

PRODUCT-SERVICE SYSTEM – A LITERATURE REVIEW

Mariusz Salwin*, Jan Lipiak* and Roman Kulesza**

* Warsaw University of Technology, Faculty of Production Engineering, Warsaw, Poland,
E-mail: amariusz.salwin@onet.pl

E-mail: bjanlipiak@etigraf.pl

** Warsaw University of Technology, Faculty of Management, Warsaw, Poland,
E-mail: kuleszaroman@hotmail.com

Abstract: This article presents the basic concepts concerning product and service systems. The classification was presented, and various concepts of such systems were discussed. The benefits of product and service systems for production companies were presented, as well as the main factors hindering their implementation. The influence of process management on the presented systems was also discussed. An example of such a system is also presented.

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1. INTRODUCTION

Competition between companies and the growing demands of customers means that product features such as functionality and usability become more important. Customers are also not interested in having a product because it is not always profitable for them, and for them most important are the possibilities that a given product is able to offer them. Services play an increasingly larger role than production in the market which leads to manufacturing companies expanding their offer with services related to the products they offer. This change may lead to an improvement in their financial performance while meeting customer requirements. The integration of products and services results in the creation of product and service systems. The aim of the study is to introduce the issue of Product-Service Systems, which is a relatively new solution for enterprises.

2. PRODUCT-SERVICE SYSTEM

The concept of Product-Service System was conceived in the late 1990s and originates from Scandinavia. They were originally understood as a set of products and services available on the market that were capable of meeting common user needs. The Product-Service Systems provided by one company or an alliance of companies may contain products (or only one) and ancillary services. It may also include a service and an additional product. Product-Service System can be equally important for all functions (Goedkoop et al., 1999).

Product-Service System is a business model aimed at ensuring sustainable development both in terms of consumption and production. Such systems are used by companies offering a combination of product and services.

Product-Service System is a system consisting of products, services, networks and supporting infrastructure meant to be competitive, meet specific needs of customers and have a lower impact on the environment than traditional business models (Mont, 2002). If a business model based on the Product-Service System is designed correctly, it can increase the efficiency of product use, both if used by one or several users and increase the product life time (Overholm, 2015).

As the concept of product and service systems evolved, a Technical Product-Service System and an Industrial Product-Service System were defined.

The Technical Product-Service System emphasizes the physical side of the product, which is expanded and adjusted through services, which are mostly its intangible part. This type of Product-Service System distinguishes itself by its most investment character among all types of system, emphasizes its physical part and better reflects the relations between entrepreneurs using these systems and customers (Azarenko, Roy, Shehab & Tiwari, 2009).

An Industrial Product-Service System can be defined as a systematic package in which intangible services are linked to tangible products to close various industrial activities throughout the life cycle of a product (Jiang & Fu, 2009). The Industrial Product-Service System is characterized by integrated and mutually agreed planning, development, delivery and use of products and services with their inherent software components in inter-company applications. It constitutes a socio-technical system based on specialist knowledge (Meier, Roy & Seliger, 2010).

The Product-Service System is a topic of interest in many areas of the economy. It is an interdisciplinary area that brings together characteristics from different areas of science. It places great emphasis on the development and design and delivery of the solution, which is the Product-Service System to the end user (Annarelli, Battistella & Nonino, 2016).

The Product-Service System is also referred to as a "functional product" or "functional sales". The main idea of this trend is to provide customers with solutions, meeting their requirements, based on a combination of products and services. At the same time, such solutions are to reduce the impact on the environment and the consumption of resources, as well as have a positive impact on sustainable development (Min, Y. Suihuai, Dengkai, Jianjie & Baozhen, 2016).

The topic of Product-Service System composes with the sharing economy, in which the boundary between products and services is very thin and even non-existent. Finally, offering a product for rent or sharing can also be considered a service (Somers, Dewit & Baelus, 2018).

3. CLASSIFICATION OF PRODUCT-SERVICE SYSTEM

There are three main categories of Product-Service Systems. The first category is Product-Service Systems product oriented. This business model is still geared towards the sale of products, but here additional services are added to the products. The second category consists of use-oriented Product-Service Systems. The product still plays a key role in this model, but it is not sold. Product ownership remains with the supplier, who makes the utility and product functions available to his customers through various distribution and payment systems. The final category is Product-Service Systems results oriented. It is worth noting that this category of product and service systems is prospective in view of the possible shift towards a circular and resource-efficient economy, since the main profit is now delivered as an end result rather than a sold product. All tangible products and materials used to deliver the final result are now becoming cost factors, creating an incentive to minimize their use (Tukker, 2004).

