BUSINESS MODEL INNOVATION STRATEGIES FOR PRODUCT SERVICE SYSTEMS – AN EXPLORATIVE STUDY IN THE MANUFACTURING INDUSTRY

Research paper

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Abstract

In saturated, product-oriented markets, services provide the potential for differentiation and growth. Innovating a firm's business model (BM) by adopting product service systems (PSSs) seems promising. However, research provides only limited insights on how manufacturing firms can innovate their BM towards offering PSSs. Literature lacks strategies not only to adopt PSSs, but also to further innovate existing PSS BMs. Therefore, this study analyzes reoccurring PSS BM patterns as well as innovation strategies to transform from one pattern to another. We use an explorative, qualitative study with interviews in 14 business units of large manufacturing corporations that are engaged in a PSS BM innovation initiative. Results show three PSS BM patterns, i.e. product-oriented manufacturing, use-oriented enabling and result-oriented service offering. We demonstrate their practical implementation and further derive a conceptual framework for PSS BM innovation describing six evolutionary or transformative innovation strategies. Evolutions, i.e. universalization, digitization and service expansion, change only modules of a BM, whereas transformations, i.e. servitization, integration and leapfrogging, affect the whole architecture. Limitations are the small number of interviews and related limited number of cases. Nevertheless, findings indicate transformation paths and extensions to existing research on PSS types regarding the customization and ownership of PSSs.

Keywords: Product Service Systems, Business Model Innovation, Innovation Strategies, Qualitative Study.

1 Introduction

As saturation of product markets increases, services offer great potential to access new revenue streams and increase competitive advantage (Forkmann et al., 2017, Cusumano et al., 2015, Wise and Baumgartner, 1999). Fang et al. (2008) show a positive effect of a service-oriented strategy for firm value regarding Tobin's q ratio. Qualitative studies confirm that shifting from product to service offerings open up new possibilities like enhancing the value chain position, innovation potential and customer value (Tukker, 2004, Ulaga and Reinartz, 2011, Visnjic Kastalli et al., 2013, Tukker, 2015).

Examples can be found in the information technology industry where product prices have fallen and manufacturers have shifted to service offerings, for example, Dell, IBM or SAP (Cusumano et al., 2015). In the automobile industry, manufacturers have achieved much of their revenue with services, for example, leasing, loans, repairs and maintenance (Cusumano, 2010). A specific example is Xerox. They introduced a Pay-as-you-use model. Customers only pay per printed page and where Xerox, as printer experts, would operate the printer as a service and ensure its availability (Chesbrough, 2010). As a lot of responsibility and the ownership of the product stays with Xerox, this example shows even more opportunities for shifting from product sales to service offerings.

Servitization describes this shift of manufacturing firms that continuously offer more product-oriented services (Vandermerwe and Rada, 1988) and how they build revenue streams (Baines et al., 2017). Research evolved from analyzing the adoption of services for product-oriented business models (BM) to the integration of both products and services (Durugbo, 2013, Barquet et al., 2013, Tukker, 2004). The combination of products and services is called *Product Service Systems* (PSSs) (Goedkoop et al., 1999). PSS research focuses on how both components can satisfy customer needs as a marketable set (Reim et al., 2015).

The process of adopting PSSs (i.e. Servitization) can be seen as a business model innovation (BMI) (Storbacka et al., 2013). BMIs are "designed, novel, and nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" (Foss and Saebi, 2017, p. 216), whereas a BM "describes the design or architecture of the value creation, delivery, and capture mechanisms" (Teece, 2010, p. 172). Both concepts receive increasingly attention in research and practice (Massa et al., 2017, Foss and Saebi, 2017, Böhm et al., 2017).

However, only a few studies address servitization from a BMI lens. Most research analyzes servitization in general or service infusion, i.e. the adoption of PSS BMs (Barquet et al., 2013, Forkmann et al., 2017). Literature addresses characteristics of BM elements for successful adoption of PSSs (Kindström and Kowalkowski, 2014, Maglio and Spohrer, 2013, Reim et al., 2015) or their internationalization (Zähringer et al., 2011). Other papers investigate the impact of servitization on firm performance (Visnjic Kastalli and Van Looy, 2013, Visnjic Kastalli et al., 2013, Visnjic Kastalli et al., 2016).

Research still lacks supporting frameworks or methods for PSS BMI (Morelli, 2006, Tukker, 2004, Reim et al., 2015, Neely, 2008, Barquet et al., 2013). Especially research on BMIs itself is missing (Cook et al., 2006, Dimache and Roche, 2013). Reim et al. (2015) and Kindström and Kowalkowski (2014) point out the lack of research on the organizational transformation, particularly from a service point of view. In addition, studies demand more practical contributions (Goedkoop et al., 1999, Ulaga and Reinartz, 2011, Tukker and Tischner, 2006) as well as conceptual analyses concerning PSSs and BMI (Velamuri et al., 2013, Adrodegari et al., 2016).

There is little research combining PSS streams and BM streams (Velamuri et al., 2013). For characterizing PSS BMs, the literature provides different taxonomies either using PSS types or business model patterns (BMP) (Adrodegari and Saccani, 2017, Tukker, 2004, Wise and Baumgartner, 1999). Although Reim et al. (2015) show how PSS characteristics shape BMs; empirical research is missing. Research lacks empirically grounded frameworks from an integrated view of PSSs and BMPs. Withal, a BMP is an abstractly or generally described BM instance or part of it that has proved to be success-

ful in the past (Gassmann et al., 2014, Amshoff et al., 2015, Remané et al., 2017). Thus, BMP is a suitable concept to describe and support PSS BMs.

