

The 9th CIRP IPSS Conference: Circular Perspectives on Product/Service-Systems

## Overcoming the product-service model adoption obstacles

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### Abstract

Product-Service Systems (PSS) benefits are not limited to its providers and costumers, but the whole society might also take advantage from its sustainability impact. Nevertheless, many PSS projects still fail, and lots of customers stick to buying mere products or services in a transactional rather than a relational context. Shifting to the PSS paradigm requires a mind-set/organizational culture change both from the PSS' provider and customer. On one hand, the manufacturing companies should change from production scale to use scale, therefore producing fewer products that will be more used, and the profit will be rather based on the services they provide. On the other hand, the customer must be flexible to give up product property in favor to product use when it pays off in the long term. Not surprisingly, this paradigm shift creates some obstacles that could deter companies from adapting the product-service concept, as a successful PSS will require different societal infrastructure, human structures and organizational layouts in order to function in a sustainable manner. This paper analyses the benefits and obstacles from/for PSS and proposes a self-assessment questionnaire that point to the needed business model changes in companies interested in adopting PSS.

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Peer-review under responsibility of the scientific committee of the 9th CIRP IPSS Conference: Circular Perspectives on Product/Service-Systems.

*Keywords:* Product-Service System; Industrial Product-Service System; PSS Obstacles; PSS Business Model

### 1. Introduction

Product Service-System (PSS) is a business approach where manufacturing firms' revenue shifts from only selling physical products to also selling services, where the value delivered ranges from more product to more service shares [1, 2, 3]. In business-to-business (B2B) applications the PSS might also called Industrial Product-Service Systems (IPSS). In this paper these two are referenced indiscriminately as PSS. PSS benefits are not limited to the PSS' providers and costumers, the whole society might also take advantage from its sustainability impact, once it can both potentially reduce resources consumption and pollution [4]. In PSS, the interrelations between the physical product and the non-physical services need to be considered proactively during the development process [5]. PSS are therefore complex systems, in which the design process must take into account products, services, support systems, business elements, and the work flow and interactions amongst them [6].

Nevertheless, many PSS projects still fail, and lots of customers stick to buying mere products or services in a transactional rather than a relational context [3]. Shifting to the PSS paradigm requires a mind-set/organizational culture change both from the provider and the customer. On one hand, the manufacturing companies should change from production scale to use scale, therefore producing fewer products that will be more used, and the profit will be rather based on the services they provide [3]. On the other hand, the customer must be flexible to give up product property in favor to product use when it pays off in the long term [7].

This paper makes a literature-based analysis about the PSS impact aspects related to the PSS provider, the PSS receiver, and the offered product-service system itself. The final paper contribution is a set of PSS readiness self-assessment questions for companies planning this paradigm shift. The questions support understanding the change consequences, and the definition of a new business model, based on the Business Model Canvas [8].

This paper is structured as follows, in order to also show the work rationale and methodology. The PSS analysis, particularly in terms of categorization and the obstacles for adoption, as showed in section 2, were made to facilitate its linking to the Business Model Canvas' elements, as presented in section 3. The questionnaire itself and its implication to the business model definition are described in section 4. Section 6 presents the final remarks and the plan for future research.

## 2. Product-Service Systems (PSS) and related benefits

Successful PSS relies on lifecycle-long relationship between its provider and customer [3]. This relationship acts like a fulcrum, by guaranteeing both the flow of money and information that will enable and sustain the PSS.

From the provider point of view, the longer the relationship the higher is the profit from setting the structure to support the customer's use. This relationship creates a customer– provider intimacy and mutual dependence, which supports a learning process where the providers better understand the product use and the market, thus better serving the customers, creating opportunities to differentiate, setting barriers for competitors imitate, and creating competitive advantage [3].

From the customers' point of view, longer relationships mean providers' better understanding of their needs and accurately providing the right PSS. These PSS release customers from the responsibilities of asset ownership [2], and from capital lock-up and knowledge restrictions to using newer and even more complex technologies, once the PSS provider can apply sharing mechanisms that reduce individual cost and risks, and thus optimizing the use phase [3].

In the society perspective, longer relationships might preserve the usability of the PSS and prolong the product's lifecycle. Once the ownership remains with the provider, there is greater motivation to establishing closed loop recycling management with reuse services [7, 9]. It might exploit information exchange with the customers and other stakeholders during the after sales and end of life phases to increase the PSS lifespan. Multiple usage phases' also make a PSS competitive by maximizing the utilization of resources.