All three categories of product and service systems, apart from the common goal of meeting customer needs, are divided into sub-categories.

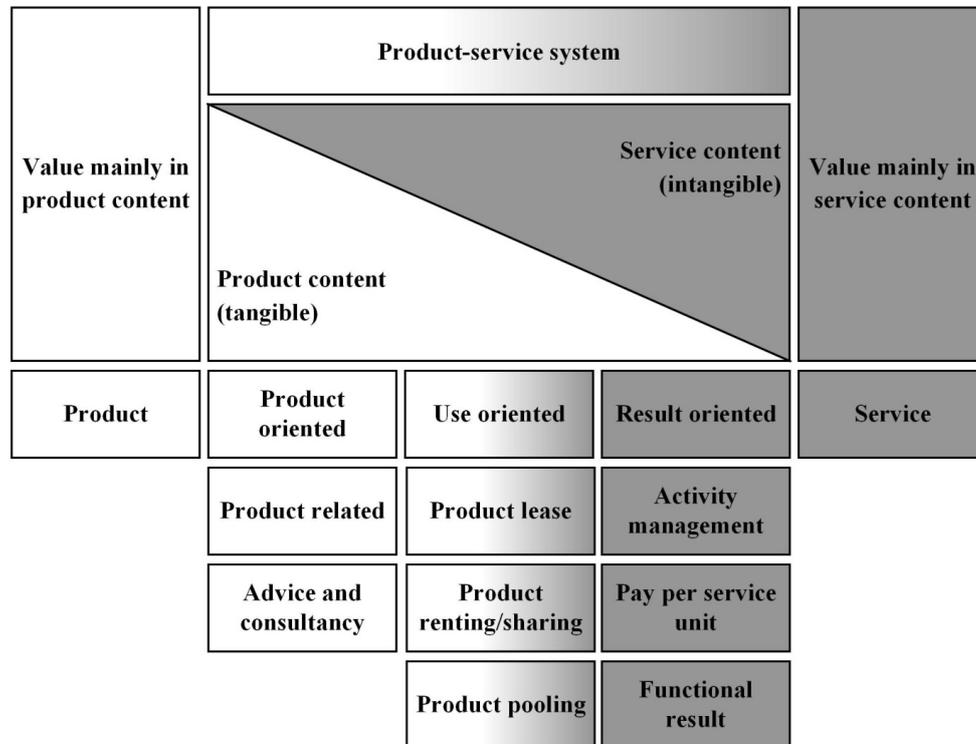


Fig. 1. Classification of product and service systems Source: (Tischner, Verkuilj & Tukker, 2002)

Product-Service Systems product oriented sell the product in a traditional way, including the sale of traditional ancillary services, which consist of: services ensuring the durability and functionality of the product held by the purchaser (repair, maintenance, reuse, recycling, as well as advice and training to help customers optimize the use of the product). In this case the company is motivated to implement a product and service system to minimize the operating costs associated with a long-lasting, well-functioning product and to design products considering the end of their useful life. In user-oriented Product-Service Systems, we are dealing with the sale of utility or availability of a given product. The customer only uses the product while the ownership right is with his supplier. The selling company is motivated to create a product and service system to make maximum use of the product and thus satisfy the demand, extend the life of the product and reduce the consumption of materials for its manufacture. Results-oriented Product-Service Systems sells results or performance instead of the product itself (e.g. voice mail to replace the answering machine). Companies offer a customer-specific combination of services for individuals while retaining ownership of the product. In this case, the customer pays only for pre-defined and agreed results, e.g. engine power used,

number of kilometers travelled, working time, etc. (Tukker, 2004); (Tischner, Verkuijl & Tukker, 2002). Each of the presented types of Product-Service Systems is aimed at meeting specific customer needs through a combination of products and services. The results-oriented system is the most complex type of Product-Service Systems, while the least complex is the Product-Service Systems oriented system. Each of the presented types of Product-Service Systems is aimed at meeting specific customer needs through a combination of products and services. The results-oriented system is the most complex type of Product-Service Systems, while the least complex is the Product-Service Systems oriented system.