Overall, current research slightly addresses the adoption of PSS BMs. However, current studies do not include PSS BMPs and transformation strategies among these PSS BMPs. In other words, current research lacks support for further innovating an already adopted PSS BM and only marginally addresses its adoption. Thus, this paper investigates the following two research questions:

1. What are reoccurring business model patterns for product service systems in the manufacturing industry?
2. What are strategies for business model innovation among these business model patterns for product service systems in the manufacturing industry?

Accordingly, we consolidate PSS BM types from literature and investigate their implementation in practice using an explorative, qualitative study with 14 business units of 10 large manufacturing corporations. Further, we deduce BMI strategies among these PSS BMPs.

For this research objective, we first consolidate three PSS BM types from literature (section 2). Subsequently, the paper elaborates on the research method as an explorative, qualitative study (section 3). The following result section first presents the implementation of PSS BMPs (section 4.1). Second, we show the six PSS BMI strategies and derive a framework (section 4.2). Section 5 discusses the results. Finally, we summarize findings and emphasize implications for research and practice, limitations, and avenues for future research (section 6).

2 PSS business model types

Tukker (2004) proposes a classification based on a spectrum of characteristics of either product or service orientation. This point of view does not focus on product business as a starting point, but shows a product service continuum (Windahl and Lakemond, 2010). Tukker's (2004) classification covers a broad range of PSS cases. The majority of PSS research uses this classification as a starting point for (Dimache and Roche, 2013, Annarelli et al., 2016, Durugbo, 2013, Barquet et al., 2013). Reim et al. (2015) expand the PSS classification of Tukker (2004) by analyzing how a firm's BM changes when implementing a certain PSS type.

Tukker (2004) and Reim et al. (2015) derive three PSS BM types. In the following, we characterize these BMs regarding the institutional logics of Lusch and Nambisan (2015), i.e. goods-dominant and service-dominant logic. Figure 1 provides an overview of identified PSS BM types and their relations to institutional logics.

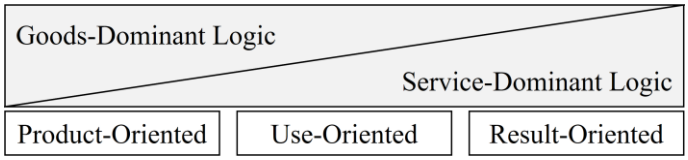

Figure 1. PSS business model patterns adapted from Tukker (2004) and Reim et al. (2015)

The *product-oriented* PSS type by Tukker (2004) and Reim et al. (2015) represents the first PSS BM type. This concept is based on a product that is bought with additional services. Thus, the ownership is transferred to a customer. Product-oriented services deliver secondary value. With this combination of products and services, firms can optimize internal processes and position themselves externally as a cost leader based on standardization. The functional features deliver the core value of the product. Additionally, the low price is another characteristic promoting sales. Services provide additional value. This PSS BM type mainly follows the goods dominant logic as a mental model in organizations (Lusch and Nambisan, 2015, Vargo and Lusch, 2004).

Second, Tukker (2004) and Reim et al. (2015) introduce the *use-oriented* PSS type, where the use of a good shall be promoted by combining products and services. Providers of this PSS BM type allow for customers' product use by applying their service, which increases risks and responsibilities. Tukker (2004) and Reim et al. (2015) further emphasize that a product is made available for usage without transferring the ownership. Examples are product leasing, renting or pooling (Tukker, 2004), so that a customer pays periodically (Reim et al., 2015). The pattern is based on a strong integration of products and services over the lifecycle (Aurich et al., 2006). Accordingly, this BM type is both product and service focused and, hence, covers parts of a goods-dominant as well as a service-dominant logic (Lusch and Nambisan, 2015, Vargo and Lusch, 2004).

The third PSS BM type according to Tukker (2004) and Reim et al. (2015) is *result-oriented*. In contrast to use-oriented, this type focuses on providing a solution. It is not about selling a product but offering a service to solve an issue (Visnjic Kastalli et al., 2013, Aurich et al., 2006, Parida et al., 2014). Products are substitutable tools used in the activity of problem solving. Providers take responsibility for an entire customer problem and are integrated into a customer's organization. As part of the value chain, the firm provides a defined output as a service without selling products. The firm is paid according to the result. Hence, this PSS BM type follows the service-dominant logic as a mental model in organizations (Lusch and Nambisan, 2015, Vargo and Lusch, 2004).

3 Research method

In order to investigate PSS BMs and their transformations, we conducted an exploratory, qualitative study in the context of manufacturing firms. We adjust our research to guidelines of a multiple case study according to Yin (2014). We used the consolidated PSS BM types as a theoretical frame (section 2). In this way, we show how the theoretic BM types apply in practice and investigate their transformations.

For the sampling of cases, we selected 10 large corporations in the manufacturing context and associated 14 business units (i.e. cases) that currently innovate or recently innovated their BM. We chose the firms and related business units in a way that all three PSS BM types are covered and that a broad range of branches is included. All firms represent large enterprises in Germany with employees ranging from 1,000 to 140,000.

