Employing the business model concept to support the adoption of product–service systems (PSS)

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ABSTRACT

Although the existing literature indicates that the business model concept can be useful to implement product–service systems (PSS), there is still a paucity of guidelines to assist companies in this respect. Therefore, this paper proposes a framework to support the adoption of PSS employing the business model concept. This framework was developed based on literature review and intends to guide the company on the analysis of their business context, on the choice of the appropriate type of PSS and on the definition of their PSS characteristics. A single case study was then performed to illustrate an application of the framework in a machine tool manufacturer and provide research insights. Overall, results indicate that the framework can provide companies with a useful reference to PSS implementation, helping on the investigation of different PSS scenarios as well as the main barriers and challenges to be overcome.

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1. Introduction

A service oriented approach provides new ways of dealing with businesses, customers and with the value chain. As a result, this approach has received increasing attention from manufacturing companies seeking opportunities for competitive advantage. Although companies constantly offer services to the market, they have only in recent years seen the integration of products and services as a possibility for growth and competitiveness (Jacob & Uлага, 2008).

Different research communities have studied the integration of product and services, adopting different terms for the same subject. Among them, three are of particular importance: servitization (Vandermerwe & Rada, 1988), service-dominant logic (Vargo & Lusch, 2004) and product–service systems (PSS) (Goedkoop, van Halen, te Riele, & Rommens, 1999). Despite the difference on terms, the central concept is the same: to shift the focus of traditional businesses on the design and sale of physical products to a new business orientation that considers functionalities and benefits delivered through products and services (Manzini & Vezzoli, 2003). Special attention is given to the interaction between customers and companies, contributing to an improved value proposition based on the integration of resources, knowledge and skills (Kowalkowski, 2010). This study uses the term PSS throughout this paper.

Manzini and Vezzoli (2003) and Tan (2010) suggested that the adoption of PSS provides insights about aspects considered relevant to businesses, such as: types of products, customer needs, product and service strategies, relationships with stakeholders and financial income options. However, Tischner, Verkuijl, and Tukker (2002) stated that there are questions without answer hindering companies in their attempts to implement. For example: How can companies create and offer value to their customers? How can this value be produced and delivered? How can companies interact with customers and partners? These questions, which are related to business logic, represent challenges that companies face when adopting PSS.

In fact, one of the main challenges for companies wishing to adopt PSS is to identify the changes required in their businesses (Meier & Massberg, 2004). These changes derive from the differences between PSS and the traditional way of developing and selling products. Since the business is a central point in this issue, the business model concept seems appropriate to be employed. Business models are representations of companies’ strategies, operations and relationships that define their business logic. It can be considered a conceptual tool that helps companies to identify, understand, design, analyze, and change their business models (Osterwalder & Pigneur, 2010).

Tan (2010) states that the business model concept is useful to characterize PSS, since its implementation often requires the redefinition or creation of new business models (Tischner et al., 2002). Tuukk and Tischner (2006) also believe that it is important to conceptualize PSS in terms of business models to facilitate its adoption. Because the success of a company depends on its operations, strategy and networks, the business model may be redesigned to support the PSS offer (Schuh, Schittny, & Gaus, 2009). Matthyssens and Vandenbempt
brought up an important point by questioning why and how the transition toward PSS affects companies and how they can deal with it in terms of their business models. Richter, Sadek, Steven, and Welp (2009) highlighted the need of investigations which combine the viewpoint of PSS and business models, aiming to gain a better understanding of this context and to assist on PSS adoption.

Despite the importance of addressing the relationship between PSS and business models, the current paucity of information about how to use the business model concept to support the adoption of PSS is challenging for companies and offers opportunities for investigation (Mont, 2004). What PSS contents should business models encompass? Should companies adapt their business models to fit with PSS characteristics or should they create new business models? The literature appears to be unable to answer these questions.

This study proposes a framework based on a business model conceptual tool, named Canvas business model, which aims to analyze companies in terms of PSS requirements and to define actions to implement it. First, this study investigated the business model concept and PSS characteristics in the literature. The findings underpinned the definition of the framework’s parts, which includes business context, types of PSS and its characteristics. The resulting framework was then applied to guide the adoption of PSS in a machine tool manufacturer, providing research insights and illustrating an attempt to introduce PSS using the business model concept.

The next section describes the research methodology. Following, this paper presents the literature review, the framework and the key results of its application. At the end, the empirical and theoretical contributions of this study are announced.

2. Methodology

This research follows an inductive approach, looking at specific cases to underpin further development in the field of product–service systems. Due to this fact, literature review and case study were employed, which are exploratory methods (Karlsson, 2009). The literature review shows the current state-of-the-art and leads to the development of a framework, which is then applied through a case study to complement theory and provide a reference for progress in the adoption of PSS. Although the case study illustrates the use of the framework in a real context, it has a conceptual nature. Thus, based on MacInnis (2011), this study follows a conceptual goal which can be defined as “explicating” with a “delineating” characteristic. This classification is appropriate since this research proposes a framework that describes the main entity, i.e., the product–service system, and can be used to guide its adoption.

The literature review and case study methods were used to set four research stages: the identification of characteristics and typology of PSS, the investigation of business model concepts, the development of the framework and the application of the framework by means of a case study.

The first two stages involved searches in academic journals and conferences. Case studies covering the description of the companies’ businesses that have already implemented PSS were used to identify the PSS characteristics. In addition, an investigation of PSS typologies was conducted to show differences among PSS characteristics. At the end, an analysis of the business model literature clarified the topic and aided in the selection of a business model concept. Results of these two phases are presented in Section 3.

