrializers*" are another type of manufacturing firms that stand out by offering products and associated services on a modular basis. The modularity helps them to increase their efficiency [22]. A case example for this archetype is the provider of propulsion systems that assembles modular maritime motors with a defined set of standard services [31]. "*Customized Integrated Solution Providers*" are manufacturing firms that offer custom solutions of products and services in an integrated way [22]. An example is a producer of hydropower generation turbines that delivers a custom solution based on actual turbines with integrated maintenance services based on remote controlling [31]. "*Outcome Providers*" are manufacturing firms that deliver results by employing products and services [22]. Kaeser Compressors is an example of an "*Outcome Provider"* that monitors its installed base of compressor stations at its customers to ensure that customers can obtain compressed air [2, 43]. Eventually, there are "*Platform Providers*" that link multiple suppliers to achieve results for customers [22]. Yet, there is little empirical evidence for this business model archetype [22].

Manufacturing firms that commit to a digital servitization strategy undergo a strategic transition of their business model. Scholars outline a typical transition from being product-oriented by focusing on product sales to offering an increased share of services to becoming use-oriented or result-oriented [9, 31].

All digital servitization strategies have in common that manufacturing firms need to ensure that their organizations are capable of providing additional services or results as a service [45]. Research finds that an appropriate organizational structure is critical for servitization [27, 46], respectively digital servitization [23, 47]. In their seminal paper, Porter and Heppelmann [45] emphasize the importance of an effective and efficient organizational structure to facilitate digital servitization – coming back to the established notion of "structure follows strategy" [48].

2.3 Organizational structures along digital servitization

In digital servitization, firms face the trade-off of separating business units by tasks of different nature while re-integrating them due to their digital servitization strategy [45]. Servitization research outlines multiple archetypical organizational structures depending on the focus of the business models' offering. Figure 1 shows an overview of overarching organizational structures along a continuum focusing on the offering of business models, from products-oriented to result-oriented [3].

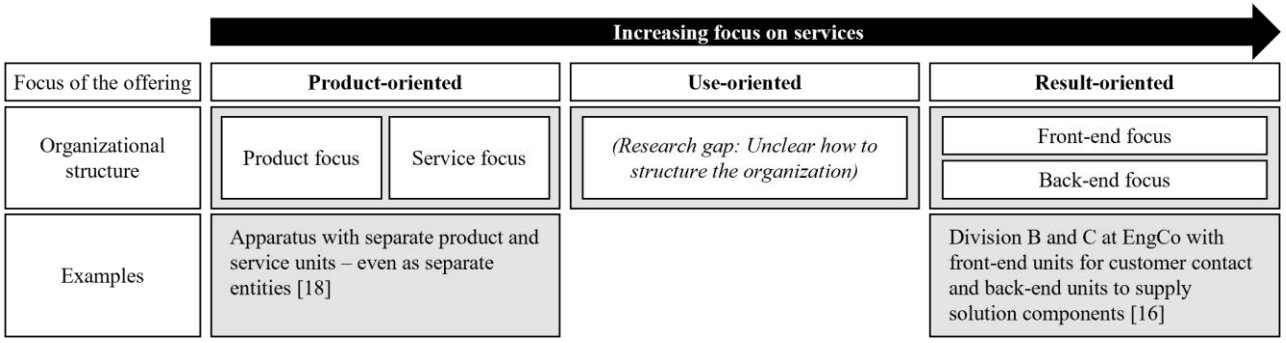

Figure 1. Typical organizational structures depending on the focus of the offering

Along with digital servitization, product-oriented firms add services to their product offerings. Scholars suggest that these firms separate product business units from service business units [26, 36, 49]. There are two motivations for this split. First, the separation of service activities contributes to becoming efficient at creating, selling, and delivering services [36]. Second, the separation fosters a product-centric and a service-centric mindset within each business unit [27, 49]. Apparatus, for example, a provider of electrical equipment for industrial machinery, operates separate product and service units. In this case, the service unit is a separate unit as a separate entity with its own profit and loss responsibility. This separation is intended to strengthen the positioning of Apparatus' services in comparison to products [18].

Another perspective suggests that firms should separate front-end and back-end units when moving their business model to an increased focus on services [9, 16, 18, 27, 47]. A business with a result-oriented business model might offer an outcome as a service with products as tools for service provision [42]. In this example, front-end units are customer-facing units to deliver the outcome [47]. Back-end units supply front-end units with the relevant components [18, 47]. This organizational structure helps manufacturing firms to focus on customer contact in the front-end units while back-end units improve efficiency and operations [27]. The result-oriented business models of division B and division C of EngCo build on a split of the organization in front- and back-end structures [16]. Customer-facing interactions are taken over by a front-end unit, whereas the back-end provides solution components [16].

The mirroring hypothesis offers a theoretical explanation of why firms establish such archetypical organizational structures: As a firm introduces additional services to its offerings, it needs to set up new processes and requires additional expertise for these services. Additionally, the firm needs to rewire its intra-organizational ties to ensure effective and efficient collaboration among existing and new processes and expertise [50]. The mirroring hypothesis posits that the organizational ties need to mirror a firm's offering and vice versa [50]. In terms of digital servitization business models, product-oriented manufacturing firms sell products and offer separate product-related aftersales services. These firms mirror their offerings by separating product and service units. Service-dominant manufacturing firms provide results to their customers by employing different supplies. A separation of customer-facing front-end and supplying back-end units helps firms to mirror their offerings.

In practice, most manufacturing firms identify themselves as in the transition from a product-oriented to a result-oriented business model [32]. Their offerings focus on the products' use as a hybrid between product sales and results as a service, so as use-oriented. Following the mirroring hypothesis, these firms should adjust their organizational structure with an alternative to a product/service split and a front-end/back-end split.

2.4 Organizational structures for digital and traditional IT modes

The second element of digital servitization is digitalization [4]. Scholars posit that firms only benefit from digitalization once they can actually exploit digital technologies [51]. IT organizations face the challenge of supporting several profiles: efficiently delivering IT solutions, like internal information systems, striving for stability [52, 53], but also enabling business units to explore new IT use cases and integrate digital technologies into their processes and products aiming for innovation [45, 53, 54]. Literature refers to this challenge as IT ambidexterity [55]. Scholars suggest adjusting the organization accordingly to resolve this inherent tension [51, 56, 57].