Branch	Expert/ Case	Position	Experience	Interview duration	PSS BM
Defense	A	In-Service-Support Manager	6 years	27 min	(R)
	B	Project Manager	6 years	24 min	(U)
Electronic production	C	Product Manager	6 years	35 min	(P)
	D	Project Manager	6 years	24 min	(P)
Propulsion systems	E	Innovation Manager	1 year	35 min	(P)
	F	Head of Innovation Management	10 years	31 min	(P)
Plant engineering	G	Service Manager	6 years	39 min	(U)
	H	Head of Strategic Development	2 years	68 min	(U)
	I	Head of Technical Development	10 years	68 min	(U)
Hygiene industry	K	Product Manager	2 years	38 min	(P)
	L	Product Manager	2 years	34 min	(R)
Power generation	M	Sales Engineer	6 years	39 min	(U)
Automation systems	N	Head of Innovation Management	2 years	27 min	(P)
Construction machines	O	Head of Corporate Strategy	4 years	68 min	(R)

Table 1. Overview of case studies, (P) Product-oriented manufacturing, (U) use-oriented enabling, (R) result-oriented service offering

We qualitatively conducted expert interviews according to Myers and Newman (2007). We selected interviewees that were involved in BMI initiatives (e.g. corporate strategy, strategic development, business development, innovation management or product/service management). The interviews rely on a semi-structured guideline with open questions to capture specific characteristics of each case. The interview guidelines covered three aspects: the initial BM, the transformation and the achieved BM. The interview language was German. Interviews were face-to-face or by phone. Table 1 shows an overview of selected cases and interviews including their duration.

For data analysis, we recorded and transcribed all interviews. We coded the interviews according to Corbin and Strauss (2014) using the qualitative data analysis software MAXQDA. Our coding concept is based three phases of BMI (i.e. initial BM, transformation and achieved PSS BM). Within these three given categories, we used, first, an open coding approach. Keywords of the transformation includes motivation, challenges, related reasons, aspects of the transformation process and practical insights. Second, we used an axial coding based on the dimensions of the *Business Model Canvas* by Osterwalder and Pigneur (2010) as recommended by Massa et al. (2017) or Zott et al. (2011). Two authors were involved in the coding: One author directly coded the interviews and both iteratively revised the keywords. The coding resulted in 29 keywords and 649 phrases.

4 PSS business model innovation framework

Based on the observed PSS BMIs and the corresponding PSS BMPs, we refine existing taxonomies of PSS BMs for manufacturing firms and demonstrate PSS BMI strategies (i.e. transformations and evolutions). Additionally, we highlight extensions to leading PSS concepts like Tukker (2004) and Reim et al. (2015), especially regarding the ownership concept, and integrate constructs in a PSS BMI framework.

4.1 Implementation of PSS business model patterns

	Product-oriented manufacturing	Use-oriented enabling	Result-oriented service offering
Value proposition	High-quality, cost-effective components and integrated and functional products	Custom products and expert knowhow as a service to operate and maintain products	Customer results as a service, products as substitutable tools
Revenue model	Sell a functional good	Sell product-service hybrid	Sell result
Customer base	Industrial firms, price-sensitive, globally sourcing	Industrial firms, highly complex and individual needs	Industrial firms, requirement of maximum cost transparency or with volatile demand
Customer interaction	Until point of sales	Until point of sales, during operation and for maintenance	Throughout customer lifecycle
Transfer of product ownership	Yes	Yes	No
Degree of product standardization	High	Low	High

Table 2. Business model patterns for product service systems

In the following, we show how the three PSS BM types based on Tukker (2004) and Reim et al. (2015) result in three BMPs in practice. We propose specifying the PSS BM debate to certain industries as we observe variances from our data in comparison to the use-oriented PSS type according to Tukker (2004) and Reim et al. (2015) in terms of ownership transfer and standardization. Table 2

shows the details of these three patterns. It shows only a few dimensions of the Business Model Canvas by (Osterwalder and Pigneur, 2010) or variances of it. Omitted dimensions did not significantly separate the BMPs.

PSS BMPs	2nd tier	1st tier	Direct Customer Contact
Result-Oriented Service Offering			A, L, O
Use-Oriented Enabling		M	B, G, H, I
Product-Oriented Manufacturing	C	D, E, F	K, N

Table 3. PSS business model patterns and value chain position of cases (A-O)

We further found different positions in the value chain in the cases (see Table 3). Direct customer access is essential for PSS BMs since providers co-create services with customers (Wise and Baumgartner, 1999, Reim et al., 2015, Lusch and Nambisan, 2015). All observed cases show the characteristics of a PSS BM, as even highly product-oriented manufacturers offer product-related services.

Product-oriented manufacturing

Based on the product-oriented PSS type and the data, we illustrate the PSS BMP of product-oriented manufacturing. *Product-oriented manufacturing* is a traditional BM focused on delivering goods with respect to their development, production, integration and sales. From our observations, we differentiate between two subtypes of this PSS BMP.