### 2.1. PSS categorization

The importance of understanding the diverse PSS types lies in the different challenges they pose to companies' adoption. PSS classical categorization is based on the value delivery shift from more product to more service shares [7]. Tukker [4] detail these categories into eight archetypical business models. Ostaeyen et al. [10] suggest a different typology, where they consider the revenue mechanisms on different levels of abstraction. The here presented business models organization is a combination from the literature (Fig. 1).

In a product-oriented PSS (type 1), while the product ownership remains with the customer, the provider sells additional services. Revenue is transferred from the customer to the provider according to the delivered products or services (input-based, IB). The offered services might include those needed during the product's use phase, and advice and consultancy about the most efficient product use. [10]

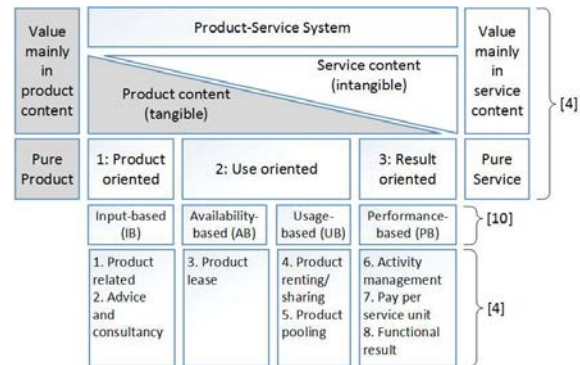


Fig. 1 – PSS' categorization.

In a use-oriented PSS (type 2), ownership (and related risks) remains with the provider and usage rights are sold to the customer. An availability-based (AB) revenue mechanism means that revenue is transferred from the customer to the provider based on the time period during which the product or service are available (unlimited and individual access) for the customer. In this case the customer still has a feeling of ownership, once he/she has complete access to the product during the contracted time. In type 2, ownership can also remain with the provider and usage rights are sold to the customer with a usage-based (UB) revenue mechanism during the actual usage of the product or service (i.e. product renting, sharing, or pooling).

In a result-oriented PSS (type 3) the provider's role is expanded from offering usage rights (type 2) to selling functional results. In a result-oriented business model the process performance responsibility is transferred to the PSS provider, as the customer pays for the faultlessly results. A performance-based (PB) revenue mechanism means that revenue is generated based on the functional performance of the product or service. This is the most complex PSS type, once it is more difficult to negotiate indicators, and it requires continuous feedback about customers' satisfaction and possible behavior and expectations changing trends.

### 2.2. Obstacles to PSS

While type 1 PSS is probably easily applicable by traditional product oriented firms, greater benefits, particularly in terms of sustainability, are achieved by the other business model types, which progressively require a more service oriented approach. [4]. This paradigm shift creates some obstacles that could deter companies from adapting the product-service concept. There are three main uncertainties regarding the applicability and feasibility of a PSS: the readiness of companies to adopt them, the readiness of consumers to accept them, and their real environmental implications.

#### 2.2.1. Obstacles to providers success (OS)

**Lack of ownerless consumption enthusiasm in the B2C (OS1):** The assumption that the customer is more interested in

use, rather than the ownership of the product itself, might not represent current reality [7].

**Lack of ownerless consumption enthusiasm in the B2B (OS2):** Often only a few customers are willing to completely outsource processes. The investment to build the necessary infrastructure to operate their investment goods on customer side often does not pay off. [3]

**Changing systems and sources of gaining profit (OS3):** The development and providing of a PSS is associated with high investment costs, but the benefits of this investment are determined during the operating stage. Profit realization changes from short term at the point-of-sale to medium and long-term amortization at the point-of service. [2, 7]

**The need of adapting the value chain to support the new business model (OS4):** The expenditure for offering a PSS is a mixture of traditional product based activities plus the associated support activities (services) for PSS applications. [1] Companies normally might lack expertise in designing and delivering these services, thus requiring a change of the organization's value chain [2]

**The need of adapting the product development process (OS5):** In the PSS, the very notion of the product to be developed might change. It should take into account the complete value chain, and the whole lifecycle [3].

**The need of considering the new customer role (OS6):** Provider and customer should collaborate to the creation of the functional product. [6] In these relationships customers act as co-creators of value, working closely and collaboratively with the provider. [11]

**The dependence in information and knowledge exchange (OS7):** A strong partnership between the manufacturer and the customer is vital for long-term performance, and that can go beyond the contracted relationship, which could also mean more risks for the contract [3]. Lifecycle long adaptability and flexibility is only achieved by good design and through the lifecycle information sharing.