Literature proposes addressing IT ambidexterity by differentiating several modes of the IT function to operate [52]. These IT operating modes are sometimes conceptualized as bimodal IT [53]. One mode enables business units to adopt new IT assets and digital technologies for "systems of engagement" (p. 1421) close to customers in an explorative way, while the other mode takes over traditional IT delivery for "systems of record" (p. 1421) for internal processes in an exploitative way [53]. In addition, some scholars point to product IT as another mode of the IT function [45, 58].

Scholars argue that over the last years, product IT and digital systems of engagement have started to integrate [59]. Digital systems of engagement, like customer apps or online platforms, control product IT components, like interconnected machinery [58]. The convergence of both types of IT leads to a single, explorative IT mode that supports systems of engagement and product IT [59, 60]. In summary, we need to consider two modes of the IT function and, in line with previous contributions, refer to them as digital IT and traditional IT mode [53].

Conceptually, there are two options for how a firm can handle its digital IT and traditional IT mode, either in an integrated or separated way [61-63]. The integrated way refers to setting up a single unit with two internal modes [64-66]. The separated way is to establish two organizational units [61, 67, 68].

Both the digital IT and the traditional IT modes constitute an IT organization as a "(…) collectivity of human resources that perform IT-related tasks" [69, p. 57-2]. Scholars differentiate IT organizations based on resource allocation and IT governance [69-73]. Bimodal IT literature suggests adding the aspect of sourcing to determine the type of an IT organization [61, 67, 74].

IT resource allocation describes how IT resources are distributed across an organization [69]. The allocation includes all types of IT human resources, e. g., for ICT infrastructure operations, programming, or integration of digital technologies [75]. Literature differentiates centralized and decentralized IT resource allocation [69, 70, 75]. Scholars acknowledge that there is a continuum that connects both extremes with hybrid IT resource allocations [75]. While the centralized allocation of IT resources refers to allocating all IT resources in a single IT unit, the decentralized allocation refers to distributing IT resources across various business units. In this paper, we capture these types as three options for IT resource allocation.

IT governance is another factor that determines IT organizations. Scholars frame IT governance as the decision authority and task responsibility for information systems and product development on a strategic and operational level [73, 76-78]. They differentiate the degree of centralization of IT governance [69, 79]. Weill [80] derives IT governance archetypes, e. g., IT monarchy as a form of centralized IT governance, federal IT governance as partially centralized and partially decentralized IT governance, to feudal IT governance as a form of decentralized IT governance [80]. We summarize these options for IT governance as centralized, hybrid, or decentralized.

Bimodal IT literature suggests differentiating IT organizations' sourcing mode [61, 67, 74]. This factor relates to the discussion about the strategic relevance of specific IT resources and capabilities [81]. Literature differentiates IT insourcing, as building up IT resources and capabilities internally, from IT outsourcing [62, 74].

In summary, literature offers four dimensions to categorize IT organizations that take over the digital IT and traditional IT mode: (1) the type of bimodality, (2) IT resource allocation, (3) IT governance, and (4) the sourcing mode. We propose differentiating the digital and traditional IT mode regarding the three latter factors, as shown in figure 2.

(1)	**Type of bimodality**		Integrated		Separated
(2)	**IT resource allocation**	**Digital IT mode**	Centralized	Hybrid	Decentralized
		Traditional IT mode	Centralized	Hybrid	Decentralized
(3)	**IT governance**	**Digital IT mode**	Centralized	Hybrid	Decentralized
		Traditional IT mode	Centralized	Hybrid	Decentralized
(4)	**Sourcing mode**	**Digital IT mode**	Insourced		Outsourced
		Traditional IT mode	Insourced		Outsourced

Figure 2. Conceptualization of options to shape the organization of digital and traditional IT resources

3. Research methodology

We conducted an in-depth case study to explore manufacturers' overarching as well as digital and IT organizations [82]. Due to the immaturity of research in the field of organizational structures for digital servitization, we decided to analyze a single, in-depth case that provides rich context and detailed insights [82, 83]. Along with the case study, we follow the four guiding principles by Yin [83] concerning external validity, construct validity, internal validity, and reliability of the research process.

We purposely selected the case firm to ensure external validity of the case study. We chose the case firm due to its commonness as a manufacturing firm [84] and the revelations of its situation [82]. First, the case firm constitutes a common case for tool manufacturing firms in the German-speaking area [85]. The case firm complies with an average manufacturing firm regarding revenue, the number of employees, and the relevance of its service revenues. Second, the case firm offers revelatory insights as it has recently reorganized to arrange for its new digital servitization strategy. The firm's adjusted strategy focuses on offering solutions over the whole lifecycle based on product, service, and digital components. The firm's organization also reflects this strategic transition.

During the in-depth case study, we collected data from multiple sources, which allowed for data triangulation to ensure construct validity [83, 86]. We collected archival documents, conducted semi-structured interviews, and codified our observations from work shadowing at the case firm. Table 1 shows our data assets. Our data collection started in July 2020, focusing on archival documents. Between August and September 2020, the case firm allowed one researcher to accompany employees at the firm's headquarters to conduct the interviews in person and capture insights from work shadowing. We concluded the data collection in March 2021.