The third stage, development of the framework, started with the classification of the PSS characteristics according to the business model elements. Then, the business model concept and PSS types, defined in the first two stages, were used to establish the framework, which is presented in Section 4.

The last stage embraced the case study on a machine tool manufacturer. The adoption of a single case study is considered appropriate in cases of theoretical immaturity of the research topic, which fits into the PSS research status. A benefit of a single case study is the possibility of a deep investigation of a specific phenomenon (Dyer & Wilkins, 1991). Guidelines proposed by Voss, Tsikriktsis, and Frohlich (2002) and Yin (2003) were employed to plan and execute the case study. They suggest three key activities for the execution of case studies: definition of a protocol for collecting data, data collection and data analysis. The protocol was built upon the framework and underpinned the development of a workshop attended by the company’s board members. Data were collected during the workshop, through annotations of research team and the use of sticky notes filled by the participants with the most relevant facts. Then, the analysis focused on verifying whether the framework is capable of supporting the adoption of PSS through the application of the business model concept. It is important to mention that the data collection and analysis involved the participation of company’s members and took into account their opinion. Results of the case study are presented in Section 5.

3. Literature review

3.1. Product–service systems (PSS)

3.1.1. Background on PSS

Product–service systems comprise combinations of products and services to fulfill customer needs (Goedkoop et al., 1999). According to Vargo and Lusch (2004), PSS focuses on offering services and the product becomes simply the means to provide the offer. In other words, products are seen as distribution mechanisms for service supply (Kowalkowski, 2010).

Exchange processes and relationships are central in PSS (Vargo & Lusch, 2004). The locus of value creation shifts from the PSS provider to the process of co-creation among different players (Jacob & Ulaga, 2008). Thus, the competitive advantage emerges through the co-creation and co-production of activities among PSS providers, customers and value network partners (Grönroos, 2011; Lusch, Vargo, & O’Brien, 2007; Vargo & Lusch, 2004).

Since value is provided to customers through services rather than products, the introduction of PSS requires changes in the way through which the business is conducted. An example is the involvement of the PSS provider with processes related to the use of products. PSS providers must support clients and ensure the usefulness of products throughout their lifecycle (Tan, 2010). Traditionally, customers purchase a product and become responsible for its performance, maintenance and disposal. In PSS, ownership of a product is not necessarily transferred to the customer. For example, a manufacturer can remain responsible for the product after its sale (Baines et al., 2007).

PSS brings benefits to both sides of the value chain — customers and companies (Baines et al., 2007; Tan, 2010), as indicated in Table 1, which describes advantages of each side.

Furthermore, PSS is considered a promising system towards a more sustainable society (UNEP, 2008). In fact, PSS supports a new mindset, with companies abandoning the transformation of resources to generate revenue and focusing on providing value and social quality to their customers (Sousa et al., 2010). An example of an environmental benefit

| Table 1
| PSS advantages for customers and companies (Baines et al., 2007; Tan, 2010). |
| Customers | Companies |
| More customized supply. | New market opportunities and competitive advantages. |
| New functionalities and combinations of products and services to better suit customers’ needs. | Access to information about the product’s performance during its use phase. |
| Responsibility for monitoring and end-of-life transferred to the manufacturer. | Higher profit margins achieved by providing services instead of products. |
| Higher total value delivered to the customer by increasing service elements. | Strengthening customer relationships increases loyalty. |


of PSS is related to the change of product ownership. Since the manufacturer retains the ownership, it is responsible for the product during its entire lifecycle, taking it back at its end of life to reuse, remanufacture or execute an appropriate disposal.

### 3.1.2. Types of PSS

Tukker (2004) presents the most widely accepted classification of PSS, which is used extensively in the literature (Manzini & Vezzoli, 2003; Tukker & Tischner, 2006). This classification proposes three types of PSS: product-oriented services (POS), use-oriented services (UOS), and result-oriented services (ROS), as illustrated in Fig. 1. These types diverge mainly in terms of the relationship between the provider and customer and revenue model.

The aforementioned types are described below:

- **Product-oriented services (POS):** traditional product sales, whereby customer assumes ownership of the product while the PSS provider offers and charges for associated services. The after-sales service which aims to ensure product functionality and durability (maintenance, repair, reuse, recycling, training and consulting) is an example of this type of PSS. In this case, the introduction of PSS can reduce the costs of using a product.

- **Use-oriented services (UOS):** the product is owned by its manufacturer, which sells product use or functions by leasing, sharing or renting. In this case, PSS can maximize product usage by extending the product lifecycle and reuse of materials. The PSS provider will prefer to develop products using long-life materials and offer services to keep its products in good working condition for as long as possible, since it owns them and bears the costs of their maintenance.

- **Result-oriented services (ROS):** a manufacturer sells a result or competence rather than products. In this case, companies offer a mix of services and, when the result is delivered through a product, the PSS provider maintains its ownership while the customer pays only for the results. Manufacturers of printers that charge according to the number of printed sheets while maintaining ownership of their printers are an example of this type of PSS.

### 3.2. Business models

According to Shafer, Smith, and Linder (2005), a business model is a tool that serves to represent the company’s underlying core logic and to communicate strategic choices. Elbers (2010) declare that it describes how a company creates, delivers and captures value based on its strategic choices. The main contribution of a business model stems from the fact that it enables the creation of practices that help companies to capture, understand, design, analyze and change their business logic (Osterwalder & Pigneur, 2010).

