



Concept, benefits and success factors of product-oriented Product-Service System: A research agenda

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Abstract. This study aims to understand the concept of product-oriented product-service system (PSS) and identify its benefits and the success factors that assist in its successful implementation. To achieve these objectives, we conducted a systematic literature review, through which 93 empirical articles were analysed. The results show that different names are used to refer to product-oriented PSS and the range of services that can be offered in this PSS category. As for the benefits, we identified the outcomes for the environment, the society, the PSS provider and the consumers. Regarding the success factors, we identified different practices that must be considered when developing the offers, which are related to human resource management, market strategies, product and service development and investment in technology. Based on the covered topics and the identified gaps, we proposed a research agenda for this subject.

Keywords: Product-service system (PSS), Productization, Servitization.

1 Introduction

Studies have demonstrated the potential contribution of Product-Service System (PSS) in the development of practices oriented to the circular economy [1, 2]. PSS is a business model characterised by the integration of products and services, which was designed to meet the consumers' needs and being sustainable [3, 4]. Different approaches exploring and classifying PSS have been proposed. In this paper, based on the categorization detailed by Tukker [5], we focused on product-oriented PSS. In this category, the business model is primarily aimed at selling products, with some extra services.

Even though PSS has emerged from the field of sustainability, its development in this regard is yet not complete [6]. There is a lack of knowledge regarding methods for identifying opportunities or developing PSS solutions considering circular economy aspects [7]. Additionally, as consumers desire to comprehend how PSS could benefit

them [8], additional studies can clarify the outcome of PSS for consumers as well as for the manufacturers [9]. Additionally, it is suggested that the characteristics and differences of each PSS category should be further studied [10, 11]. By categorising according to each of the classifications, organisations can refer to successful examples and adjust their offers [12].

Considering the above, the objective of this study is, through a systematic literature review, to understand the concept of product-oriented PSS and identify its benefits and the success factors that assist in its successful implementation. Finally, this paper also features a research agenda to guide further studies in the area.

2 Method

A systematic literature review was carried out following three main steps: (i) planning phase; (ii) conduction and systematisation; and (iii) description and synthesis of the results [13].

The (i) planning phase aimed to define criteria for the protocol. The search string used was "Product Service System" OR "servitization". As for the selection of the databases, the research was conducted on Scopus and Web of Science. The phase of (ii) conducting and systematising the review comprised the databases search/review using the previously mentioned search strings, also the selection and analysis of relevant contributions and the stages of reading and cataloguing. The following inclusion criteria were established in the mechanisms of the databases: only studies published in journals and, finally and in the English language. 1.911 articles were obtained, including duplicate materials.

From reading the title and abstract, were excluded those that: dealt specifically with the use-oriented or result-oriented PSS categories; did not agree with the objectives defined. After excluding duplicates, 463 potential articles were selected. Further reading of the introduction, method and conclusion sections of the remaining articles were conducted, aiming to exclude papers that: were not related to the product-oriented PSS; theoretical review articles. In the end, 93 empirical articles were selected for data extraction and analysis. Phase (iii) of synthesis and description of the results was conducted, in which the contributions of the studies were identified, and the conceptual aspects, benefits and success factors were identified.

3 Results

3.1 Product-oriented PSS concept

During the systematic literature review, the articles selected were classified into three categories (Table 1).

Table 1. Selected articles

Theme	Possible research questions
Product-oriented PSS denomination	[14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34] [35] [36] [5] [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [12] [53] [1] [54] [55] [2] [56] [57] [58] [59] [60] [3]
Another denomination but correspond to that category	[61][62][63][64][65][66][67] [68][69] [70] [71]
Any denomination, but classified as product-oriented PSS	[72] [73] [74] [75] [76] [77] [78] [79] [80] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [85] [91] [92] [93] [94] [95] [96] [97] [98]

Product-oriented PSS corresponds to the product and service development process of a company that is moving towards the servitization process [19]. In this category, the emphasis is on services related to the sale of a product, which is still the focus of the company [18, 20, 26]. This PSS can be conceptualised as products plus integrated services [14], in which services are considered as “product complements” [28, 49]. In the case of product-oriented PSS, tangible ownership is transferred to the consumer and some additional services are provided [54, 58, 59].

Examples of product-oriented PSS are manufacturers that, in addition to their products, offer some type of service, such as installation, maintenance, repair, updates, remote monitoring, consulting, training, financial services, supply of spare parts, home delivery, documentation, consumer support, warranty, inspection and diagnosis. At the end of its useful life, services such as return, recycling, remanufacturing, and dismantling can also be offered.