The first type focuses on the manufacturing of parts and components in a cost-effective way based on high volumes and high quality (cases C and D). The next step along the value chain after their production is to sell their goods to firms integrating these components into products/solutions, for example, simple control components like switches that are assembled into next tier control systems (case C). For their customers, the firm delivers high-quality, cost-effective components based on their production capability. As their customers can source from globally competing providers at similar quality levels, they show price sensitivity. Even though cases also provide basic services like repairing or overhauling, this is no key selling point (case C). However, these customers also face the issue of minimum order quantities, as they need to purchase only few of various components. An example is the need to source electronic control units for final product assemblies. Customers have the choice between multiple unit-types and the problem of minimum order quantities, even though they need only a few of each type for their own assembly (case D).

The second type is a product manufacturer integrating parts and components into complex systems being the architect and final assembler (cases E, F, K and N). The more complex system requirements appear, the closer they have to work with customers, for example, in the production of gearshifts for public transport bus fleets (case F). Product manufacturers have more visibility towards the end customers than parts and components producers do. These cases show service aspects as part of the pre-sales-phase to understand the customer's requirements, for example, into which type of bus the gearshift is integrated (case F). Nevertheless, there are further steps along the value chain between the producer and the end customer, for example, complex sales processes and after-sales services. Within this value chain, product manufacturers take over the role to translate customer requirements into system architectures to finally assemble and sell them, for example, small batch series of maritime motors (case E). The customer base expects integrated and functional products that deliver high value for their own value chain.

To conclude for both subtypes, customers collaborate with these product-oriented manufacturers until the point of sales and before they contact third-party service experts for the major after-sales activities. In general, we describe this as a product-oriented BMP that focuses on the value chain especially until the point of sales. We observe a few service options (i.e. product-oriented services) along the use

phase. Even though maintenance activities are available, no case of product-oriented manufacturing confirms providing extensive pre-sales services (e.g. financing contracts) or major after-sales services (e.g. supply of consumables). We find that these services require resources, logistic capabilities and sales channels that do not exist (so far) for product-oriented manufacturers. Eventually, this PSS BM shows the existence of a *traditional product sales model* (Vezzoli et al., 2015) or *product sales* (Fang et al., 2008, Wise and Baumgartner, 1999). It remains on a goods dominant logic (Vargo and Lusch, 2004).

Use-oriented enabling

Use-oriented enabling is based on the PSS BM type use-oriented and represents a BMP intended to ensure the availability of goods for customers (cases B, G, H, I and M). Providers become an essential part of the supply chain, even though the product fully stays under the control of the customer. Firms offer products for sale with integrated interfaces or other options, so they can always monitor the necessity of maintenance activities. They source these products and add enablers (e.g. IoT-solutions as connectivity functions for goods). This enables remote steering and creates the basis for use-oriented PSSs. Delivering hydropower generation turbines and maintaining them remotely with expert knowhow is a key element of case M. Another example are engineer-on-premise contracts. Case G does not just plan and build plants, but also sends service experts to the customer's production plant to launch operations and ensure 24/7 availability. Corporations, like case G, profit from their strong technical knowhow for their service activities and enable seamless operations for the customer. IT resources help to partly automate expert knowledge and improve processes. Finally, customers can use their assets to solve their problems while being supported by the use-oriented enabler (Visnjic Kastalli et al., 2013, Aurich et al., 2006, Parida et al., 2014). This BMP focuses on both the product and the customer's use of it. These BMs customize, sell and integrate products and provide a lifecycle-oriented support service. In practice, project-based PSSs implement use-oriented enabling. The enabler supports the customer throughout the whole lifecycle from the planning into operations with a customized solution, ensuring the usability of the goods. In case B, they integrate mobile shelter solutions and deploy them for their customers. Nevertheless, their customers own and operate them.

In contrast to Tukker (2004), we propose that firms rely on a hybrid product of service and sales instead of leasing, renting or pooling. We observe three major reasons for this. First, industrial investment goods incorporate a significant financial value. Keeping this as one's own asset would strongly influence the financing structure of a firm. In case M, turbines reflect about one quarter of the whole project volume of their customers, with a medium-sized turbine being around €5 million of €20 million in project volume. With a total tangible asset value of around €400 million on the balance sheet, renting would strongly increase long-term financing needs. Second, customized investment goods include the expertise of the customer, as it is tailored to its processes, recipes or further intellectual property (IP). Transferring the ownership of such a good relieves the expertise at the customer's site as part of his competitive advantage. In case H and I, customers are tire producers, for example. The implemented processes in their facilities build on their highly secret rubber processing and recipes. If the use-oriented enabler keeps the production plant as an asset, this would imply they take away IP from their customer. Third, product and service organizations often work together as separate units (Fang et al., 2008, Visnjic Kastalli et al., 2013). In case M, product sales and after-sales services are organizationally subdivided into separate business units. Nevertheless, they continuously use more synergies by improving their use orientation. This challenges use-oriented enablers to maintain a sales strategy as opposed to disrupting their organization. Despite these variations, we do not see the cases as product-oriented PSSs since customers need provider services to operate these customized products. Thus, the service aspect is essential in this PSS BMP, in contrast to product oriented PSSs according to Tukker (2004) and Reim et al. (2015), where the services provide only additional value (e.g. expanding the supply chain with services or take-back agreements). Thus, use-oriented enabling integrates both goods- and service-dominant logic (Vargo and Lusch, 2004, Lusch and Nambisan, 2015).