A business model decreases business logic complexity by providing a vision of how a company can derive value from its resources and implement its strategy. Therefore, it creates a holistic view of a business and clarifies important points to an organization. According to Osterwalder, Pigneur, and Tucci (2005), a business model is a conceptual tool composed of objects, characteristics and their relationships, which provides a simplified description and representation of a company’s business logic.

Several studies have suggested elements that should compose business models. Aziz, Fitzsimmons, and Douglas (2008) examined business models and found more than fifty-four different elements. According to them, these elements include the following: value network, target market, value proposition, company’s competences, cost elements, strategy, processes and activities, revenue and price considerations, competitors, customer relationships, and many others. The variety of business model elements shows that different structures can be used to create business models. This may be confusing when establishing characteristics related to each element and, thus, may hinder the definition of a complete business model.

Business model concepts presented by Chesbrough (2006) and Osterwalder and Pigneur (2010) are the most relevant to this study, since they define and describe the elements that comprise business models, which support the analysis of company’s requirements to implement PSS. In addition, these two works are established and accepted by practitioners and theorists.

An analysis of proposals from Chesbrough (2006) and Osterwalder and Pigneur (2010) reveals that they are substantially similar. The most of their elements are the same, such as cost structure and value proposition. Some of their elements have different names, but with the same meaning, e.g., market segment and customer segment. The main difference remains in the fact that Chesbrough (2006) includes the competitive strategy as an element of business models, while Osterwalder and Pigneur (2010) do not include elements related to strategy, since they claim that strategy and business model are different entities, albeit related.

This study follows the business model concept of Osterwalder and Pigneur (2010), named Canvas Business Model, as reference for analyzing business models. The authors of this research agree with Osterwalder and Pigneur (2010) that strategy needs to be distinguished from business models. Strategy is a driver for the creation of business models because it guides companies in the definition of their business model. Therefore, a company’s strategy may be formulated before its business model is created.

Canvas Business Model was developed through an extensive investigation of business models and represents the consensus of a large group of experts from academy and industry. Moreover, a detailed process to use Canvas Model was proposed to support the development and management of business models. Finally, there is empirical evidence that supports the performance of this model. It has been applied successfully by many organizations, such as IBM and Ericsson (Osterwalder & Pigneur, 2010).

Nine elements constitute Canvas Business Model, which are depicted in Fig. 2: value proposition, customer segments, distribution channels, customer relationship, revenue streams, key resources, key activities, key partners and cost structure. These elements are described below.

- **Customer segments:** groups of people or organizations a company aims to reach and serve.
- **Value propositions:** products and services that create value for a specific customer segment.
- **Distribution channels:** company’s interface with its customers.
- **Customer relationships:** types of relationships a company establishes and maintains with specific customer segments.
- **Revenue streams:** revenue a company generates from each customer segment.
- **Key resources:** assets required to offer and deliver the aforementioned elements.
- **Key activities:** activities involved in offering and delivering the aforementioned elements.
• Key partners: network of suppliers and partners that support the business model execution.
• Cost structure: costs incurred when operating a business model.

4. Framework to support the adoption of PSS

Goedkoop et al. (1999) considered several business aspects when they defined PSS as a system of products, services, infrastructure, and network that continually strives to be competitive in satisfying customer needs and may result in lower environmental impacts. Among the features proposed for adoption of PSS, Baines et al. (2007) and Goedkoop et al. (1999) included the following aspects:

• Shift of mindset from a product-based to a system-based approach.
• Create direct customer relations to intensify contact or to increase its frequency.
• Greater involvement between customers and companies.
• Greater company involvement and responsibility throughout product lifecycle.
• Greater involvement of stakeholders.

This study developed a framework to support companies interested in adopting the PSS, which considers the aspects cited above, among others described in the literature review. The framework comprises three parts, as described in Fig. 3: the business context, the types of PSS, and the PSS characteristics.

The first part – the business context – involves an analysis of the current business model in terms of PSS requirements, verifying the potential restrictions, which can be internal and external to the organization. There are two alternatives, either adapt the current business model or create a new one. The second part – the types of PSS – identifies the link between the business context and the PSS characteristics. It defines the main goals of the business model and allows for the selection of the most appropriate PSS characteristics. The third and last part – the PSS characteristics – embraces, for example, the definition of the customer relationships and partners that are required to develop and deliver the product–service offer. It is a description of the characteristics that should be incorporated by the new or adapted business model in order to create a specific type of PSS.

The next sections outline the first and third parts of the framework: the business context and the PSS characteristics. The second part, the types of PSS, was described in Section 3.1.2, within the literature review.

4.1. The business context

Before choosing the type of PSS and defining the PSS characteristics to be considered, company needs to understand its business situation and forecast how it should work after the implementation of PSS.

According to Tan (2010), PSS should be adapted to the current business, since the performance of the product–service offer can be compared to the existing product offer, enabling the analysis of
potential barriers and benefits. Furthermore, in this regard, the adoption occurs incrementally, reducing the impact and risks involved in the business change process. However, there are also examples of companies that prefer to create additional business to implement PSS, rather than shifting the existing business to a new mindset (Mont, 2004). The latter approach is comparable to spin-offs used to allow for the development of radical innovations (Christensen, 1997). Therefore, considering the two aforementioned approaches, the company needs to decide whether to adapt its current business model or create a new one.