3.2 Benefits

Several studies highlight the potential of the product-oriented PSS to encourage consumers to use the product for a longer time, extending its useful life [59, 93]. Thus, products will take longer to reach the end of life phase, with less generation of materials and waste [83]. Product-oriented PSS can contribute to the circular economy [1, 2, 51, 92] since it increases the rate of repair, remanufacturing, recycling, recovery and reuse. Environmental benefits can be obtained from programs that return and recycle end-of-life products [3], by encouraging product reuse [24], updating and training [25]. Reuse practices can directly contribute to waste management. Besides, PSS can reduce waste generation, pollution and energy consumption [40, 59, 61, 83].

The services provided can become a source of employment [75, 93]. Additionally, services such as reuse can benefit low-income groups since they can purchase high quality reused goods at a more affordable price and obtain assistance on how to use their products for a longer time [75]. Also, reuse services contribute to a sustainable lifestyle. The safety and protection of operators were pointed out as social benefits, in addition to the possibility of increasing employee satisfaction and salary [59].

Providers can offer product-oriented PSS as a way to add additional value to products, opening new market niches and gain a competitive advantage [3, 69, 92, 96]. Competitive advantage is obtained due to innovative and sustainable offers. In addition, the service offering contributes to revenue growth, leading to an increase in financial performance [42, 54, 95, 96]. Several studies have demonstrated the potential of product-oriented PSS to reduce costs as well as increase customer satisfaction and loyalty [12, 52, 65, 89]. Additionally, PSS promotes a closer relationship between manufacturers and users of the product [92].

Customers can benefit since services tend to improve performance [92, 95] and product durability, which means that they can postpone the replacement of their products [5, 24, 69], leading to costs reduction [56, 61, 83]. Cost savings can also occur if customers compare to the cost of creating their own service teams. Through after-sales services, business efficiency is improved over time [32, 40]. Through PSS, customers' needs can be met, and their experience with the product is improved [52, 59, 89]. Through updating services, customers can keep their equipment up to date with technological advances. With the application of remote monitoring systems, customers can obtain benefits in terms of risk mitigation, efficiency, in addition to obtaining better knowledge about the performance of the products [39, 84, 86]. As remote monitoring allows tracking the condition of the machine, it is possible to predict when maintenance of the equipment is necessary, benefiting in terms of machine availability and reduction of maintenance costs [39, 52, 66].

3.3 Success Factors

PSS requires an approach centred on customer satisfaction. It is essential to collect the needs and desires of customers and define the PSS requirements based on their needs [19, 35, 42, 91]. As the PSS implies a closer relationship with the customers [61], the company must find a way to deal with them [22]. Customer's feedback on services provided is an important source of information [30, 80, 92]. Another relevant aspect refers to the response time for customers and the role of the information flow between customers and the PSS provider [91]. Consumers must be willing to contribute to the provider [75, 98]. The strategic level is important, and also the definition of objectives for the organization [80]. Companies must define their goals regarding the PSS according to their general strategy concerning the pillars of sustainability [48, 61]. It is important that the PSS provider develop ways to protect against threats from competitors [3, 37].

Some studies emphasise the importance of multifunctional teams responsible for the development of new products and services [40, 66, 85]. Human resources management is fundamental to the implementation of PSS. [41]. The successful implementation of the PSS requires that those involved in providing services be adequately trained to promote and deliver the services offered [35, 90, 95]. Likewise, the support team must be trained to effectively assist customers [91]. It is necessary greater investments in human resources to develop the PSS [62, 64]. The provider must develop mechanisms to educate consumers and assist them in comparing PSS costs with traditional purchasing methods. PSS requires organisational and managerial changes in the area of innovation

[62]. Companies can designate people in charge of raising environmental awareness across the company and create a vocabulary shared among all involved [37, 62]. It is essential to identify the skills and resources needed to offer PSS [26]. Companies need to have a positive attitude towards PSS [64].

The literature indicates that the use of different information and communication technologies favours the implementation and execution of the PSS [49, 88, 96]. There is a need for specialists capable of analysing and interpreting the data collected from the remote monitoring of equipment [81, 84]. Appropriate implementation of PSS requires an integrated set of performance indicators for products and services [19]. The existence of historical data can assist in future design decisions [96].