Result-oriented service offering

Third, we use result-oriented PSS BM types and findings from the cases to derive result-oriented service offerings as a pattern. Result-oriented service offerings create results as a service by integrating products and services as a hybrid service (Aurich et al., 2006). This model helps customers as firms deliver results as part of the customer's supply chain (cases A, L and O). These result-orientated service providers are independent of selling investment goods or good-related services. In contrast to product-oriented manufacturing, this BMP works in close contact with the end customer and accompanies him throughout his value production. Case A conducts complete drone flight missions for their customers, for example. Service providers cover a value creation step for their customers similar to outsourcing providers. In contrast to other BMs, service providers do not transfer the ownership of a good but deliver everything needed as a bundle and ensure not just the availability of goods, but also the result of their operation. Case L offers a pay-per-wash concept for industrial warewashers. The firm owns, operates and maintains the warewashers including the refilling of required chemicals. To provide this, result-oriented service offerings rely on standardized goods as part of the PSS. They offer two major advantages. They profit from scale effects, so they source these standardized goods cost-effectively from third-party providers. Construction machines of case O, for example, are sourced from a hardware partner who focuses on the efficient production of these goods. For results as a service, the brand or type of the good are almost irrelevant. Assets become a substitutable tool in this scenario. Standardized goods also deliver an ideal base for evaluating product-related data. Being an operator of a fleet for several customers, provider offer a powerful database to learn and optimize operations. This enables transparency for result-based contracting. The pay-per-wash provider can learn from hundreds of parallel operating hours and improve their diagnostic capabilities for preventive and corrective maintenance.

The customer base of result-oriented service offerings requires a high degree of transparency and flexibility. One part of customers of case L are streamlined gastronomy services that appreciate to reduce the risk of machine downtime to a minimum plus reducing assets. Furthermore, precise pricing helps them to improve their financial planning. Another customer segment consists of young food entrepreneurs that cannot afford to invest in expensive warewashers. A result-oriented BM helps to overcome this former market entry barrier due to its flexibility. A third group of customers prefers result-oriented service offerings in the case of volatile demands to capture exceeding capacity. In alignment with Tukker (2004), we characterize this PSS BMP as similar to outsourcing providers, but with a strong integration into the customer's value chain. Eventually this PSS BM is based on a service dominant logic (Lusch and Nambisan, 2015).

4.2 PSS business model innovations strategies

We observed different approaches how firms innovate their BMs. We propose two types of BMI strategies and differentiate them according to the degree to which a firm's BM is changing, i.e. *Business Model evolution* and *transformation*. For differentiation, we build on Foss and Saebi (2017) who categorize BMIs into *modular* and *architectural* according to the scope. An architectural change is a fundamental change to the architecture of an existing BM, which we call a *Business Model Transformation*. A *modular* change refers to an optimization adapting specific modules of a BM, what we call a *Business Model Evolution*. We see both as sub concepts of a BMI. In the following, we illustrate all six BMI strategies using the dimensions of the Business Model Canvas (Osterwalder and Pigneur, 2010).

PSS business model transformations

We differentiate between *Servitization* in a narrow sense, *Integration* and *Leapfrogging* as transformation strategies for PSS BMs. *Servitization* helps to innovate a product-centric business concept by adding service opportunities. This refers to all components of a PSS BM (Storbacka et al., 2013). As product margins become more unattractive (Wise and Baumgartner, 1999, Spring and Araujo, 2013), the main driver for this transformation is to profit from downstream services that can be provided

based on the expert knowledge of the manufacturer. We see *Servitization* within the PSS BMI framework in a narrow sense as a BMI from *product-oriented manufacturing* to *use-oriented enabling*.

As the focus of this business changes from producing and selling a good to enabling the use of it, the value proposition shifts. Cases B and M, for example, shift to ensuring entire operations and logistic capabilities for production plants instead of solely selling them. Consequently, key activities change by integrating servicing activities and interfaces to the product organization. Firms do not just manufacture and source product parts, but also integrate them into a service concept. Additionally, new resources (e.g. (servicing) skills, toolsets, etc.) extend the portfolio of key resources to provide, for example, operational maintenance (case G or H). Either former partners for downstream operations, such as after-sales service providers, are integrated into the BM or existing partners enter a new role as strategic partners, for example for spare parts management. Finally, servitization affects the channels and relationships to customers. In contrast to contact limited to the point of sales, the relationship expands throughout the whole product lifecycle, for example, not just in fields of maintenance, but also in operations, customer training and further after-sales (case B). This creates the need to expand the customer channels and to build a sustainable infrastructure to maintain them. Further, servitization implies an extension of income streams to service activities formerly owned by pure service providers. New cost structures include an increased resource base to maintain product and service business (case G and H). Eventually, this transformation also influences customers. Earlier, only customers with the capability to operate goods throughout their product lifecycle were attracted, whereas this BM transformation relieves the risk of ensuring the availability. To conclude, servitization offers the transformation from *product-oriented manufacturing* to *use-oriented enabling*.

The second transformation strategy, *Integration*, relates to integrating products and services into a result-oriented service that focuses on customers' key problems. The driver of this business is to overtake even more risks of a customer and charge a risk premium. This risk of failure decreases by continuously monitoring and operating one's own goods for the customer. The combination of risk premium and included service fee offers attractive income opportunities, while the customer receives a comfortable result as a service solution. Thus, we define *Integration* within the PSS BMI framework as a BMI from *use-oriented enabling* to *result-oriented service offering*.