As archival documents, we used publicly and non-publicly available documents. In addition to documents available as brochures or on its website, we had the opportunity to screen internal documents of the case firm, e. g. organizational charts across the firm, internal portfolio reviews of the offering and its components. For the interviews, we conducted semi-structured interviews [87]. Each interview consisted of four structural sections with pre-defined questions while leaving space for improvisation depending on the interview situation: (1) we started with an overarching view of the business model, (2) we moved to a business unit-specific perspective about its organizational role in the business model, (3) we focused on digital and IT resources of the business unit, and (4) summarized the insights by linking the overarching organizational structure and the digital and IT organization. As agreed with the interview participants, all interviews were recorded and transcribed afterward. To ensure confidentiality, it was required to anonymize the interviews in the transcription process. For work shadowing, the researcher could attend strategic meetings and take part in operational tasks. For this purpose, the researcher could accompany the interview participants. When meeting further stakeholders, the researcher was introduced by the interview participants as a neutral observer with a scientific interest in getting to know the firm's organization [83]. Throughout the day, the researcher codified the observations from work shadowing in field notes. After each day, he summarized the core topics in a daily protocol and recapped them with the interview participants. The researcher used these daily check-outs to solicit the participants' views to identify further relevant information [86]. As a result, the researcher decided to schedule further meetings and operational tasks to be attended and searched for specific archival documents. Eventually, the researcher aggregated all documents, interview transcripts, and field notes and linked them in a research diary [83, 86].

After data collection, we established a three-step coding approach to derive insights [88]. The first and second authors of this paper collaborated to review, discuss, and revise each step. The first author started with open coding of documents, interview transcripts, and protocols. We discussed the resulting codes between the first and second author to ensure that there is no investigator bias [83]. Next, we aggregated the initial codes into axial codes. In the last step, we abstracted these axial codes. We used the software tool MAXQDA for our coding. The overall coding resulted in 46 codes based on over 500 coded phrases. In appendix A, we provide a pruned overview of our coding structure.

Overall, we ensured a reliable procedure for our research [86] by planning our approach before entering data collection and analysis. During data collection, we created a research diary and codified our data assets. For the data analysis, we adhered to the three-step coding as a tandem of researchers.

Table 1. Overview of case data assets

Type	ID	Name	Content (Length)
Document	D1	Annual report 2015	Shareholder report – outline of an upcoming new strategy
Document	D2	Annual report 2016	Shareholder report – implementation of the new strategy
Document	D3	Annual report 2017	Shareholder report – acquisition of a respective target firm
Document	D4	Annual report 2019	Shareholder report – last annual report before impact of COVID19
Document	D5	Annual report 2020	Shareholder report – last annual report for strategy implementation
Document	D6	Vision and strategy	Overview of the current vision and strategy with tactical goals
Document	D7	Firm-wide OrgChart	Internal organizational charts covering the case firm up to N-2 level
Document	D8	Portfolio Presentation	Internal presentation of product portfolio for sales pitches
Document	D9	Sales document: automation	Internal sales document about an automation software
Document	D10	Decision document AR Pilot	Internal discussion document about an Augmented Reality (AR) app as a pilot
Document	D11	Remote Service Flyer	Sales brochure describing the functionality of the technical setup
Document	D12	Use Case Remote Service	Sales reference describing use case of remote service functionality
Document	D13	IT Outsourcing	Press release on IT outsourcing contracts of the case firm
Document	D14	Service portfolio flyer	Internal service portfolio overview as a brochure
Interview	I1	Service Manager	Interview with responsible Service Manager (50min)
Interview	I2	Head of New Business Sales	Interview with Head of New Business Sales (55min)
Interview	I3	Head of Sales	Interview with Regional Head of Sales (50min)
Interview	I4	Head of Product	Interview with Head of Product (50min)
Interview	I5	Executive New Business	Interview with an executive of the New Business Unit (45min)
Observation	O1	Discussion: evolution of organization over the past years	Internal discussion about the firm and its evolution after the commitment to its new strategic target, future potential of digitalization for machinery among three leaders of the service unit
Observation	O2	Discussion: AR glasses for maintenance	Internal discussion of the potential of digital technologies like Augmented Reality as a service application
Observation	O3	Discussion: reduced production due to COVID19	Internal discussion centered around the production and the impact of COVID19 on the production load
Observation	O4	Creation of an eLearning	Creation of an eLearning for customer services to exchange air filters
Observation	O5	Creation of service catalogue	Creation of a service catalog for the salesforce
Observation	O6	Observation of service technician	Work shadowing of a service technician solving customer issues as 2nd level support via remote maintenance

4. Results

4.1 Case overview

Our unit of analysis is the organization of a manufacturing firm from Switzerland. The case firm operates globally, with ~75% of revenues from Europe and Asia. The primary customer segments include aerospace, automotive, electronic production, Information and Communications Technology (ICT) providers, and medical technology. Over the last decades, the case firm has created an innovative product portfolio based on organic and inorganic acquisitions of new

technologies. The firm employs over 3,000 employees at a revenue of EUR >1bn in 2019 (D4). These numbers and structural characteristics qualify the case firm as a common case among its branch of manufacturing firms in the German-speaking area [85].

In the past years, the market dynamic in the tool manufacturing market shifted: With the growing presence of Asian competitors, prices changed rapidly (D1). In parallel, the demand for connectivity and "Industrie 4.0"-compatibility increased (D2). In this competitive environment, the case firm was positioned as a product innovation leader and renowned for its "Swiss quality," referring to its products' high precision and endurance (D1, O1). Services were perceived as an addition to the product in the sales process (I1).

In 2015, the case firm analyzed the competitive situation and decided to reshape its strategy to seize new business opportunities over the whole lifecycle of its products (D1). The new strategy set out the ambition until 2020 to move to higher-value products and services in the spirit of an innovation leader while maintaining an efficient organization (D6). This strategic shift induced the case firm's transition from a product-oriented to a more service-oriented business model.

Before its strategy implementation, the case firm's portfolio consisted of several product lines based on specific manufacturing technologies (D1). Individual sales colleagues approached customers to sell the products with services as an addition (I3). Customers integrated the machines into their production processes, and product-associated service units helped in case of maintenance needs (I1).

Since 2016, the firm has been implementing its new strategy that emphasizes the two core elements of digital servitization: shifting its value proposition towards higher-value products and services and employing digital technologies to enable these services (D2). In 2020, the last year of the strategy implementation, the COVID19-pandemic significantly impacted sales for specific customer groups (D5). Despite this impact, the manufacturing firm has already achieved several strategic ambitions since undergoing its digital servitization.