### 4.2. The PSS characteristics

This section presents characteristics to be considered in a business model when implementing PSS. These characteristics are sorted according to the elements of the Canvas Model. It should be noted that although the elements of Canvas Model are interrelated, they are described separately to facilitate their understanding and the description of the PSS characteristics.

- **Value propositions:** relates to the value provided by the integration of products and services. Examples of value are as follows: lower responsibility for product lifecycle; functional guarantee (Isaksson, Larsson, & Rönblæck, 2009); and reduced cost of manufacturing operations when the client is another company, since the PSS provider may be responsible for services such as maintenance and repair (Alonso-Rasgado, Thompson, & Elström, 2004). Customization can also be a value proposition, since PSS enables the combination of product and service elements (Tukker & Tschner, 2006). These perspectives of value indicate the shift from traditional products to PSS, which does not have embedded value, but creates it by enhancing the customers’ satisfaction (Tan, 2010). Stakeholders notice differently the value, depending of their roles, responsibilities and product experience. For example, the perception of a product value changes when it is sold or leased, as does the trade-off between incurred costs and liabilities for the customer (Fishbein, McGarry, & Dillon, 2000). A particular perspective is the value of the relationship with customers during the role lifestyle of products (Tan, 2010; Wise & Baumgartner, 1999). Finally, value has also a subjective dimension, for example, trust, commitment and attraction (Grönroos, 2011).

- **Customer segments:** indicates the presence of different target groups with distinct ideas about product ownership (Tukker & Tschner, 2006), caused by cultural and regional differences and sets of consumer habits, behavior and values (Manzini & Vezzoli, 2003). A common option to define the customer base is to consider different types of user behavior, since PSS involves changes in ownership, responsibility, availability and cost (Matzen, 2009).

- **Distribution channels:** sales and retail areas should promote the PSS offer, making it more attractive than a product-based option (Tukker & Tschner, 2006). The adoption of PSS often requires training of the retail and sales staff, as well as other changes (Mont, 2004). Another important aspect is to "sell the idea" through marketing campaigns (Tukker & Tschner, 2006) that highlights the advantages of PSS (Mont, 2004).

- **Customer relationships:** involves the creation of added value and its delivery through direct relations and intensified contacts with customers (Mont, 2004). This enables the development of long-term relationships, instead of short-term and transaction-based relationships typical of the traditional "product sale" context (Mont, 2004; Williams, 2006). The "relational" path can be achieved by building closer relationships with customers through increased operational links, information exchange, legal ties and the establishment of cooperative rules (Matthyssens & Vandenbempt, 2010).

- **Revenue streams:** PSS can bring opportunities for augmenting companies’ revenue through the enlargement of functions offered by the PSS provider (Mont & Mont, 2000). Instead of one-off payments, companies can structure their sales to customers in different ways (Tan, 2010). The long-term nature of the relationship between a PSS provider and its clients implies that companies must create new revenue models based on performance-based pricing (Matthyssens & Vandenbempt, 2010). However, in a network, i.e., when more than one company is involved, revenue distribution must be well managed to avoid misunderstandings (Mont, 2002). Payment may be based on the availability of the product and/or service, on how often the product and/or service is used, on the end result of the use of products and/or services, or even on collateral for other valuable entities (Tan & Mcalooe, 2006). Therefore, new earnings options based on the integration of products and service can be created (Grönroos, 2011).

- **Key resources:** PSS providers must make considerable investments in human assets (Tan & Mcalooe, 2006). New competencies to deal with customers must be developed, people trained and sometimes additional personnel recruited (Cook, Bhamra, & Lemon, 2006; Mont, 2004). A fundamental shift is also required in the organizational culture and market engagement, which necessitates time and resources (Cook et al., 2006; Tan & Mcalooe, 2006). In addition, an efficient infrastructure is required for the cooperation between customers and suppliers (Meier & Massberg, 2004).

- **Key activities:** PSS providers must focus on the key activities of their customers, rather than concentrating efforts on activities related to physical products. With PSS, a dependency is created between company’s (providing) operations and customer’s (receiving) activities. Even when the product delivers a core function, essential activities are performed before, during and after the product’s usage phase (Cook et al., 2006; Tan & Mcalooe, 2006). In fact, the most important activities take place during the usage phase, when PSS providers can monitor the product performance through sensor technologies and also. In this sense, they can identify when maintenance should be done, supplying preventive maintenance to clients (Schuh et al., 2009). Additionally, the integration of operations and activities must be managed carefully, both tactically and strategically, since business processes require a new orientation to support PSS (Meier & Massberg, 2004). An example of this is the decision about whether or not to integrate the new product development to the service development process (Isaksson et al., 2009). Further examples of activities and processes that PSS providers should address are: order taking, deliveries, installing, maintenance, invoicing, complaints handling and service recovery. Correspondingly, order making, storage, installing, using, maintaining, paying and cost control, and resolving problems are examples of customer’s activities to be incorporated by the PSS provider (Grönroos, 2011).

- **Key partners:** the proposition of value through products and services embraces a complex network of suppliers and competencies. (Tan, 2010). The establishment of a PSS network requires the identification of actors and of the core competencies they can provide (Mont, 2002). Furthermore, when designing partnerships, it is important to specify each partner’s value throughout the product lifecycle (Sakao, Sandström, & Matzen, 2009). In this sense, the scope of the relationship between the manufacturer and the PSS network affects the PSS lifecycle and customer’s activities (Mont, 2004; Tan, 2010).