This BM transformation refers to all components of the BM. The value proposition is not limited to enabling a customer to use his goods; it shifts to ensure the solving of a customer problem. A massive extension of the key resources is needed to offer a viable solution. In case O, for example, a fleet of construction machines needs to be maintained to offer construction site operations. Resources have to be expanded by goods that formerly have been part of product sales and the value proposition. In this concept, they become tools of this BM enabling the solution. This implies that the good's ownership remains with the provider. Instead of being part of the customer's assets, they add on the resource of the firm. Additionally, activities changed to create a result instead of enabling customers to use products. This has an impact on the culture of a business towards a customer-centric organization. Moreover, former partners are integrated. They do not just deliver value on a parallel value chain. They become strategic partners supplying the firm with what they need to attain a certain result as a service (e.g. hardware partners). Shifting the strategic relevance from a supplier to an essential part of a customer's value chain intensifies the relationship. Modes of communication channels become part of the BM's value chain. Integration as transformation affects the income structure from product and service sales to service sales based on results. This BM transformation also changes the cost structure, as the firm has to cover new resources and more activities. This leads to increased capital and personnel costs, for example. Finally, integration attracts new customers that face a lack of competences or resources concerning a certain aspect of their value chain. Accordingly, this transformation is relevant for use-oriented enablers combining their products and services to result-oriented service offerings.

Leapfrogging is the third type of BMI we observe. This describes the BMI from *product-oriented manufacturing* to *result-oriented service offering* without transforming towards *use-oriented enabling*. We found only one case conducting Leapfrogging (Case L). The key driver of this transformation is to capture completely new customer groups by disrupting the business offerings. The value proposition of such a BM shifts from high-quality, functional products to the creation of a result, by combining the

use of products and corresponding services. Case L shifted from building and selling warewashers using a third-party sales force to selling cleaned dishes directly. They set up dishwashers at a customer place, fully maintained them and provided consumables. Customers just start the machine on demand. The formerly product-oriented manufacturer has to set up new resources including service personnel and finance machines for the integrated product service provision. In addition to this extension of key resources, the service provider has to expand key activities by everything in relation to the lifecycle-oriented customer care and servicing. Furthermore, new partners complete the portfolio that offer consumables for operating the goods. In contrast to formerly limited sales channels, they implemented new processes to manage the customer lifecycle for end customers. Two major groups extend the customer base. The first group requires cost transparency as a core value and prefers to adjust their asset dependency by receiving the results on demand. The second group avoids market entry barriers by choosing to purchase results on an operational basis instead of assets on an investment basis. Especially for new market entrants, this offers the chance to start flexibly. The cost structure shifts from a production-focus to a service-focus. This influences personnel costs for servicing and increased customer care. Furthermore, the transformation comprises an additional assets load on capital costs. On the income side, there is new potential due to service fees including their risk premium offer and recurring revenue. Instead of selling machines at low margins, case L uses their extensive knowhow to provide results. As remote maintenance solutions enable the optimization of these services, they create attractive business opportunities.

PSS business model evolutions

In contrast to drastic changes of BMs, we observe adaptions of individual BM modules focusing on the product or the service of a corporation. We call these kinds of BMIs *Evolutions,* as they illustrate the shift to closely related BM characteristics within a PSS BMP. Evolutions often help to realize transformations as small steps of them.

We differentiate evolutions based on their surrounding PSS BMP. However, we only found evolutions in two of three patterns, i.e. *product-oriented manufacturing* and *use-oriented enabling*. *Universalization* is the first adaption of product-oriented manufacturing. It describes the standardization of a product portfolio (Schilling, 2000) and increases the products' application potential.

Universalization influences the BM as it relieves the pain of customizing parts or components, which exposes major R&D and organization efforts. A second main driver of *Universalization* is to increase sales opportunities by improving the product-market fit and opening up novel use cases due to universal application scenarios. In case D, modularizing and standardizing help to turn a wide portfolio of specific electronic control units into few multi-purpose units. This supports existing product-oriented manufacturers to focus their strategic value proposition and to offer a broader usage range of their standardized parts, components and products. The service offering changes similarly. Still, providers offer only basic services like repairing and overhauling. However, with increasingly standardized products, the basic services also become less diverse. The BM evolution does not affect the partnering base or key resources. It helps to decrease efforts that have been part of key activities, for example, the management of variations of goods (case C). On the opposite, the potential customer base increases. Wider ranges of use cases for modular and standard products help to explore new markets or customer segments, as the products can be used for multiple purposes. *Universalization* does not change channels or relationships. By optimizing internal processes due to a reduced product portfolio, the firm can reach cost optimizations. The income side varies due to reduced prices and higher sales volume. To conclude, *Universalization* does not change the BM as drastic as transformations but helps to sharpen the value proposition that affects several BM components.

In contrast, *Digitalization* includes creating and opening interfaces to capture and control good-related data and, thus, build the foundation for further business opportunities (Yoo et al., 2010). This is the basis for adding services based on data, including remote maintenance or other comfort features. Digital transformation strategies of product-oriented manufacturers drives this BM evolution. A digitalized product also allows for interfaces to external platforms and ecosystems of offerings. Thus, we see *Dig-*

italization within the PSS BMI framework in a narrow sense as a BM evolution focusing the digitalization of products.