**Defining good performance criteria (OS8):** The more service oriented is the PSS type, the more difficult is agreeing about a set of good performance criteria, which balances risk among PSS provider and user. In many cases the 'functional result' cannot be defined in sufficiently concrete terms, where liabilities related to the promised result are too high, or where the provider simply has insufficient control if the result is to be reached. [4]

### 2.2.2. *Obstacles to customers adoption (OC)*

**Low level of maturity and lack of engagement in the PSS market (OC1):** Consumers not aware of the possibilities from PSS and not enthusiastic about ownerless consumption. [2]

**Lack of confidence from the customers (OC2):** Working closely together with providers might cause several concerns on the customers that might prevent the PSS purchase [13]. Thus, in order to have a sustainable relationship in a competitive and challenging environment, manufacturers should build enough confidence in the customers [14].

**PSS acquisition complexity and cost (OC3):** Purchasing a PSS is normally a more complex and time consuming process than purchasing a mere product or service. It requires high investments on both provider and customer sides. [13]

**PSS acquisition complexity and risk (OC4):** Evaluating PSS' providers and their offerings is much more difficult than in case of stand-alone offerings. The difficulties in the evaluation process raise customers' perceived risk, which is defined as a combination of the probability and magnitude of negative consequences in case of a poor purchase decision. [13]

**Loss of know-how (OC5):** PSS provision requires engaging in a close relationship and knowledge transfer. In this context, the fearing of know-how loss and being overly dependent on PSS the provider might prevent its buying. [13]

**The resistance of companies to extend involvement with a product beyond point-of-sale and historical practice (OC6):** The extended involvement leads to intra-organizational and interorganizational changes [7], where both partners to adjust to each other. Customers have to learn how to handle new product components, like implemented machines or self-service devices; they further have to adapt to service times that are offered by providers, even if this affects their own activities [12, 15].

### 2.2.3. *Obstacles to relevant sustainability impact*

**Uncertain impact on using consequences (OE1):** although PSS have the potential of reducing material consumption (less produced units, which are more constantly used), there might be no environmental impact related to use, once the total using hours might remain the same. [4]

**Possible use and its related effect increase (OE2):** Multiple use does not automatically lead to less impact on the environment [4, 16]. Leasing, for instance, can promote use of products which otherwise would not be affordable for customers. Without the option of leasing, the purchase could have to be postponed to a later date [7].

**Impact of misusing (OE3):** The lack of ownership might lead to less responsible user behavior and its negative environmental impacts [4].

## 3. PSS impact on business models

In order to overcome the PSS' obstacles a company must adjust its business models elements while shifting to PSS. Indeed, one of the main challenges for companies wishing to adopt PSS is identifying the changes required in their businesses model [17].

A business model represents the company's underlying core logic and to communicate strategic choices, by describing how the company creates, delivers and captures [19]. The main contribution business modeling is helping companies to capture, understand, design, analyze and change their business logic [8]. In the same way as Barquet et al. [18], the Canvas Business Model [8] is used here to represent the PSS' characteristics; but, instead of considering only the provider point-of-view, the customer organizations are also taken into account.

The Canvas Business Model is composed by 9 elements, and Fig. 2 shows which of these elements are affected in the provider and in the customer organization, according to the obstacles identified in section 2.2. The affected elements in the provider point of view are:

- Customer segments (for whom are you creating value?): once you are changing from offering a product to offering a PSS, your previous customers might not be the customers for this new business; even if they remain, you might need to educate them and gain their confidence.
- Value propositions: your value proposition must match the customer's needs and face the obstacles to adopting the PSS model you are offering.
- Distribution channels: new channels have to be developed to reach the customer through the offered services (from point-of-sales to point-of-services).
- Customer relationships: they also relate to some extent to the offered services, and include support to information and knowledge exchange.
- Revenue streams: revenue models and expected ROI according to the chosen PSS type and the total revenue from servitization. The revenue model must also be acceptable according to the customer cost structure.
- Key resources: these include the most important assets to make the business model work (physical, intellectual, human, financial) according to the chosen PSS type.
- Key activities: the most important things the company must do to make the business model work, which includes the new service offering, information gathering and processing, and continuous PSS development activities.
- Key partners: the network of suppliers and other partners that make the business model work. In PSS the customer also becomes a key partner, due to the needs of information sharing and co-creation.
- Cost structure: describes all costs incurred to operate a business model, according to the chosen PSS type. From type 2 on, the provider must consider the total cost of the product shares ownership.

IPS2 costumers, in the case of B2B applications, might consider either keeping the same value proposition or taking advantage from additional benefits offered by the IPS2 provider, and rethinking its own business and improving its value proposition. In the case of keeping the same value proposition, the affected business model's elements are:

- Key resources: the supplied PSS might substitute a key resource, thus requiring different management effort. Additional information provided by the PSS, and that the customer might not get by its own means, can also become new key resources.
- Key activities: additional activities might be set in order to allow the interface with the PSS' provider, contract management, and information feedback.
- Key partners: the PSS' provider becomes a key partner.
- Cost structure: the PSS contribution to the cost structure changes from cost of ownership to cost of outsourcing.