4. ADVANTAGES OF PRODUCT-SERVICE SYSTEMS

The benefits of Product-Service System are addressed to stakeholders, the environment and society. One of the main benefits is differentiation. A company using a business model can simultaneously offer the customer the product itself, its possibilities of use or its effects. Product-Service System offer various possibilities and are an alternative to standardization and mass production (Baines et al., 2007); (Anacleto, Paladini & Vaz, 2018). From the company's point of view, product and service systems provide an opportunity to notice new strategic market opportunities, develop market trends and potentially maintain competitiveness. The lack of transfer of ownership from the company to the customer is also a very important issue. This makes it easier for the company to use more innovative technologies in production. The main benefits of the Product and Service System for the supplier are the following:

- new market opportunities,
- building competitive advantage,
- an alternative to standardization and mass production,
- improve the overall value delivered to the customer by increasing service elements,
- access to data on product performance during the use phase,
- the possibility of adding new added value to the product,
- the prospect of basing development strategy on innovation in industries in late stages of development (maturity),
- improving customer relationships through better contact and continuous flow of information on their needs and preferences,
- reusable re-use of a product and increasing revenues from the sale of integrated services.

Using Product-Service System, consumers receive greater value from suppliers in an integrated product and service, as well as within customized, higher quality offers. Such a combination can also give new combinations of products and ser-

vices that respond better to changing customer needs and conditions of use. The main benefits of the Product-Service System for the consumer are as follows:

- more customized offers and higher quality,
- new functions and combinations of products and services that better meet customer needs,
- responsibility for monitoring and completing the work transferred to the manufacturer (Mont, 2002).

Product-Service Systems also bring many environmental benefits. Companies become responsible for the entire life cycle of their products by implementing this model, the used product regenerates and then makes it available again on the market. This reduces waste, energy and raw materials used to make new products. It is worth noting here that the expenditure incurred by an enterprise on the regeneration of a used product is often lower than on the production of a new product. The main environmental benefits of Product-Service Systems include:

- reduction of the use of materials in production,
- life extension of the product,
- the development of eco-friendly usage patterns by companies.

Despite these benefits, the introduction of a product/service model poses major challenges for companies as it requires new relationships with stakeholders (Manzini & Vezzoli, 2002).

5. BARRIERS OF PRODUCT-SERVICE SYSTEMS

The use of the Product-Service System model is a challenge for enterprises. There are several barriers to accepting the Product-Service System for both the supplier and the customer. One of the barriers for customers may be ownership, which is not always transferred to the customer, and the problem of handling the products that are usually bought. In the case of enterprises, offering a product service system has an impact on their relations with suppliers and consumers (Mahut, Daaboul, Bricogne & Eynard, 2017).

The main barrier for companies is that the adoption of a strategy based on Product-Service Systems is more complex than the traditional way of supplying products. An important obstacle that Product-Service Systems may encounter is the necessity of changes for both manufacturers and customers. From the producers' point of view, there should be a change in their organizational culture and the concept of business value. Other important barriers include a lack of know-how, experience in designing services, technological information and specialists in service development (Mahut, Daaboul, Bricogne & Eynard, 2017); (Barquet, de Oliveira, Amigo, Cunha & Rozenfeld, 2013); (Kuo, Ma, Huang, Allen & Huang, 2010). The transition from a traditional production company to a product and service system also requires appropriate infrastructure (e.g. IT infrastructure). If a similar

system already exists in an enterprise, it may be necessary to adapt it to new tasks, if it does not exist, a completely new infrastructure is needed. To this end, the implementation of Product-Service Systems requires continuous education, training and updating of information systems to solve problems encountered by customers (Kanda & Matschewsky, 2018). It is also important to develop schemes and conditions for the use of a product so that the customer uses it for its intended purpose, so that the company as a supplier does not incur additional costs related to poor use and continuous repairs, and so that the environmental impact of the product is kept to a minimum. These schemes must maximise the life span of the product and anticipate possible events.

Completing these gaps may generate increasing costs due to the need to recruit qualified staff and the time needed for market entry with the solutions offered by this system, which can be considered as an additional barrier. A major obstacle for companies can be the profitability of the solutions offered in this way. In this case, account should be taken of the expected annual ratio of revenue from units offered in a Product-Service System-based manner to annual sales in the traditional way. The costs associated with the customer's use of the product throughout the entire product life cycle must also be considered in relation to the price of the product (Wise & Baumgartner, 1999).

An important barrier related to the environment is the so-called reflection effect. The environmental impact depends to a considerable extent on the circumstances, patterns and conditions of use of the product. Therefore, certain types of Product-Service Systems based on lack of ownership for consumers, such as leasing, sharing or bundling of products may lead to unsustainable use by the same consumers with negative environmental impacts instead of benefits.

From the point of view of customers, there must be changes in consumer habits and systems, particularly about the product-centred categories and the resulting criteria for Product-Service Systems.

