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EXPLORING OVERARCHING PSS DESIGN IN B2B INDUSTRIAL MANUFACTURING

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ABSTRACT

Purpose: The objective of this study is to explore PSS design approaches for product-service innovation in the B2B manufacturing industry. This paper builds on current research within the Delft University of Technology, researching the role of design as a driver for change and servitization.

Design/Methods/Approach: We studied 13 product-service design cases of ten weeks, carried out by students industrial design engineering. We collected the case data, observed their process and analysed the outcome of the project. We mapped the product-service proposals and built frameworks categorising levels of innovation and the applied strategic design elements and methods.

Findings: Taking an overarching innovation approach, creating a broader perspective on the value chain, exploring new business contexts without being hindered by conventions and limitations and using state-of-art design methods, increase the innovation level of product-service propositions.

Originality/Value: This study draws attention to the importance of strategic design processes in PSS innovation.

KEYWORDS: client-of-the-customer, overarching servitization, strategic design, value proposition

1. INTRODUCTION

Servitization research has so far mainly focused on its effects in terms of benefits for the companies. For example, Baines & Lightfoot (2014) and Visnjic et al. (2013) have shown in their surveys that industrial companies are more successful when they add services to their products. In the long run, these companies show growth in their turnover and profits (Baines & Lightfoot, 2014). Moreover, they know better how to arm themselves against disrupters. In fact, by going through a servitization process, they discovered that they show more resilience and better prepared for drastic changes in their market. They learned that servitization could be an excellent strategy to respond proactively on new market circumstances (Visnjic et al., 2013). Some industrial companies even learned to develop disruptive services complementary to their products (Visnjic et al., 2013). However, considering the process of servitization, we see industrial companies struggling with the transition from product-oriented into service-oriented value propositions. They find it difficult to change the related business model, and they tend to get stuck in their known way of working. They often lack the right capabilities and experience to implement such a strategic change (Tongur & Engwall, 2014). Their organizational structure is also usually not fit to design services added to physical products (Baines et al., 2007). To address such strategic elements, several scholars took the initiatives to increase knowledge in the manufacturing industry in this regard by studying servitization practices and reflecting on implementation processes. For example, Grubic & Jennions (2018) analysed multiple outcome-based product-service solutions (PSS) cases and a framework for service development. Adrodegari et al. (2017) discussed a process framework for PSS business model design. Concerning organisational aspects, Burton et al. (2017) explained the challenges companies face during a servitization journey. Reim et al. (2015) carried out an extensive literature review of papers that discuss business models and tactics in servitization.

Overall, in these efforts for a better understanding of servitization, the design-driven approaches for successful service development (Dong, 2015) have been largely overlooked. Therefore, this paper studies the design of PSS within the business-to-business (B2B) manufacturing industry, addressing end-user needs and behaviour. This paper builds on recent efforts within the Delft University of Technology in which we

study design as a means for strategic innovation in the industry, where we see a growing interest in the role of design as a driver for change and service innovation. In a recent study, Price et al. (2019) captured how companies can use design as a means for strategic innovation and provided a framework to identify the different levels of innovation.

In this paper, we used this framework (Price et al., 2019) first to categorise 13 design project cases that student groups carried out, developing product-service solutions for an industrial company. Then, we analysed the strategic elements of PSS design in relation to servitization and uncovered an *overarching servitization* approach.

In the next section, the theoretical background is addressed. Then the method is described, followed by our findings in the result section, ending up with the discussion of the findings and an outline of further research avenues.

2. THEORETICAL BACKGROUND

2.1. Servitization in B2B industrial manufacturing

From a recently carried out literature scoping study concerning the state of servitization knowledge in the B2B manufacturing industry, we concluded that this research concentrates in Europe, mainly in the UK and the Scandinavian countries (Bluemink et al., 2020). In these studies, we found that moving into service-oriented products requires a servitization strategy, which inevitably entails a change in how companies create value for end-users and consequently impact the company's business model (Baines et al., 2009; Reim et al., 2015). Product-service design affects the internal organisational structure of design processes and triggers design collaboration with partners in the company's network (Ziaee Bigdeli et al., 2017). However, the design-driven approaches for successful service development (Dong, 2015) have not been practised widely within the B2B manufacturing industry. Only a few papers study the design of product-service solutions addressing end-user needs and behaviour. Although Ryu et al. (2018) recognised a growing interest in UX-design as a servitization strategy, overall, the servitization literature focused on the B2B manufacturing industry lacks product-service design approaches.