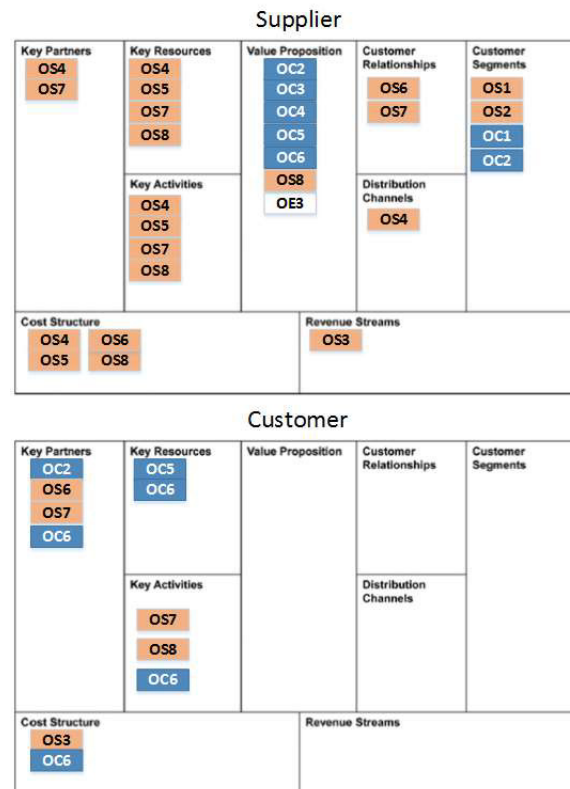


Fig. 2 – Affected Canvas's elements and related obstacles to PSS.

#### 4. Business model assessment questions

Once the PSS' obstacles impact on the business model's elements have been identified in section 2, the next step is defining a structured way to overcome these impacts while planning the company's strategy, considering the mapping between the obstacles and the Canvas' elements, as presented in section 3. The questions were grouped according to the provider point of view. Rather than expecting a direct cause and effect relation ("perceived fact => specific strategy") from each question's answer, the questionnaire objective is reminding all the relevant aspects that must be taken into account during the business model elaboration. Some questions might require adaptation to either IPS2 (B2B) or PSS (B2C). Regarding the obstacles to relevant sustainability effect, OE1 and OE2 are intrinsic to the PSS, while preventing misuse (OE3) can be considered into the value proposition.

##### 4.1. Customer segments, customer relationships, and distribution channels

The customer segment analysis requires understanding if the customers (and market) are ready to be the new PSS's customers. The accurate comprehension of the customer motivation and fears is paramount to the successful PSS strategy definition and deployment. The analysis also aims at



understanding the obstacles effect and influence in setting the customer relationships and distribution channels strategies.

- What are the customer segments you want to serve with the PSS? What value does the customer pull from the PSS's product and service shares?
- In the case of previous customers, which value they already pull but that will be delivered (or better delivered) by changing to PSS? Why will they remain your customers after you change to PSS?
- What evidence is available that confirms the customer's enthusiasm to embrace your PSS? (OS1, OS2)
- How the user's (organizational) culture supports shifting to services receiving instead of product ownership? (OS1, OS2)
- How comfortable and knowledgeable is the customer about PSS and its possibilities? Will you need to educate them before/during the PSS offering? (OC1)
- What evidence is available that the customer has confidence in your capacity to fulfil your PSS promise? (OC2)
- How sensible the information and knowledge related to the product operation to the customer? (OC5)
- Which know-how is the customer going to lose? Is there any learning compensation or additional value being delivered, in terms of knowledge the company is acquiring due to adopting the PSS? (OC5)
- Are there resistance factors to extend involvement with a product beyond point-of-sale? How is the customer historical practice? (OC6)
- How much the offered product is normally related to the customer's core business? (OC2, OC4, OC5, OC6, and general outsourcing issues)
- How do you rate the PSS in terms of supporting/interrupting the customer's core business processes? (OC2, OC4, OC5, OC6, and general outsourcing issues)
- How much will the customer need to adjust its processes to integrate the offered PSS? Can you identify alternate scenarios? (OC6, OS6, OS7)
- What are the PSS performance indicators? How easy is monitoring the PSS use and/or performance? (OC4, OC6, OS8)

#### 4.2. Value Proposition?

When defining the value proposition the most relevant aspects are related to confirming that the chosen product fits the PSS, and that it is possible to define a win-win value proposition. While defining the value proposition, the motivations and fears identified in section 4.1 should be considered as opportunities and obstacles. The following questions support identifying if the considered product benefits from the PSS model.