Digitalization helps product-oriented manufacturers to enable further service offerings. New product features add up in functionality as a value proposition. Case E, for example, equips maritime motors with telematics solutions. Opening digital interfaces certainly affects the partner base and requires new key resources, as the capturing of produced data needs an enhanced infrastructure. This demands an extension of suppliers for digital components. Furthermore, the portfolio of activities extends. It creates demand for new skills and tasks to manage new product characteristics. Moreover, channels and relationships profit from digital input or automated processes showing strong synergies with new service options. Digitally oriented customers can become a new target group. The base of digitalized products offers the potential to implement further services and, thus, additional income. To conclude, R&D efforts and digital components increase the cost side. Overall, *Digitalization* itself enables additional services and changes the BM evolutionarily. Often it is the first step to servitization, as digital interfaces to one's products allow for the selling of PSS bundles.

Starting from *use-oriented enabling*, a *Service Expansion* is an evolutionary BMI. Firms extend the service portfolio and implement new service structures in order to capture more attractive downstream offerings. This includes lifecycle-oriented offerings, for example, to not just maintain goods at a certain point in time, but also support ongoing operations with expert knowhow (case G). Use-oriented enabling already ensures the availability of a good. A *Service Expansion* provides even more services for customers. In contrast to *Servitization*, *Service Expansion* takes place within the BMP *use-oriented enabling*. The provider already offers a PSS where services enable the usage of a product.

Service Expansion leads to the adaption of a more product-lifecycle-oriented service attitude, which improves the service value. As part of this evolution, the firm adds new features, for example, the utilization of data from digitalized products or the integration of formerly downstream service tasks. The evolution affects the partner base, as some partners become competitors within the after-sales segment. The portfolio of activities and resources extends by new service resources and skills to realize new service features. These adaptions marginally influence customer base, relations or channels. However, new services offer new sales opportunities and affect revenues. Due to higher personnel costs to perform the corresponding tasks, costs rise. Eventually, this evolution is used to focus one's own BM towards a stronger service portfolio.

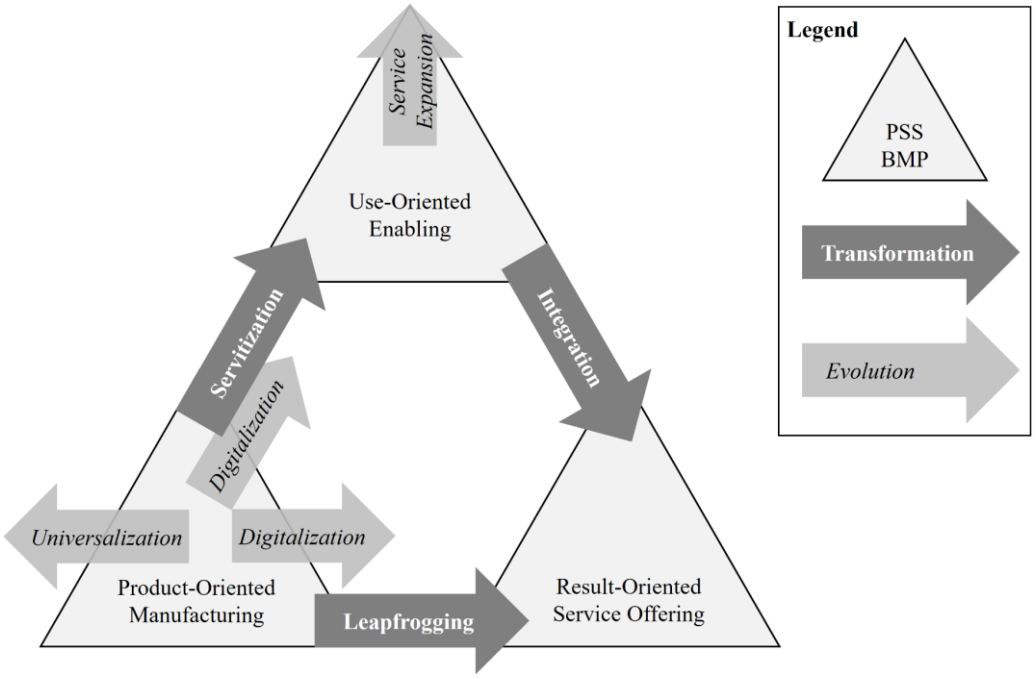

Figure 2. Business model innovation framework for product service systems

Figure 2 shows the PSS BMI framework summarizing strategies and relations to PSS BMPs. It illustrates the three transformations and their relations to patterns as well as the three evolutions. *Digitalization* can be a first step towards *Servitization* as well as towards *Leapfrogging*. *Universalization* and *Service Expansion* do not directly contribute to a transformation strategy. However, they can sharpen the focus of the BM.

5 Discussion

We derived three BMPs based on PSSs as an operational core of a BM from literature and demonstrated their implementation in practice. They focus on either a goods- or service-dominant logic or a combination of them. We further split strategies of the overarching concept of servitization (Baines et al., 2017) in six PSS BMI strategies, i.e. three transformations as structural innovations and three evolutions as BM adaptions. In the following, we discuss theory extensions and integrations in relation to identified PSS BMP and PSS BMI strategies.