- **Cost structure:** cost structure management and price definition are challenges to the success of PSS (Sundin et al., 2009). The new logic of value creation requires new value-based pricing models, which include products and their associated services (Grönroos, 2011). Financial and accounting practices need adaptations, since the time scale of financial flows changes considerably from an almost immediate return of capital to an extended usage period (Mont, 2004). This means that the PSS provider must have the financial resources or receive support from its financing partners to bridge this period (Mont, 2002). In other words, when function is sold rather than ownership, cost structures should be arranged to support a new demand of cash-flow. In PSS, the payback period of the value delivered is often longer than the payback period of physical product sales.
Fig. 4 summarizes the PSS characteristics related to the elements of Canvas Business Model.

The framework proposes the selection of the PSS characteristics after the definition of the business context and the type of PSS. Therefore, the PSS characteristics presented in this section are generic, which permits their allocation and adaptation according to the requirements of each company. To demonstrate this, the framework was applied through a case study in a machine tool manufacturer. Apart from describing the use of the framework, the case study supplements the information gathered in the literature review, which can be considered in progress, due to current status of PSS theory.

5. Case study of a machine tool manufacturer

This section summarizes the execution of the case study and results gathered through the application of the three parts of the framework. The framework was applied by means of two 6-h workshops attended by representatives of the company’s sales, planning, engineering, and production departments. The company in question is a Brazilian machine tool manufacturer located in the state of São Paulo. More than 2500 of its machines operate in Brazilian and Latin American factories. Its core business is the design and manufacture of pressure forming machines and machines to produce plastic bags.

Several reasons have led this company to seek new business options such as the product–service system. In the machine tool market, companies are striving to improve machine performance, provide better maintenance and reduce the consumption of tangible resources (Zhu, Jiang, Huang, & Qu, 2011). A particular fact that motivated this company to investigate PSS is its adoption by a relevant competitor, located in the United States, which designs, manufactures and sells machines with additional services, such as: monitoring, training and preventive maintenance. The competitor has also long term relationships with its customers and it has increased its market-share.

In a first moment, a presentation was made to the company describing the objectives of the study, explaining the main PSS concepts and listing the advantages for clients and companies. The presentation included a description of successful cases of PSS implementation by manufacturing companies.

Although the company’s representatives know how a PSS works, particularly because its main competitor already adopted it, they were unfamiliar with the terms “service-dominant logic” and “product-service system.” Next sections present the application of the three parts of the framework.

5.1. Part 1 — business context

In this stage, information was garnered about the general characteristics of the current business of the company. Some authors believe that companies wishing to implement a PSS approach must first analyze their current business models (Kuo, Ma, Huang, Hu, & Huang, 2010; Matzen, 2009; Sakao et al., 2009). For this purpose, a brainstorming session was held with the company’s main representatives. The company of this case study has been in the B2B machine tool market for over 48 years, manufacturing machines for transforming plastics.

The company’s main business unit manufactures thermoforming machines. The current business model for the thermoforming business is based on the sale of machines and the supply of maintenance and technical assistance services. However, these services account for only 5% of the company’s revenue. The company’s representatives stated that the services provided cover only its operational costs. They consider that the only advantage in providing technical assistance is to ensure customer loyalty, but the company does not currently exploit and prioritize services as a competitive factor.

As for the destination of the machines at their end of life, the company stated that it is currently not responsible for their disposal. However, the recent approval of a law on solid waste disposal has raised increasing concern about product end of life. In addition, the growing concerns of the company’s clients about the environmental impacts of products have led the company to rethink its products’
end of life disposal. In this sense, a few attempts have been made to recondition machines, but the time and resources spent in doing so have proved to be more costly than manufacturing new machines. Nevertheless, the company sometimes purchases used machines that have proved to be more costly than manufacturing new machines. Nevertheless, the company sometimes purchases used machines from clients and resells them at considerably lower prices. In some cases, the client himself reconditions his machines, aiming to extend their service life.

5.2. Part 2 — PSS type according to business context

Focusing specifically on the current business of thermoforming machines, alternatives were then analyzed for the implementation of different types of PSS. Three alternatives were considered for the current business for a specific customer segment. The fourth alternative considered a new business development, which may pose fewer cultural barriers and allow for more disruptive improvements. The four alternatives are described below.

Alternative 1: product-oriented PSS for an existing business

Aiming to apply the product-oriented PSS to the business of thermoforming machines, the initial idea was to integrate the service element to the product. As mentioned earlier, the company already provides a few services, which facilitates the adoption of the product–service system since the company already has some expertise in supplying services. At the same time, the supply of services is also seen as a good opportunity to increase the value it delivers to clients. To implement this alternative, the company would have to make changes in three elements of the business model: key resources, key activities and customer relationships.

In terms of key resources, it was found that the company does not yet consider services a value-added differentiator. This constitutes an internal cultural barrier that can be difficult to cope with. Therefore, if the company decides to change the way it proposes value, some of the opportunities it will make use of are: to increase its revenue by supplying services, to monitor the product’s performance during its use phase, to increase the value delivered to and perceived by the client, and to effectively use the client’s feedback about the product.

New resources and activities would be required, e.g., the structuring of a new service development process and the decision to integrate it to the product development process, as well as employee training to improve the company’s current services and to provide new ones.

Furthermore, the supply of these services would generate new relationships with customers, mainly in the phase when the product is in use. This would require rethinking how the company deals with its customers in this phase.