The case firm has adopted new manufacturing technologies to extend its product portfolio (D1), core systems of existing products have been upgraded to next-generation industrial computers (I1), and new digital solution components have become part of the internal portfolio by acquiring a previous digital solution supplier (D3). The firm has created new service offerings enabled by new digital solution components, e. g., remote servicing and control of machines or enhanced digital training services (D11, D14, I2). Additional digital components complement the growing service portfolio, e. g., app-based production control dashboards (D11, I2, I5). In terms of its sales approach, the case firm has shifted to a unified sales approach to cover overarching customer needs in terms of its products (I3).

A regional Head of Sales summarizes the strategic changes and indicates the cultural shift that the firm and its employees are undergoing as well: "*It is a challenge for us (...). The business that we did over the past years was selling machinery. Today, we need to sell complex solutions*" (I3).

Another achievement of the strategy implementation is the case firm's overarching reorganization and the establishment of a structure of its digital and traditional IT. In the following sections, we first describe the overarching organization in terms of business units before focusing on the digital and traditional IT organizations.

4.2 Overarching organization for digital servitization

This section focuses on the overarching reorganization of the manufacturing firm that supports the firm's strategic ambition to offer higher-value products and services, as shown in figure 3. We illustrate the former organization in 2015 before focusing on the state after the reorganization in 2020.

Before its reorganization, the case firm was organized in product divisions that operated their own functional business units like engineering, production, sales, and servicing (O1, I3). Each product division made its own decisions (I3). Each product division was centered around products following a typical value chain approach: The engineering departments built and evolved the product, the production units manufactured the machines, and dedicated sales units sold the products to the customers (I3). In the after-sales phase, product-associated service departments organized spare parts, repair services, or training sessions (I1). Digital technologies were sourced as digital solution components from

third-party suppliers (I5). Corporate support units took over corporate activities, like HR or finance, and monitored traditional IT services outsourced to a third-party provider (D13).

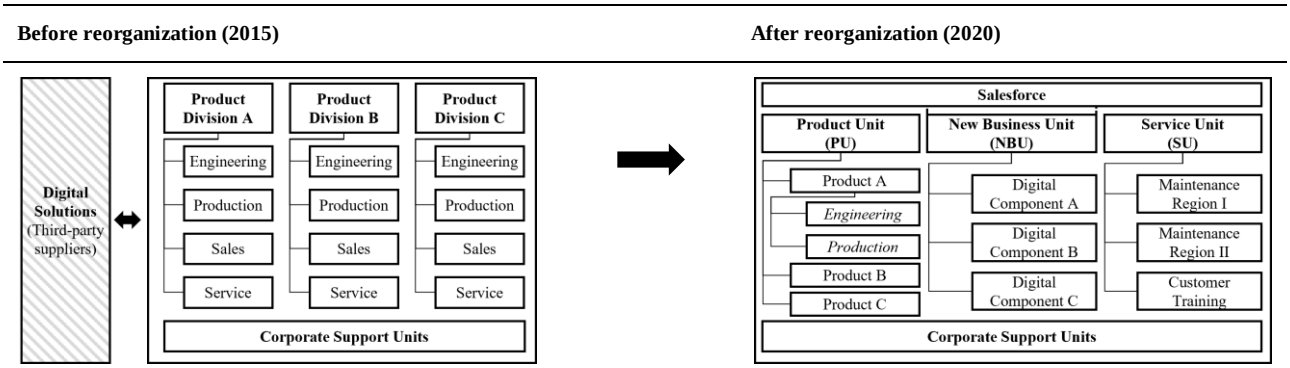

Figure 3. Comparison of the organization before and after the reorganization

In its digital servitization, the case firm transitioned from a product-oriented manufacturing firm to a provider of higher-value products and services. Another part of the case firm's strategy was to address the strategic changes of the adjusted offering through a reorganization (D6). Throughout the case study, we found that the case firm followed three guiding principles along with its reorganization.

The first guiding principle is the split of the organization into front-end and back-end units. In contrast to its previous organization, the case firm now operates a unified salesforce. The unified salesforce orchestrates all customer interactions from the first touchpoint over sales to servicing (O1). A regional Head of Sales emphasizes the importance of a unified front-end layer to sell products and services as solutions: *"We need to act with a unified salesforce (…). This helps us to address detailed questions (…) Today, we need to sell complex solutions." (I3).* The complex solutions are combinations of product and service components enhanced and connected by digital solution components (I1). The salesforce's operating model is to combine these components as a solution and sell them with a mark-up. Therefore, it sources the components from internal back-end units and external companies (I3). The back-end units provide catalogs of available components to the salesforce (D8, O5). In addition, the back-end units support the salesforce with technical know-how for the sales process. The Head of Product confirms that his back-end unit delivers *"(…) training, demonstration software tools, sales brochures, and material" (I4)* to the salesforce. The salesforce also takes over aftersales activities (I3). In the event of complicated technical questions, the front-end unit involves experts from the respective back-end unit (I1, I4).

The second guiding principle is a revised divisional split for back-end units. There are two types of back-end units at the case firm. One type supplies the salesforce with solution components, and the other type refers to corporate support units for administrative tasks. The supplying back-end units focus on solution components, like machinery, services, or digital components. Each supplying unit is responsible for developing, producing, and delivering its components reimbursed by cross charges. The case firm operates three supplying units, the product unit (PU), the service unit (SU), and the new business unit (NBU) (D7). This setup reflects the importance of all components for the firm's solutions. *"Since this year we have a separate service unit. Our management realized that it is worth pushing this topic" (I1).* An NBU executive characterizes the positioning as an internal supplying unit: *"[The NBU] sells [its digital offerings] as an internal supplier to the [salesforce]" (I5).* While the PU and SU only act as internal supplying units, the NBU additionally sells its components to third-party customers. This decision aims at scaling the NBU as it was recently acquired from an Internet of Things (IoT) provider and still has a relatively small footprint in the firm in terms of revenues (I2, D3). The external revenues help to scale the NBU (I5). The second type of back-end unit refers to

corporate support units that take over HR administration, financial accounting, and IT infrastructure in a centralized way (D7).