2.2. Servitization and PSS Design

Servitization is a useful strategy for technology-intensive manufacturers to extend their current product portfolio with linked services. In essence, servitization is defined as a transition process from selling products to selling product-service systems (Kohtamäki et al. 2018). Along with the increasing use of data platform technologies, many opportunities have arisen for differentiation in service propositions. Based on which also newcomers got a chance to disrupt industrial manufacturing markets. In considering competitive advantage, technology-intensive manufacturers in the capital goods industry have shown a growing interest in servitization. Previous studies learned that manufacturers that adopted servitization were able to increase their business profitability (Baines et al., 2010; Reim et al., 2013; Story et al. 2017). In the literature stream of design, similar studies argued that a design-driven approach is a useful strategy to achieve successful PSS results (Price et al., 2019; Dong, 2015). However, a combined approach of PSS Design in the manufacturing industry has not been found. In the Aerospace industry, Price et al. (2019) conducted research that was triggered by earlier research initiatives by Dong (2015), showing that design-driven innovation leads to successful results for organizations and industries. She evaluated 82 master and doctoral theses conducted in the Dutch aviation industry and captured how companies can use design as a means for strategic innovation. Based on this case evidence, she has built a framework to identify the different levels of innovation. In this study, we extend this framework to the B2B manufacturing industry.

2.3. Strategic Design and PSS Design

In addition to PSS design-driven approaches to achieve successful PSS results Table 1 shows the thematic results of our scoping review study (Bluemink et al., 2020). We found that the five strategic design elements *business models, organisational capabilities, value creation, collaborative networks* and

servitization strategies are helpful to take into account in PSS design. Moreover, we argued that to better understand PSS design as a strategic approach to increase the competitiveness and resilience of the company in a future context, we currently have insufficient knowledge of *overarching servitization*, about how to create PSS that serve customers throughout the value network. Both findings led to our research question: how to design strategic elements in PSS in B2B industrial manufacturing.

Table 1: Number of Studies per Main Strategic Element Addressed

Strategic Element	Number of Studies	Short Description of Topic
<i>Business Models</i>	17	<i>Discussing Business Models in Servitization</i>
<i>Organizational Capabilities</i>	10	<i>Discussing Organizational Capabilities to execute Servitization</i>
<i>Value Creation</i>	9	<i>About Value Creation through Servitization</i>
<i>Collaborative Networks</i>	6	<i>Discussing Providing PSS's through Cooperation in a Network</i>
<i>Servitization Strategies</i>	8	<i>Discussing Strategic Frameworks and practices for Servitization</i>

In previous studies, Price (2019) and Dong (Dong, 2015) argued that a design-driven approach is a useful strategy to achieve successful PSS results. Bluemink et al. (2020) found that the five strategic design elements of our scoping study *business models*, *organisational aspects*, *value creation*, *collaborative networks* and *servitization strategies* are helpful to take into account in PSS design. Moreover, he argued that to better understand PSS design as a strategic tool to increase the competitiveness and resilience of the company in a future context, we currently have insufficient knowledge of *overarching servitization*, about how to create PSS that serve customers throughout the value network. Both findings led to our research question: how to design strategic elements in PSS in B2B industrial manufacturing.

3. METHOD

3.1. Data Collection

In total, we selected a sample of 13 design cases of a strategic design course provided at the Delft University of Technology, as part of the International Strategic Product Design master program. We used three selection criteria. First, the company operates in a B2B market. Second, it manufactures and supplies mainly physical products. And third, it has strong R&D-capabilities and in-house knowledge of advanced technology. Five groups carried out the course assignment for ten weeks in the autumn of 2018 for an industrial company that produces baggage handling systems for the aviation industry. In the fall of 2019, eight groups took the same course for a manufacturer of commercial vehicles. In all cases, the students drew up a strategic plan for the company and to propose a new integrated product-service. At the end of the project, we gathered the data the students delivered, consisting of a poster presentation, a minimum viable product (prototype) and an end report explaining the proposed product-service solution.