Alternative 2: use-oriented PSS for an existing business

When questioned about the application of use-oriented PSS in the thermoforming business, several important questions arose. The investigation of this alternative revealed that the company in question will have to make changes in all the elements of its business model except the Customer Segment, which is already established for the current business. Therefore, the changes would encompass the elements: distribution channels, key resources, value propositions, cost structure, revenue streams, customer relationships, key activities, and key partners.

With regard to the element distribution channel, leasing could be complex for the company, particularly due to cultural resistance. An example cited was the sales area, which would find it difficult to adapt to this new form of relating to the customer. Therefore, resources would have to be spent on training of the sales staff to offer PSS to the customer.

In fact, the company had already analyzed the alternative of leasing, and had decided not to adopt this alternative because several questions concerning the development of leasing could not be answered. In addition, leasing its machines instead of selling them would increase the company’s costs since it would require high initial capital investments, which the company cannot afford. With respect to the value proposed to the customer, the company was not convinced that leasing would give him higher revenues than simply purchasing the product. This is mostly due to the easy financing of machines that companies operating in the Brazilian market can obtain from the Brazilian Development Bank (BNDES) through the Finame program. With such financing, customers can pay back their loans in up to 10 years and own their machines outright when the loan is paid off. This incentive for purchasing new machines makes it difficult to implement a use-oriented PSS.

In addition, the company considers that the supply of “guaranteed” services associated with its products throughout their lifecycle, by means of a periodic fee instead of payments for services rendered, could encourage the client to adopt a careless attitude about the use and conservation of the product, which would translate into higher costs and more resources spent on repair and maintenance services by the manufacturer.

The question of revenue also gave rise to many doubts in the company, e.g., how much time would be required to amortize the initial investment, since the client would no longer pay for the acquisition of the machine but would, instead, make periodic payments for his right to use it. In addition, this option could not be considered competitive when compared to the type of financing that BNDES Finame offers. When the client acquires a machine using this financing, he also makes periodic payments for the right to use it, but the difference lies in the fact that he owns the machine outright after paying off his loan, which is not the case of PSS.

The company also had several questions about tax payments, which is an extremely important point to consider in the adoption of a use-oriented PSS. What are the existing taxes for companies that lease but do not sell machines? If the company had many assets used as services, what level of taxation would it be facing? Another relevant factor is that the company enjoys a close relationship with most of its clients. However, this relationship is characterized by informality. Also, business agreements are signed directly with the client’s top management. This makes it difficult to formalize the customer relationship through contracts, which are essential for the proper operation of a PSS.

Hence, the company would have to rethink the services it currently offers and to think about proposing new services, when considering the alternative of implementing a use-oriented PSS. Therefore, new activities and resources would have to be established to ensure the proper supply of these services, as mentioned in Alternative 1 — product-oriented PSS for an existing business.

Alternative 3: result-oriented PSS for an existing business

Some points involved in Alternative 2, i.e., adoption of a use-oriented PSS, also apply to the third alternative. An examination of this alternative indicated that the company of this case study would have to make similar changes in elements described in the second alternative: key resources, value proposition, cost structure, revenue model, customer relationships, key activities and key partners.

The company also believes that it would face internal resistance to the change to a PSS, especially in the sales area, as mentioned earlier. In both cases, the PSS provider would continue to own the machine. Therefore, the easy financing of machines, the doubts concerning the time to amortize the initial investment and how to obtain revenue also apply to this third alternative, as well as the changes required in customer relationships and new activities, resources and partnerships to develop and supply services described in the second alternative.

An issue specific to result-oriented PSS that was brought up and has been broached in many studies about PSS is how to define
the price of this type of supply, given the difficulty of pricing services. The company has doubts about how to price units of plastics, which would be the result provided to the customer. Alternative 4: use-oriented PSS for a new business

The new business involves the development of a new type of machine that produces aluminum packaging. The company already has a specific market to supply it, which comprises small and/or new companies, but it does not have the technology required. As a result, an alternative would be importing from a low-cost supplier, such as a Chinese one, aiming to lease under the company’s quality seal and warranty.

For both customers and the manufacturer, the use-oriented PSS is a more advantageous alternative in this case than product or result-oriented alternatives. Since these are imported machines, financing though BNDES Finame is not available. Therefore, for the customer, this alternative offers value mainly in terms of the lower initial investment and the lower operational costs, since the PSS provider takes responsibility for maintenance and technical support. For the company, the result-oriented PSS is a more risky choice than the use-oriented one due to cultural issues and pricing difficulties.

The main barrier of this alternative is the high initial investment by the manufacturer to purchase machines and train staff. However, the creation of a new business unit implies fewer cultural barriers on the part of employees. The customer relationship would also involve fewer cultural barriers, since new customers would probably not find formal contracts a problem, unlike alternative 2. Thus, the main challenge in this alternative remains in key resources and cost structure elements of the business model.

After examining the current business context, it was suggested that one of the following types of PSS be adopted: POS (Product-Oriented Services), which was characterized in alternative 1, UOS (Use-Oriented Services) in alternative 2, and ROS (Result-Oriented Services) in alternative 3. Alternative 4 is a new business model according to the UOS type of PSS.

After describing the four alternatives, they were analyzed to identify the most attractive one for implementation. This analysis, performed jointly with the company, considered the number and complexity of barriers to each alternative and the number of business elements that requires changes. Fig. 5 summarizes the barriers described for each PSS alternative. The barriers are related to the elements of the Canvas business model and the elements that pose barriers in each alternative are highlighted in gray. Alternative 1 presents barriers in the elements key activities, key resources and customer relationships. Alternatives 2 and 3 present barriers in almost every element of the business model except customer segments, since the customer to be reached is already defined. Alternative 4 presents barriers in key resources and cost structure elements.