The third guiding principle refers to the autonomy of intra-organizational units. Each unit of the manufacturing firm is responsible for its profit and loss statement. Only the corporate support units are financed by a top-down budget allocation (O1). In practice, salesforce, PU, SU, and NBU collaborate on an internal customer/supplier relationship. Internal customers reimburse internal suppliers based on cross charges. This relationship decouples intra-organizational units. The salesforce sources solution components from the supplying back-end units and compiles a solution based on these components. Each unit along the value chain charges its own margin (I3).

Two aspects of intra-organizational autonomy become prevalent: First, autonomy causes additional administrative work across units. A regional Head of Sales introduces the example of licensing software access for remote machine access to a customer. The salesforce must first subscribe to the respective NBU license before re-selling it to the customer. *"You [as salesforce] need to unsubscribe if your customer no longer needs it" (I3).* A SU representative positions the administrative work between units as a critical step to support the internal shift to value every part of a solution offering: *"Today, it is critical to scale the service aspect to differentiate from competition. (...) We use customer trainings for differentiation. (...) Customer trainings are not cheap. They need to be organized to address customer needs and expectations" (I1).* Second, autonomy requires each unit to build a competitive and sustainable business model itself. The Head of Sales explains their business model: *"The [NBU] charges EUR 500 for the app. (...) I need to add my margin and sell it to the customer for EUR 800. (...) [As salesforce] I offer bundles, including maintenance, remote services, digital offerings" (I3).* An NBU executive describes how autonomy helps the NBU in acting in an entrepreneurial way: *"Every stakeholder [like PU or external customers] wants his requirements with [the] highest priority. This would be unmanageable. We decide based on the highest business value [for us]" (I5).*

4.3 Organization of digital and traditional IT resources for digital servitization

Similar to the changes of the overarching organization, the case firm realigned its IT resources throughout the reorganization. Before the case firm's reorganization, its IT resources monitored a third-party provider to deliver traditional (corporate) IT services. Predecessors of digital solution components were sourced from external providers (D3, I5). As part of the reorganization, the case firm structured its organization of traditional and digital IT resources. Therefore, we look at the case firm's organization of IT resources after the reorganization in the following section. We focus on the case firm's type of bimodality, IT resource allocation, IT governance, and sourcing mode and summarize them in figure 4.

(1)	Type of bimodality		Integrated		Separated
(2)	IT resource allocation	Digital IT mode	Centralized	Hybrid	Decentralized
		Traditional IT mode	Centralized	Hybrid	Decentralized
(3)	IT governance	Digital IT mode	Centralized	Hybrid	Decentralized
		Traditional IT mode	Centralized	Hybrid	Decentralized
(4)	Sourcing mode	Digital IT mode	Insourced		Outsourced
		Traditional IT mode	Insourced		Outsourced

Figure 4. Digital and traditional IT of the case firm

The case firm separates digital and traditional IT resources. In its daily language, our interview partners consistently refer to the *"IT colleagues"* as traditional IT resources that supply IT infrastructure and IT applications as part of the corporate support units (I2, I5). In contrast, digital IT resources are part of the PU, SU, or NBU. The Head of New Business Sales demonstratively includes digital IT resources when talking about his team: "*In our [new business] team, we currently develop a dashboard"* (I2). Similarly, the Head of Product points out that software development is a department with close collaboration with the product engineering in his PU. *"(...) We have a separate department for the software, but we are at least together in the same building"* (I4). In summary, the digital and traditional IT modes are separated. Therefore, each of the other aspects of the IT organization needs to be separately examined per mode.

Concerning the IT resource allocation, the PU, SU, and NBU act decentralized as they have different digital IT resource needs. The PU requires digital IT resources with hardware-related skills to extract machine data. The Head of Product (I4) illustrates that the digital IT resources of the PU are *"(...) part of the assembly and production team" (I4)* and develop the data interface of the machine (D9). The NBU employs another type of digital IT resources. These digital IT resources use machine data to create new business opportunities, e. g., an IoT application for remote machine access (D11, D12, I2, I5). *"We use the data [provided by the interface]. In the next step [the IoT application] processes the data (...) and makes them available via a dashboard (...)" (I5).* Similarly, the SU requires another type of digital IT resources for digital services based on machine data. The ramp-up of its own Augmented Reality (AR) developers to extend existing training services with AR eLearning modules is an example of how the SU employs its digital IT resources (D10, I1, O2, O4). *"We [as service unit] ramp up one or two [AR] developers. We know that this topic is becoming more and more important. (...) We are less dependent and do not have to worry about a loss of data or ideas" (I1).* The salesforce does not employ its own digital IT resources. The unit involves digital IT resources from the supplying back-end units as needed by the salesforce (I3). This punctual salesforce support is important as customers' buying centers increase their digital literacy, e. g., to understand cybersecurity risks associated with machines and their digital services (I3). In conclusion, the case firm allocates digital IT resources in a decentralized way across the PU, SU, and NBU to address their specific demands.

In contrast to the digital IT mode, the traditional IT mode is centralized in a corporate support unit and manages business applications, e. g., the CRM or the ERP (I2), provides the ICT infrastructure, or manages the IT helpdesk (I3).

Another characteristic of the IT organization is its IT governance. A Head of Product describes the business units' digital IT as separate islands (I4). The separate islands align based on a minimum standard. The Head of New Business Sales refers to this minimum standard as a common language (I2). *"What we did, was to choose [a standard communication protocol] and [a standard machinery data mapping norm] as joint standard. (...) We speak the same language based on the similar data structure" (I2).* Another executive confirms the importance of this minimum standard for the intra-organizational collaboration between units with different components, like the PU with machinery and the SU with services. *"Often, this [interplay between units with long and short innovation cycles] did not work. (...) Now, based on this standardization, we can collaborate (...) much more efficiently"* (I5). The interviewed service manager confirms this and argues that the decentralized IT governance supports the business units' flexibility (I1). In conclusion, the case firm operates a hybrid IT governance structure for its digital IT mode: A minimum set of decisions remains centralized based on the decision of all involved business units, e. g., regarding machinery communication protocols and data mappings. The remainder of the decisions of the digital IT resources is decentralized to their specific business units.