- Describe the actual product: What are its main functions? How do they differ from the planned PSS' functions?
- Do you already offer any related services to your actual product? (List them and describe how they are contracted

and executed) How the PSS's services differ from the previously offered services?

- Do you expect any need of customization among customer segments/ among different customers in the same segment?
- Does technology or changing in the customer behavior (or any other aspect) play an important impact in the product obsolescence? (Which/How/What is the obsolescence cycle?) Considering products that become obsolete quicker might reduce the resistance to the PSS.
- Can product adaptability and flexibility reduce the TOC? Adaptability and flexibility features might reduce the resistance to the PSS.

The following set of question aim to identify if the PSS supports a win-win value proposition, and if it is worthwhile pursuing. As a rule of thumb, the opportunities and threats for the PSS adoption identifying while analyzing the answers from the questions related to the customer segments, customer relationships, and distribution channels should be considered and balanced here.

- Considering the PSS acquisition complexity and cost, how does the way the PSS is offered reduce these obstacles? (OC3)
- Considering the PSS acquisition complexity and risk, how does the way the PSS is offered reduce these obstacles? (OC4)
- How does the PSS add value to the customer in the sense that instead of risking its core business processes it potentially can give better results than the non-product-service model? (OC2, OC4, OC5, OC6, and general outsourcing issues)
- Considering that the customer will need to share his proprietary knowledge, what value does the PSS aggregate to this shared knowledge and return to the customer as an asset he would not get otherwise? (OC5)
- How does the PSS guarantee minimum need of changes (and associated costs) to the customer's processes? (OC6)
- How does the offered PSS facilitate the monitoring by the customer? (OC4, OC6, OS8)
- How does the offered PSS prevent misuse? (OE3)

#### 4.3. Key resources, key activities, and key partners

Depending on the chosen PSS type, different adaptation in the company's structure and processes might be required. Now the provider readiness to offering the PSS is checked, and the company might even conclude it is not yet ready for embracing the PSS.

- How the company's organizational culture supports shifting to services offering instead of product offering? (OS4)
- How strongly is the company structured to support the service sale paradigm? (cost of change, risk/resistance for changing) (OS4, OS5)
- What are the needed physical product changes and investment to support PSS (OS5, OS6)?

- What are the needed value chain changes and investment to support the PSS (manufacturing, after sales, EOL) (OS4)?
- Is all the needed information potentially available? (OS7)
- How the information gathering and the measuring capabilities impact the actual product and business processes? (OS8, OS8)

#### 4.4. Cost structure and revenue streams

The PSS chosen business model must support both the provider's cost structure and revenue streams, and be as well compatible with the customers' cost structure.

- In the customer point of view, is the PSS cost lower than the total cost of ownership (TCO) of the product? (OS3)
- Are the revenue model and ROI (change) acceptable (provider's TRS – Total Revenue of Servitization > TCO – provider's Total Cost of Ownership)? (OS3)
- Are the costs of changing the product into PSS acceptable? (OS5, OS6)
- Are the costs of changing the provider's processes acceptable? (OS4)
- Are the costs of changing the customer's processes acceptable? (OC6)
- Do the measuring costs compensate its impact in the cost structure? (OS8)

#### 5. Final Remarks

The self-assessment questionnaire presented in this work provides a structured way to overcome the PSS identified obstacles while planning the company's strategy. Particularly, by organizing the obstacles to PSS and the related questions according to the Business Model Canvas [8] facilitates applying this work's results, by linking them to a previously established body of knowledge. As results this paper presents two contributions: (1) identifying a set of obstacles for the PSS' success, according to the provider, customer, and sustainability points of view, and (2) Presenting a self-assessment questionnaire to support companies defining their new business model, according to the chosen PSS type and considering the mapping between the obstacles and the Business Model Canvas' elements.

The defined directives support deciding: (1) adopting or not a PSS; (2) defining which PSS type to choose; and (3) planning a business model that fits the chosen PSS.

However, if the concepts presented in this paper are to achieve its full potential, more work must be done. Additional studies are required to more fully capture the relationship among the obstacles, and the actual impact on the business model's elements. A challenge for future research is to interview companies planning the shifting to PSS, and understanding how it facilitates, in practice, the strategy

definition. Another future challenge is to capture an empirically grounded decision making from PSS experts and practitioners, in order to both validate a general model, as well as assess the questionnaire usability.

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