As can be seen in Fig. 5 and also from the description of the alternatives, Alternatives 2 and 3 involve more barriers than Alternative 1, which in turn presents more barriers than Alternative 4. The main difference between Alternatives 1 and 4 is the type of action involved to adopt PSS. In Alternative 1, the change concerns the organizational culture towards the value of services, which is known as hard to be addressed, and the redefinition of a business that is currently profitable, which tends to be a barrier to change. Several authors have already argued that one of the major barriers faced by companies wishing to adopt PSS is the change in culture from product to service orientation (Goedkoop et al., 1999; Manzini & Vezzoli, 2003; Martínez, Bastl, Kingston, & Evans, 2010; Tan, 2010). Mont (2004) argues that this change requires numerous resources and comes up against psychological barriers in companies. On the other hand, alternative 4 requires major investments and depends on the company’s current situation and potential revenue.

Since Alternative 4 faces fewer cultural barriers than Alternative 1, and given that the company can afford the necessary resources to implement it, this was the alternative chosen. Therefore, after deciding about the business context and PSS type, the next stage begins, representing the last phase of the framework — the definition of PSS characteristics for each element of the business model.

5.3. Part 3 — PSS characteristics

The discussion with company’s board members focused on describing the business model to fit Alternative 4 and on clarifying the PSS characteristics that each element of the business model should possess. This discussion resulted in the model illustrated in Fig. 6. PSS characteristics proposed for each element of the business model is described below, completing the application of the framework.

• Customer segments: the company seeks to reach small companies or companies that are entering the market, which do not have enough capital to purchase new machines and will find it difficult to make heavy investments.

• Value proposition: the PSS options offered by the company could be customized according to each client’s needs, considering, for instance, the frequency with which the machine is used and the package of services that clients want to acquire. A training course on the use of the machine could be offered to the client, who would benefit from its improved performance and operation. The value provided to the client could be increased by integrating products and services to meet the customer needs, thus increasing the quality added to the offer. The company can also offer a lower initial investment option for the customer segment, considering the fact that the client would not purchase the machine but would pay for its use, which spreads these costs over the time the machine is used. Also, as the PSS provider is responsible for the machine during its entire lifecycle, the client’s expenses with maintenance and technical assistance services are reduced.

• Customer relationships: the company aims to establish long-term relationships through formal agreements, seeking close relationships with its clients and helping the proposed values to be achieved, such as alternatives for the co-development of solutions. In this case, the PSS provider could support the development of solutions at the client’s facilities. The greater proximity between the PSS provider and the client increases their contact and communication, making it easier for the PSS provider to participate in the client’s processes.

• Distribution channels: it was decided that a customer service trained to assist this new client segment would be developed, as well as a new sales channel qualified to demonstrate to clients the benefits of the PSS offer. In addition, the company intends to use its website as a tool for constant communication with the client.

• Revenue streams: revenue would be generated through the monthly payment of a fixed rate, which would cover both the product and services that would be made available throughout the machine’s lifecycle.

• Key resources: the key resources considered by the company in this new offer are mostly human and financial resources. The former should involve qualified staff to service the machines during their use and to provide technical, mechanical, electrical and electronic services. In addition, training for sales staff should be considered, as well as the definition of staff and of people directly responsible for managing contracts. The financial resources involve the investment required to acquire this new offer, i.e., the resources required to purchase the machines from China and create the website.

• Key activities: small and new clients entering the market are rarely aware of how a PSS works. Given that the company aims to establish close relationships and develop co-solutions with clients, it would be interesting for it to help clients develop a business model that
enables them to have a PSS as their supplier, which would be the manufacturer of this case study. The company should consider the use of specific software programs to monitor the machine during its use phase, provide maintenance when necessary, monitor its performance, and be aware of its end of life. Also, the increase in the number of partners needed for the development of a PSS offer demonstrates the importance of managing this network. Risks and profits will have to be shared with partners on a contract basis.

The fact that the company aims to forge closer relationships with its clients requires a differentiated management of the activities conducted with these clients. New forms of communication with clients will be required on a regular basis. Suitable performance indicators should be created to measure the results of this new offer. These indicators must be able to measure gains and even losses based on financial issues. In this case, the form of payment must be considered. Client satisfaction with the product will also have to be measured, mainly while the services are rendered during its use. The client–PSS provider relationship should also be a measure of client satisfaction.

• Key partners: One of the most relevant elements for PSS-oriented business is the partnerships required to develop and deliver the offer. Upon examining the values and clients it considers, the machine tool manufacturer identified several partnerships it would have to enter into in order to deliver the offer. The company intends to develop a new business unit or company, which will be responsible for the PSS of the new machines. Because the machines will not be manufactured by the company under study, a partnership should be established with a Chinese supplier to acquire new machines. Since the machines will be owned by the company of this case study, a transportation company will be hired to deliver the machines to the clients' facilities and remove them for servicing and eventually for disposal. Due to the new types of agreements signed with partners and clients, it will be necessary to have a law office in charge of contract management. It will be also necessary to create architecture for product monitoring; aspects of both hardware and software must be considered. As hardware, the machines and their accessories must be prepared to generate machining capabilities to enable the execution of the software.