For the traditional IT mode, the corporate support unit aligns centrally on IT service levels based on the other business units' requirements and decides for the appropriate technology stack and its operations. The decisions are bundled in IT service level agreements (D7, D13).

The fourth characteristic of the digital and traditional IT modes points to the sourcing of IT resources. In its strategy, the case firm commits to addressing digitalization as a driver of the competitive environment while maintaining an efficient organization.

The PU views digital IT resources as critical to its products as mechanical engineers. Therefore, the PU insources digital IT resources on a long-term basis (I4). *"Developing new products is not a single task only for a mechanic (...)*

We want to have all the knowledge and the know-how inhouse. We want to tie up our developers and software expertise (...)" (I4). A second observation shows the NBU's sourcing strategy for digital IT resources. The whole unit has been acquired from a leading IoT provider (I2, I5, D3) to insource IoT capabilities (I5). This insourcing shows a shift of the sourcing policy as the IoT provider has previously been among the third-party suppliers for digital components (I5). The sourcing of own AR experts for new service offerings confirms this sourcing policy (D10, O2). Even though the AR application development is still in a pilot phase, the case firm views the associated AR application developers as strategic digital IT resources for its future service delivery. *"With own developers (...) that focus consequently on AR applications, we can differentiate our customer training offering"* (I1).

The corporate support unit follows a sourcing policy to create an efficient organization (D2). It cooperates with an IT outsourcing partner to run and operate its IT infrastructure and manage business applications (I1, I2, D13). While the case firm owns the ICT assets (I2), it outsources IT services based on long-term contracts (D13).

5. Discussion

This section discusses our four key findings regarding a manufacturing firm's overarching and digital and IT organization while undergoing digital servitization. Table 2 shows an overview of our findings and indicates industry-oriented implications.

Our case study's starting point was that the case firm transitioned from a product-oriented business model to a more service-dominant business model to strengthen its role over the whole product lifecycle. This strategic transition affects the firm's organizational structure. The case firm started from an organizational structure centered around products to an organizational structure that accommodates its new offerings based on products, services, and digital components. From the digital and IT perspective, the firm established a decentralized and internalized digital IT supporting the offerings' structure while maintaining a centralized and outsourced traditional IT for efficiency reasons.

Table 2. Overview of the four key learnings

	Case-specific findings	Industry-oriented implications
#1	The case firm adopts a hybrid organizational structure.	Realign front-end as a unified salesforce to ensure a consistent customer experience
		Split back-end along components to mirror the architecture of the offering
#2	The case firm decouples its intra-organizational business units.	Align the business units as an internal value network contributing to an overarching solution
		Decentralize decision-making to enable entrepreneurial thinking of the business units
#3	The case firm decentralizes and internalizes its digital IT resources along with the business units.	Decentralize digital IT resources by mirroring the structure of the offering to strengthen intra-organizational autonomy
		Emphasize the alignment of the decentralized digital IT resources based on minimum standards
		Internalize strategically relevant digital IT resources
#4	The case firm centralizes and outsources its traditional IT resources.	Increase efficiency and standardization for traditional IT services

Our first finding refers to the case firm's new hybrid organizational structure that consists of a unified salesforce as a front-end unit and back-end units split along the product, service, and digital components. The hybrid organizational structure combines a product/service split, such as a front-end/back-end split, as indicated in the middle column ("use-oriented") in figure 5. Before its strategic transition, the case firm's digital servitization business model archetype was similar to a "*Product-oriented Service Provider"* with a primary focus on products [6, 22]. Services were considered as an add-on to products. The new strategy aims at combining the characteristics of two archetypical business models: (1) an "*Industrializer*" that strives for efficient delivery of combinations of products and services, and (2) a "*Customer*

Integrated Solution Provider" that pursues an integrated offering to address the customers' needs over the lifecycle [22]. The case firm mirrors these strategic changes in its hybrid organizational structure. The consolidation of sales resources as a unified salesforce increases consistency at the customer interface. Other researchers have captured the idea of a unified salesforce as a customer success unit [27, 45, 47]. Literature indicates that such a unified salesforce may be helpful to link multiple system components as solutions to generate customer value [28, 89]. Similarly, scholars confirm our observations that the salesforce approaches customers with a team of interdisciplinary experts to offer solutions consisting of different components [47]. This unified team provides a seamless customer experience versus multiple, component-specific salesforce teams. In the back-end, the units' structure mirrors the offerings' components. This structure creates equal attention for the importance of product, service, and digital components [25]. Operationally, the back-end split supports a division of labor with an optimization per component-specific business model [16, 18, 47]. Even though the back-end split increases focus and efficiency per unit, it also increases the coordination effort among these units. Servitization literature labels this phenomenon as the paradox of performing. Manufacturing firms strive for operational excellence and efficiency while creating customized hybrid offerings [90].

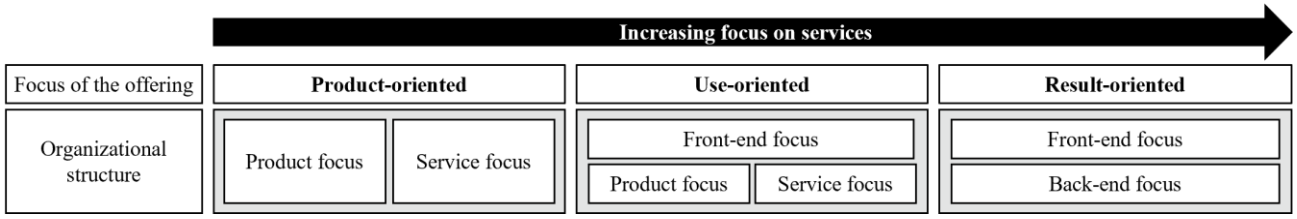

Figure 5. Hybrid organizational structure mirroring the hybrid structure of the offering