3.2. Data Analysis

We analysed this data according to the classification model of Price et al. (2019) to determine the level of innovation. We first classified the innovation level of the expected outcome as defined in the initial design brief. Both companies asked the students to propose an integrated product-service solution as part of a strategic plan. Based on this, we classified the expected solutions as Integrated Products. We then mapped out the design case results by the level of innovation to understand to what degree the students elaborated their product-service solutions. After analysing the collected data, we were able to sort all projects according to the innovation level and mapped them the out on the framework of innovation level (Price et al., 2019). The course coordinator who also was involved in the study of Price (2019) contributed to the aerospace and manufacturing comparison. The second author secured the objective stance to the data analysis. In the second phase, we classified to what extend the students covered the strategic design elements of Bluemink et al. (2020). We analysed the deliverables of each case and extracted, clustered and

mapped out additional strategic design elements. We then determined the extend of element coverage in the particular case by using three categories: fully, partly, or not covered in the case.

4. FINDINGS

Two out of 13 cases created a product-service solution on the same level of innovation level compared to the initial brief (Table 2). Four groups were able to design solutions as classified in the second level of innovation, *Services, Processes and Interactions*, creating user experiences and services for end-users. With their answers, they ‘jumped over’ the B2B-customer of the company, direct addressing end-users in the next step of the value chain. Seven groups, however, added complexity to their proposed value proposition by involving other stakeholders in a joint product-service network solution. We categorised their solutions in *Systems and Organizations*. 12 out of 13 groups made use of digital data platform as part of their solution to manage the end-user interactions and value transactions.

Table 2: Levels of Innovation at the begin and end of the project

Year	Team	1st Coach / Principal Researcher	2nd Coach	Innovation Levels according Price et al. (2019)		
				Integrated Products	Services, Processes and Interactions	Systems and Organizations
2018	Group 6 Pick&Go	1	2	●	→	▲
	Group 11 PickUp	1	2	●	→	▲
	Group 12 GiftDrop	1	2	●	→	▲
	Group 20 Baggage Hotel	1	2	●	→	▲
	Group 29 UX	1	2	▲		
2019	Group 12 Vita	1	3	●	→	▲
	Group 14 Unboxing	1	3	▲		
	Group 15 Quook	1	3	●	→	▲
	Group 21 Incubator	1	3	●	→	▲
	Group 22 Craft	1	3	●	→	▲
	Group 26 Switch	1	3	●	→	▲
	Group 28 MedX	1	3	●	→	▲
	Group 29 Delivery	1	3	●	→	▲
<p>● = Innovation level asked in the brief of the project</p> <p>▲ = Innovation level result at the end of the project</p> <p>→ = Increase of innovation level during the project</p> <p>← = Decrease of innovation level during the project</p>						

During the coaching sessions, we observed that all groups show a more or less standard approach in the way they carry out their project. In most cases, they used one or two of the following design methods and techniques that we teach as part of the Strategic Product Design master program of the Delft University of Technology Faculty of Industrial Design Engineering: the Vision-in-Product Design method by Hekkert (2014) and the Design Roadmapping method by Simonse (2017). Both approaches, each from another angle, focus on the future perspective and make a PSS design strategy more tangible and explicit, by creating a future vision, exploring a new business development strategy and designing a roadmap to deploy the new strategy (see Table 3).