Fig. 5. Alternatives of the PSS business model investigated.
• Cost structure: some of the costs involved in this PSS differ from the usual ones pertaining to product sales. The increased number of partners means that profits will be shared with them. Moreover, unlike the sale of a product, the entire revenue will not be realized at the moment the machine is delivered to the client. This means the company will have to make a substantial initial investment. And, since the company retains ownership of the machines, it will have to bear the costs involved in the use phase of the PSS (maintenance services, upgrades, replacement parts and shipping of same) and their end of life and/or disposal costs (reverse logistics, end of life alternatives).

5.4. Insights from the framework application

The application of the framework occurred in the presence of the company’s board members, who helped with the selection of PSS characteristics required in the new business model. At the end of the workshop, they agreed on the feasibility of implementing such model on the near future. This fact confirms the potential of the framework to guide the company in the analysis of its current business and in the definition of actions to adopt PSS. Additionally, the framework supported:

• The understanding of the current business model and the investigation of how this model could work in different PSS scenarios
• The identification of barriers related to the different PSS scenarios
• The creation of a new business model aligned to the company’s strategy and to the PSS requirements
• The investigation of PSS types by understanding their differences and characteristics, enabling the proposal of scenarios according to PSS types
• The definition of PSS characteristics for the selected type of PSS (alternative 4)
• The generation of new ideas and opportunities as a result of the knowledge acquired during the workshop

Next section highlights the challenges noticed in this study regarding the implementation of PSS.

5.5. Challenges to implement PSS

Some challenges to implement PSS came to light during the case study. Unlike the barriers identified in each of the PSS alternatives during case study execution, these challenges seem to pertain not only to the company under study but also to its environment and market demand. They are grouped and presented in the following types: machine leasing, financial aspects and internal resistance.

The readily available financing of machinery in Brazil is an important point to consider. The government, through BNDES (national development bank), has lowered the interest rate for the acquisition of machine tools produced in Brazil, granting a payback period of 10 years to pay loans. Due to this incentive, companies prefer to purchase new machines than purchasing maintenance services or leasing machines. As a result, the implementation of PSS has been hampered in Brazilian companies.

The financial aspects also raise many doubts, e.g., how long would it take to amortize the initial investment, since customers would no longer purchase the machine, but would make periodic payments for the right to use it. Another question that was brought up and has been already mentioned in many studies about PSS is price definition, given the difficulty of pricing services.

The company of the case study had several questions about taxation, which is an important point for companies that sell only products and wish to adopt PSS. In Brazil, there are specific taxes for products and services, but the legislation is not clear about how to tax product–service systems. The company struggled to identify the taxes it would have to pay and to determine whether the new business would fit as a product seller or a service provider.

Finally, there was internal resistance to implement PSS in the company studied, because its employees are unaware of the potential value of services and they would therefore lose opportunities related...
to PSS. These kinds of opportunities include increasing its revenue by supplying services, monitoring product performance during the usage phase, increasing the value delivered to and perceived by the client, supplying services, monitoring product performance during the usage phase. The company also pointed out concerns regarding the definition of a new service development process and the training of employees for new services or improvement of the existing ones. These concerns were drivers that motivated the company to implement PSS through the creation of a new business unit, reducing the risks and impact on the performance of the current business.

6. Final considerations

From the academic standpoint, this study investigates the adoption of PSS through a perspective based on the business model concept. This perspective differs of current studies, which have focused on the PSS characteristics related to product design or on specific elements of business, e.g., customer relationships, cost management and partnerships.

From the empirical point of view, the first contribution that can be delineated is the identification and classification of the PSS characteristics according to a business model structure. This result enables companies to better compare their business models to the characteristics expected when adopting PSS. Moreover, an overview of the PSS characteristics supports companies to discover opportunities for their current business models or to new ones. An understanding of PSS characteristics can therefore help companies in the selection of the characteristics that best fit into their business context or that can lead to new business opportunities (Tan, 2010). The second contribution is the creation of the framework to support companies that want to implement PSS. It gives to companies a starting point to deal with PSS. The third contribution is the case of the machine tool manufacturer, which illustrated the use of the proposed framework to identify opportunities for the adoption of PSS. During the application of the framework, which embraces an analysis of the requirements to implement different types of PSS, several barriers were identified. The description of such barriers can help companies to mitigate future risks and adopt PSS successfully. In addition, examples of challenges that can affect PSS are revealed, such as machine leasing, financial aspects and internal resistance. The analysis of these challenges can be deployed into actions capable of stimulating the PSS implementation.

By deciding to adopt or to create a new business model to fit with the PSS requirements, companies should check constantly whether and how this decision can impact on their business or corporate strategy. Since the implementation of PSS can lead to changes of elements linked to ongoing businesses, managers should keep in mind the importance of reviewing strategic constraints and redefining the types and characteristics of PSS to overcome potential issues. Therefore, even if the framework implementation occurs without issues, a feedback loop to the framework first part may be required to analyze whether the first decision of adapting or creating a new business model continues valid.

The major limitation of this research relies on a single application of the framework. More studies have to be performed to increase its credibility and the validity of its results. It is also important to emphasize the aim of this application is to give an example of how the framework can support companies interested in adopting PSS. The case was not designed to assess it, which should be part of the future actions planned for this research.

This study recommends for further research the analysis of the environment in which PSS wants to be introduced, in particular the legal, technological and economic aspects. In fact, the alignment with external factors is primordial to the effective design and implementation of PSS.

The next steps of this research embrace the proposition of an application process for the framework and the identification of linkages between the PSS characteristics and the types of PSS. In addition, cases that present the implementation of the framework could be performed to assess its results in a more concrete manner.

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