Our second finding refers to the decoupling of business units. The case firm decouples its intra-organizational units as a network of value-creating instances. This finding resonates with literature regarding two aspects: acting as a value network and striving for decentralized decision-making in digital servitization. In our case, the business units (except the corporate support units) operate autonomously and focus on their component-specific business models in the back-end and the overarching offering in the front-end. Each unit carries its own profit and loss responsibility. This intra-organizational structure is similar to the idea of value networks or partnerships in digital servitization research [91, 92]. Value networks consist of multiple actors contributing specific components to a complex, overarching offering [22, 93]. Typically, these multiple actors are numerous different firms [91, 93]. Our case shows a value network within a firm building on internal partnerships. Each of the case firm's units with profit and loss responsibility makes its own decisions for its own business model, e.g., the NBU markets its components beyond the "internal" value network to third-party companies to strengthen its business unit. This aspect of decoupling the business units is consistent with the idea of decentralized decision-making of business models undergoing digital servitization [45, 94]. The decentralized decision-making regime facilitates actors to be entrepreneurial and seize business opportunities autonomously [91]. Still, these actors need to align on their links to prevent conflicts of interests and ensure strategic fit [22, 25].

Even though decoupling stimulates entrepreneurial thinking, we question whether this extreme level within a firm is preferable for digital servitization. Decoupling supports the creation of intra-organizational "islands" instead of modular value networks [18]. The stronger the units are decoupled, the more each "island" optimizes its own component-specific business model. Some scholars even report executives' concerns about partial mutual cannibalization [92]. Hence, this extreme approach could be an inferior option in the long term. It fosters optimization for local maxima, e. g., profit per business unit, instead of a global maximum, e. g., firm-wide profit.

Both observations about the overarching hybrid organizational structure with a high level of intra-organizational decoupling indicate that this might generally be a favorable option for manufacturing firms undergoing digital servitization. It remains questionable whether extreme levels of intra-organizational decoupling support this transition.

Our third finding refers to the decentralized internalization of digital IT resources. The case firm allocates digital IT resources per business unit as internal resources. This finding aligns with literature in supporting the autonomy of the business units, creating an effective digital IT governance, and strengthening the strategic transition to digital servitization. At the overarching firm level, PU, SU, and NBU act as autonomous actors that create separate components for the offering. Each business unit has a specific demand for digital IT resources. The decentralization of digital IT resources strengthens the business units' autonomy [73]. This IT resource allocation is in line with servitization research that suggests combining digital expertise with traditional firm functions as interdisciplinary firm functions [45]. Recent digital servitization literature even contends that manufacturing firms undergoing digital servitization should develop their own digital capabilities like software companies [28]. The internalization of such resources promotes the creation of novel offerings by unlocking previously unexplored potential [92]. The decentralized digital IT governance at the case firm works by decoupling while committing to a common set of minimum standards based on communication protocols and data mappings to align their decentralized digital IT resources. This IT governance could be an example of "the most visionary destination" [62, p. 116] to govern decentralized digital IT resources in an organization. Furthermore, the case firm internalizes its digital IT resources across its back-end units. This aspect of the digital IT organization confirms the increased importance of digital IT resources for the strategic transition of the case firm towards digital servitization [13, 81, 95]. Our in-depth case study showed that the case firm has a high level of digitalization in the back-end, but also in the front-end, e. g., with the development of app-based digital customer interfaces. Literature suggests allocating IT resources in correspondence with an offering's architecture [59]. Therefore, we found it counterintuitive that the case firm's salesforce does not have its own digital IT resources. Instead, we found that the NBU, a back-end unit, develops several digital customer interfaces. In the future, it might be an opportunity to reallocate the development of digital customer interfaces to the salesforce that interacts with customers to reduce the risk of intra-organizational friction [59].

Our fourth finding addresses the outsourcing and centralization of the traditional IT organization. Our case firm centralizes the allocation of traditional IT resources and corresponding decision rights in a small unit that orchestrates an outsourced provider. This sourcing decision follows the firm's strategic direction to build an efficient organization by outsourcing non-core competencies, e. g., ICT infrastructure operations or internal IT helpdesk [96]. For this purpose, the centralization contributes to an efficient organization by standardizing the ICT infrastructure [18, 97]. In addition, the long-term nature of the observed outsourcing relationship confers with existing digital servitization research that identifies such ICT infrastructural aspects as indispensable for a firm's viability [92].

To the best of our knowledge, this case of a manufacturing firm's IT organization with a digital and a traditional IT mode presents one of the first codified in-depth case examples in the context of digital servitization from an organizational perspective. It shows that the decentralized internalization of digital IT resources facilitates the transition towards a more service-dominant business model enabled by digital technologies. The outsourcing of traditional IT services resonates with previous contributions about IT infrastructure provision as non-differentiating activity [98].

6. Conclusions

Our research has several contributions. First, we address the call to clarify how to approach digital servitization from an organizational perspective to answer RQ1 [21, 22]. We summarize the current perspectives of organizing for digital servitization for a product-oriented or a result-oriented and thus service-dominant business model. We aggregate two theoretical perspectives on firms' organizational structures as a hybrid organizational structure. We describe the hybrid organizational structure based on the case of a common manufacturing firm. The hybrid organizational structure helps to understand how manufacturing firms can manage multiple autonomous business units for solution components in their back-end complemented with a unified sales approach [17].

Second, we clarify how a manufacturing firm sets up its digital and traditional IT modes to support its digital servitization [4, 9, 23] to address RQ2. The decentralized digital IT resources support autonomous business units and ensure that they can utilize digital technologies according to their demand. A minimum consensus serves to align the

digital IT resources across business units. This digital IT mode is suitable for manufacturing firms that orchestrate multiple teams of digital IT resources as part of a hybrid organizational structure [18, 23].

For practitioners, we outline the hybrid organizational structure as a reference structure for manufacturing firms that plan to transition from a product-oriented business model to a more service-dominant business model. Our contributions support manufacturing firms that move to a business model with an offering based on product, service, and digital components. We describe intra-organizational decoupling as an option to establish a solution based on such components. Further, our findings offer a perspective of how manufacturing firms can shape and align their IT organization based on a digital and a traditional IT mode for digital servitization.