The company's service model must be developed simultaneously with the product development process [25, 35]. Companies must develop their products recognizing service requirements from the early stages of the development project, to smooth servitization options from the beginning [97]. Customer support issues should also be considered in the early stages [32]. Products can be redesigned to facilitate disassembly or repair, allowing easy maintenance [2, 32]. It is recommended to use raw materials and assembly techniques that increase the options for reuse and recycling at the end of the product's useful life [72]. The design elements must consider reducing future maintenance, repair and recycling costs [54]. Companies must use existing methodologies, make use of lessons learned and use the experiences and best practices of other companies [76]. The areas and processes that deserve investment priority when switching to PSS are also relevant to companies. Some studies highlight that the adoption of partnerships with different types of partners [17, 65, 71].

4 Research agenda

Although the results of the study shed light on this topic, there are still gaps and opportunities in the current literature on product-oriented PSS. Therefore, based on the studied papers, in Table 2, we propose a research agenda for this topic, highlighting particularly relevant issues within this area. The research agenda is divided into three major topics, according to the topics covered in the review.

Table 2. Research questions for future studies.

Possible research questions
Concept
<ul style="list-style-type: none"> •What is the overview and trends related to product-oriented PSS in manufacturing companies? Are there any differences from the country or region in which they are located? •What are the differences in the development of offers between large and small companies? What strategies can be applied to minimise them? •Do companies with limited resources have the potential to succeed in PSS offerings? •Does the human resource management of companies that implement product-oriented PSS differ from those that do not? •What capabilities need to exist to achieve innovation in product-oriented PSS?



- How to reduce the limitations imposed for the implementation of product-oriented PSS?
- What are the most frequent mistakes made by companies when implementing product-oriented PSS?
- What are the challenges for organizations to develop and implement product-oriented PSS?
- Are the proposed models and frameworks suitable for all industries?
- How to synthesise the proposed models in a single model for the development of product-oriented PSS? How to consider the contribution of this model to the circular economy?

Benefits

- How to make the product-oriented PSS offer more socially and environmentally sustainable?
- When and under what conditions does the product-oriented PSS contribute to the three dimensions of sustainability?
- Do companies operating in different segments have a positive attitude towards the implementation of product-oriented PSS and sustainable practices? What are the differences?
- What are the difficulties faced by companies to develop sustainable offers that contribute to the circular economy? What factors motivate them to develop such offers?
- Are there significant statistical differences between the different services offered in the product-oriented PSS associated with the three dimensions of sustainability?
- What are the (quantitative) economic, environmental and social impacts resulting from the implementation of product-oriented PSS?
- What are the potential rebound effects and consequences of adopting large-scale product-oriented PSS?

Success factors

- What are the factors that motivate or inhibit customers from purchasing a product-oriented PSS offering?
- What strategies can be proposed and employed to motivate consumers to purchase offers and contribute to providers?
- How can entrepreneurs better interpret customer feedback and incorporate validated learning into their offerings?
- What are the customers' positive and negative perceptions regarding the attributes of an offer?
- What metrics can be used to properly monitor the performance of products and services?
- What is the impact of the integration between information and communication technologies in the product-oriented PSS offerings?
- How to integrate the knowledge of different stakeholders in the development of PSS?
- To what extent does the integration between different functional areas in the development of PSS affect the market performance of offers?
- How to make the offer more tangible for consumers?

5 Conclusions

There are several contributions related to PSS in the academic literature. However, these research contributions have focused on PSS in general or addressing the three categories, where specific research on product-oriented PSS is still lacking. To fill this

gap, we conducted a systematic literature review, which through the selection of 93 empirical studies focused on the product-oriented PSS category. We found out that although different PSS classifications were proposed in the literature, in many cases, the different denominations refer to the same term and have similar characteristics.

As contributions of the study, we highlight the understanding of the concept of product-oriented PSS, the benefits of implementing product-oriented PSS and the best practices carried out by companies. We also highlight the proposed research agenda, which can guide future research on the topic. We provided information that can be used to assist companies in implementing product-oriented PSS. Specifically, by mapping good practices from other companies, we demonstrated important factors that must be considered when developing the offers. Through the mapped benefits, organisations can develop advertising campaigns that demonstrate the environmental and social potential of PSS offers, in addition to the benefits for consumers when purchasing them. This information can also be used to encourage managers and employees to develop product-oriented PSS offers. Also, the study can inspire companies from different segments to implement actions that contribute to the circular economy.

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