6. EXAMPLE OF PRODUCT-SERVICE SYSTEM

Rolls-Royce PLC is one of the largest aircraft engine companies in the world. The company produces engines for civil and military aviation. It also offers engines for vessels, including submarines. The Rolls-Royce PLC has developed and successfully implemented the "Power-by-the-Hour" package. This is an example of a business system based on Product-Service Systems used in practice. Instead of selling the turbine engine, the company sells the power it produces. Thanks to this approach, the customer pays only for what he uses, and at the same time gets access to Rolls-Royce PLC technology. In addition, he is not interested in services, repairs, spare parts and settings related to turbine engines, as this is ensured by their supplier.

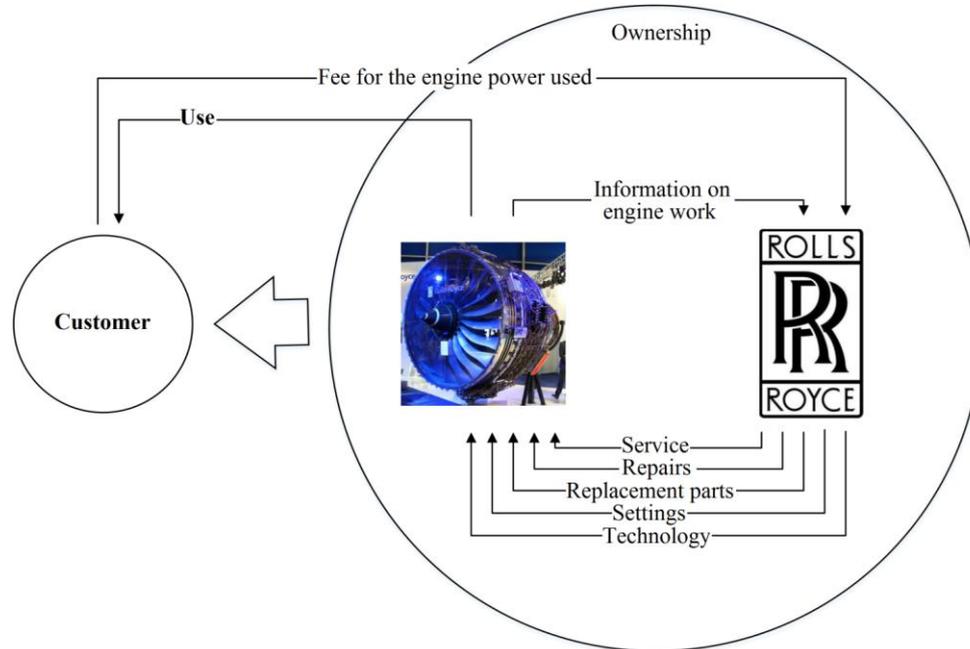


Fig. 2. Diagram of the "Power-by-the-Hour" Product-Service System

By using this business model, Rolls-Royce PLC has continuous access to its engines, which enables continuous monitoring of their operation, collection of information on their usage and performance. The information collected in this way gives Rolls-Royce PLC the opportunity to continuously improve its engines by improving engine efficiency, operating parameters, ergonomics and optimizing resources, service and maintenance plans. This solution also allows the company to improve modernization and develop better engine solutions. By using this system, Rolls-Royce PLC reduces the environmental impact of its products and "Power by the Hour".

7. CONCLUSION

The long-term increase in the share of services in the economy, called service-oriented economy, was an inspiration for a closer analysis of this phenomenon and its consequences for enterprises. Many companies decide to gradually expand or change their customer offerings, moving from designing, manufacturing, manufacturing, distribution and selling tangible products to selling a combination of products and related services (together) and, in the long run, only services. This phenomenon is called serialization of products and production and it relates to the

creation of product and service systems being a composting of material products and existing or new services offered jointly to customers.

The article presents the genesis and essence of Product-Service Systems and their benefits for the economy, enterprises, individual customers and the environment. The typology Product-Service Systems was also presented as well as the problems related to the transformation of enterprises from the traditional model of a purely (or mainly) production enterprise to the model of a service oriented one. Product-Service Systems should also be considered in the context of the problems of sustainable development of enterprises, the economy and society.

Products and services have so far been two different areas of the economy. Product-Service Systems create a new business model and show how combining products and services in a combination can meet specific customer needs. Adding services to products and services involves many benefits for each side of the transaction. The issues presented in the article concerning product and service systems do not exhaust the whole subject connected with it. On the other hand, they point out that the discussed systems bring with them several changes in the activity of enterprises, as well as in the customer's perception of the product and service.

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