Our findings are not free from limitations. First, our results build on a single, in-depth case study. We selected this case purposively as a common case from the tool manufacturing industry and chose to describe the case firm's organizational structure. By describing the context of the case firm as well as the situation before and after the reorganization, we claim that readers can – based on their experience – use the case for understanding new settings as well, i.e., at least so-called "naturalistic generalization" (inductive analogy) is supported [33, 99]. Still, our findings cannot be generalized to other industries or different firm sizes without caution. Second, even though our data is grounded on multiple perspectives, we could not gather an explicit interview from the case firm's support unit. Due to the ongoing COVID-19-pandemic, the case firm's workforce was ramped down so that the remaining employees needed to cover higher than usual workloads. As an alternative, we agreed with the case firm to explore the role of the support unit from interviews with experts of the firm's remaining parts and observations from work shadowing of these experts.

Future research can extend our findings on how firms can approach digital servitization. We propose three avenues for future research.

First, researchers could analyze other manufacturing firms that balance product and service focus and update our suggestion of a hybrid organizational structure as they transition to a more service-dominant business model. It would be interesting whether different types of manufacturing firms exploit different sub-types of hybrid organizational structures.

Second, the case firm shows a high degree of intra-organizational decoupling. This decoupling creates internal friction. While we explicitly observe coupling mechanisms of the digital IT resources across the decoupled business units, it remains unclear how this is concretely managed on the overarching level. Future research should clarify appropriate coupling mechanisms to overcome local optimization of solution components leading to global optimization of hybrid solutions.

Third, we found that our case firm has increased demand in digital IT resources, e. g., for AR or IoT development. In an extreme case, the firm acquired an IoT provider to offset its gap in expertise. It remains unclear how this might work for firms with fewer capital resources. Future research could clarify IT sourcing strategies of manufacturing firms that initiate digital servitization.

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Appendix A. Overview of the coding structure

For clarity reasons, we pruned our 46 codes to 28 codes displayed in figure 6. Hence, we provide an overview of our coding structure up to the 3rd coding level for the codes "context" and "offerings", and due to the relevance of the "organization" up to the 4th coding level for this branch.

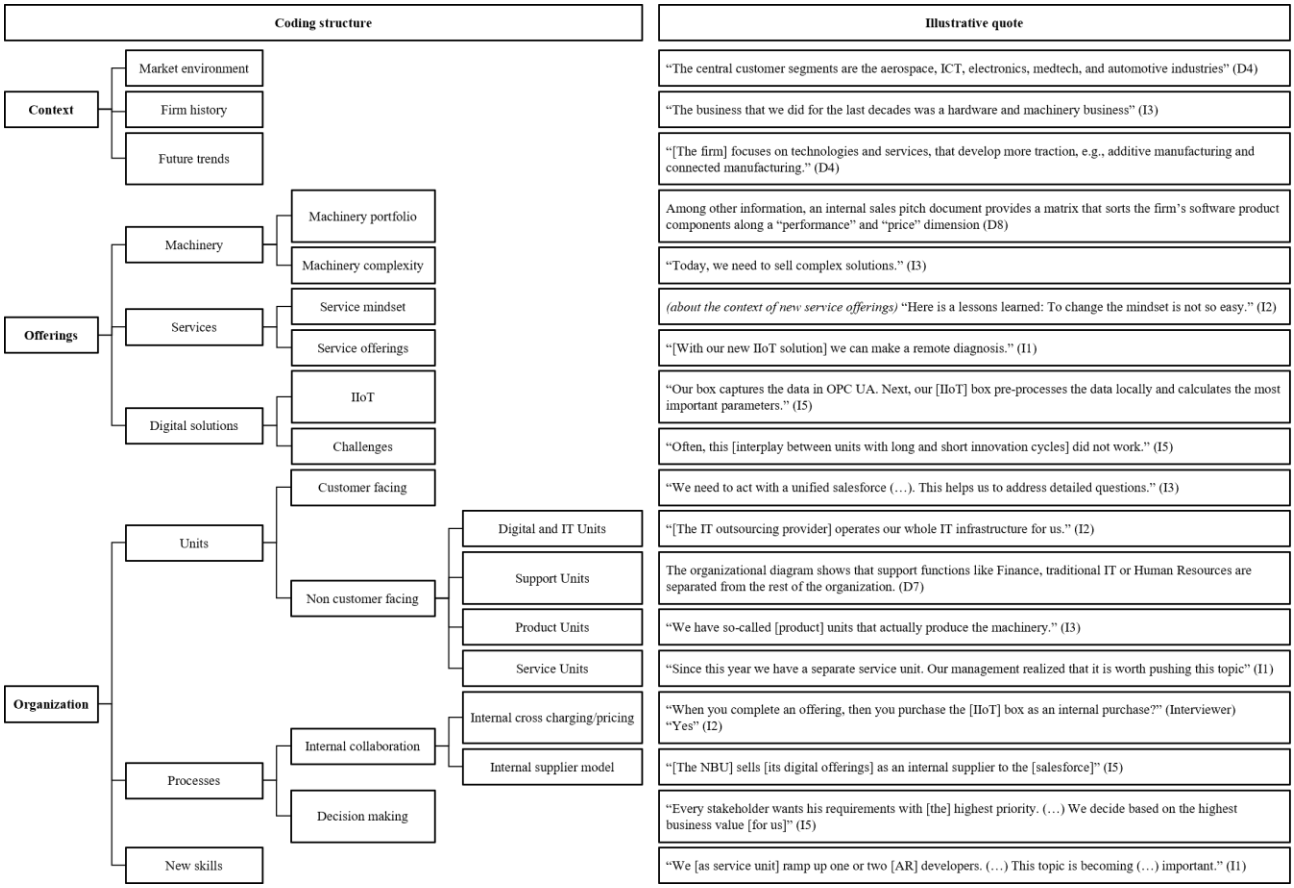

Figure 6, Pruned overview of the coding structure with illustrative quotes

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