Table 3: Strategic Design Elements Covered in the PSS Design Cases

Year Team		Strategic Design Elements									
		Business Model	Organisational Capabilities	Value Creation	Collaboration in a Network	Servitization Strategy	Future Vision	New Business Strategy	Design Roadmap	Overarching Servitization	
2018	Group 6 Pick&Go	✔	✔	✔	✔	✔	✔	✔	✔	✔	
	Group 11 PickUp	⚠	⚠	✔	✔	✔	✔	✔	✔	✔	
	Group 12 GiftDrop	⚠	⚠	✔	✔	✔	✔	✔	✔	✔	
	Group 20 Baggage Hotel	✔	✔	✔	✔	✔	✔	✔	✔	✔	
	Group 29 UX	✖	✔	✔	✖	✔	✔	✔	✔	⚠	
2019	Group 12 Vita	⚠	⚠	⚠	✔	✔	✔	✔	✔	✔	
	Group 14 Unboxing	✖	✔	✔	⚠	✖	✔	✔	✔	✖	
	Group15 Quook	⚠	⚠	✔	✔	✔	✔	✔	✔	⚠	
	Group 21 Incubator	✔	✔	✔	✔	✔	✔	✔	✔	✔	
	Group 22 Craft	✔	✔	✔	✔	✔	✔	✔	✔	✔	
	Group 26 Switch	⚠	⚠	✔	✔	✔	✔	✔	✔	✔	
	Group 28 MedX	⚠	⚠	⚠	✔	✔	✔	✔	✔	✔	
	Group 29 Delivery	✔	✔	✔	✔	✔	✔	✔	✔	✔	
		✔	= Fully covered in case deliverables								
		⚠	= Partly covered in case deliverables								
		✖	= Not covered in case deliverables								

Five out of 13 cases covered all strategic elements in their deliverables. All cases delivered PSS design that focused on a future business context by providing a future vision, a new business strategy, accompanied with a design roadmap for deployment. Ten out of 13 cases applied an overarching servitization strategy, bypassing the company's direct customer, addressing the end-user in the value network. As Table 3 shows, the students encountered most problems with setting up business models throughout the value network and determining the capabilities that an organization must deploy to introduce the PSS.

5. DISCUSSION

Generally spoken, manufacturing industries usually operate in a B2B market, with a strong focus on the needs of their direct customers. The two companies involved in our cases also focused mainly on this one-to-one relationship with their customers, creating PSS within their current B2B context. However, in most cases, we saw the student-designers looking beyond the current B2B context and shifting to the next levels of innovation of Price' framework (Price et al., 2019). By creating solutions that entail an extended supply chain, we unravelled strategic design elements. First, as the designers built a business-to-business-customer value chain (B2B2C), they were overarching current company's customers. Second, at the end of the strategic design project case, both company representatives showed surprised by the quality of the strategic design process and the completeness of the final PSS design results.

5.1. Limitations and further research

Although the students lack the expertise and knowledge of experienced R&D-engineers, they are unbiased; they have a fresh look at the business and can open up a broader perspective, exploring new business contexts without being hindered by conventions and limitations of their context. Further, they bring skills, toolboxes and up-to-date knowledge into the project, using proven design methods and techniques as described in the Delft Design Guide (van Boeijen et al., 2014; 2019).

5.2. Contribution to the field

The majority, 11 out of 13 design cases resulted in an increased level of innovation, leading to outcomes that were above expectations of the representatives of both companies. We may, therefore, conclude that it makes sense to set up and implement future projects according to this approach and to advise companies to develop and nurture these capabilities in-house.

In our introduction, we showed that the existing servitization research focuses strongly on creating or redesigning business models (Adrodegari & Saccani, 2017; Tongur & Engwall, 2014). This finding, we justified with our study on strategic design elements, as business models are, in most cases, an indirect result of a designed value proposition. After all, both are closely linked and cannot exist without each other. However, we argue that the focus should be on the design of the value proposition itself, not the other way around. Therefore, we promote to start the design process at the end of the value chain and create product-service solutions that bring value upstream into the supply network, then design the related business models.

6. CONCLUSIONS

We examined 13 cases of strategic design carried out by students. We found that using strategic design methods and in particular, taking an overarching servitization approach, enable designers to increase the level of innovation of PSS design results.

Regarding practical implications, we conclude that by creating a mind-set and conditions as present in the student design cases, industrial manufacturers operating in B2B environments can increase the innovation level of their service innovation projects. Moreover, user-centred design, creating product-services and user experiences, improve the outcome of the innovation process. We, therefore, advise focusing on the design of the value proposition itself, rather than on its related business model.

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