We found extending characteristics in comparison to agreed PSS classifications especially in the context of ownership transfer of use-oriented PSSs. The results indicate an additional subtype of use-oriented PSSs according to Tukker (2004) and Reim et al. (2015) with a transfer of product ownership due to three main issues: IP, standardization and customization, and financial impact on firm structures. Customized goods contain IP, which customers prefer to own. Further, customized goods offer less potential for reusability and scalability. Standardized, connected goods provide similar data to learn from, which facilitates the calculation of result-based fees. Customized goods lack this potential. Thus, standardized goods are more suitable for result-oriented BMs than customized goods. Whereas Tukker (2004) shows the applicability of these concepts for use-oriented purposes, we found that customized goods (e.g. hydropower turbines) are less likely to be operated on a result basis, whereas standardized goods (e.g. commercial dishwashers or printers) can be tied to result-oriented contracts. Additionally, customized goods are rather sold than rented if they represent a significant financial value for both parties, provider and customer.

Building on PSS BMPs, some identified PSS BMI strategies apply known concepts in literature. The PSS BM evolution universalization uses standardization and modularization. Standardization enables the exploitation of economies of scale (Farrell and Saloner, 1985). Further, modularity allows for an increased number of options to utilize a product (Sanchez and Mahoney, 1996). Universalization shows how PSSs use these concepts to enable economies of scale for standardized products and basic services. In addition, the PSS BMP result-oriented enabling shows a trend towards using economies of scale based on rather standardized products.

Digitalization in this paper is related to digitization as a general BMP (Gassmann et al., 2014) and the trend of digital transformation, which receives increasingly attention in research and practice (Hess et al., 2016, Fitzgerald et al., 2014). Digitalization as a PSS BM evolution shows how PSSs can digitally transform products and, thus, implement the general BMP. Product-oriented manufacturers digitally equip offered products to build the foundation for new BMs.

Regarding PSS BM transformations, only one case conducted leapfrogging. We see leapfrogging as an exceptional transformation that exposes an organization to high effort and risk. It transforms the value proposition from products to services and disrupts the financing structure. New value chain steps also influence activities and resources. Further, result orientation requires direct customer access. Thus, leapfrogging seems like a major change that opens change gaps in various parts of a BM. The dominant strategy transforms to use-oriented enabling first, before offering result-oriented services. For result-oriented service offerings, goods-related options are out of scope since goods are substitutable. We found no BMI strategies here. Overall, the transformation paths indicate how strategic options of BMI are dependent on the firm's initially followed BMP.

6 Conclusion

We demonstrate that PSSs and BMs conceptually form PSS BMs. We show how a combination of products and services interrelates as an operational core of a BM. Based on Tukker (2004) and Reim et al. (2015) as well as an exploratory study, we propose PSS BM types and their practical implementation as PSS BMPs. The three patterns are *product-oriented manufacturing*, *use-oriented enabling* or *result-oriented service offerings*. Second, we reveal six BMI strategies. Three strategies innovate the BM evolutionarily (i.e. universalization, digitization and service expansion) and three innovate it transformatively (i.e. servitization, integration and leapfrogging). Thus, we identify strategic paths of firms and derive the PSS BMI framework.

Our research has several implications. For research, we, first, addressed the call for more detailed research on PSS BMPs from Adrodegari and Saccani (2017) and Annarelli et al. (2016). Further, the PSS BMI strategies show transformation paths within the PSS BMPs as recommended by Velamuri et al. (2013) and Adrodegari and Saccani (2017). We recommend building on this PSS BMI framework. Research can be based on a clear differentiation of evolutions and transformations. Both BMI concepts have a structurally different impact and imply different strategic opportunities. Second, we extend PSS types according to Tukker (2004) and Reim et al. (2015) with PSS BMPs. Identified patterns are especially suitable for the manufacturing industry with respect to their characteristics, i.e. capital intensity for industrial investment goods, IP and customization and standardization. We additionally demonstrate a use-oriented PSS type with ownership transfer, which extends prevailing theories of Tukker (2004) and Reim et al. (2015).

For practice, we demonstrate PSS BMI strategies in forms of evolutions and transformations. We further illustrate strategic paths with different cases. Based on the strategic position within an existing value chain, firms can use our framework and example cases to support decisions regarding BMI. Furthermore, identified PSS BMPs support managers in evaluating their own BM and in analyzing their strategic fit of products, services and their BM. Additionally, we reveal preconditions, challenges and opportunities for each pattern.

The findings are subject to limitations. Results are explorative and qualitative. We conducted one interview for each of the 14 business units as first, explorative research. Findings are limited to ten examples of the business-to-business manufacturing industry in Germany. However, several cases confirm each identified BMP and each strategy, except for leapfrogging (case L only).

Several avenues for future research emerge from the findings. First, future research should clarify how the evolutions and transformations of PSS BMs affect financial performance. Second, we did not find cases in our data where customized goods offer potential for scalability. However, technologies like 3D-printing enable customized goods as part of a product-oriented BMs. Third, we could not find any evolutionary BMIs in the pattern of result-oriented service offerings. Future research should focus on this pattern since it also requires significant organizational changes. Fourth, researchers should challenge the BMI strategy of leapfrogging. We observed this as a unique transformation that bears potential for future research. Overall, future research can build on the findings of this paper with further analysis on rare patterns and transformation strategies as well as quantitative analyses.

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