Proceedings of the 2nd CIRP IPS2 Conference, Linköping, 14-15 April 2010, pp 535-542

Product-Service Systems across Industry Sectors: Future Research Needs and Challenges

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Abstract
This paper explores the current research in Product-Service Systems (PSS) across various industries such as industrials, basic materials, utilities, and financials, based on the Industry Classification Benchmark (ICB). PSS elements are identified within each industry in terms of tangible and intangible elements of products and services. Based on this identification, the differences in PSS delivery across industry sectors are defined based on two sources namely (i) actors, relationships, and networks, and (ii) delivery packages. Founded on the differences identified, the paper explains future research needs and challenges with focus on the scope of PSS, intra- and inter- sector flows and interactions between actors involved in PSS delivery and PSS design.

Keywords:
Product-Service Systems, Value creation, Industry production, Benchmark, Networks

1 INTRODUCTION

Across industry sectors, production trends continue to emerge in which the importance of offering services for value creation is promoted. Product-Service Systems are arrangements for production (in industry) that emphasise the importance of integrating products and services [1].

A product-service system (PSS) is also a 'business model' for promoting the co-creation of value between customers and companies [2]. This business model offers a generic approach to production that delivers value propositions based on providing functionality, availability or results to customers. The generic approach can then be applied across a range of industry sectors for the delivery of products and services that meet customer needs.

As a result, the delivery of a PSS within an industry sector is dependent on the characteristics of products and services that determine how customer solutions are integrated to realise value propositions [3]. Furthermore, the delivery of a PSS involves exploring and identifying relevant partnerships, networks and relationships in industry and with clients to aid the flow of material, information, cash, products, services and so on [2]. Consequently, capturing the industry sectors where a PSS could be applied can be crucial in identifying possible configurations that are consistent with the PSS premise of minimising resource use and maximising value for customers and companies [4].

This paper begins with an overview of the PSS concept. Next, the characteristics of products and services are described. The Industry Classification Benchmark (ICB) will then be introduced. This industry classification offers a high-level structure of sectors and sub-sectors for production by companies. Its selection was based on two criteria: completeness of sectors and reliability in terms of global coverage. The current state of product-service systems in industry will then be highlighted using literature examples. The examples provided will be based on sectors captured by the ICB approach. An approach for PSS delivery will then be proposed to identify: (1) industry relationships and company networks within and between industry sectors, and (2) 'delivery packages' for the co-creation of value between customers and companies. Finally, considerations for PSS delivery highlighted by the approach will then be discussed and used to make recommendations for future PSS research.

2 PRODUCT-SERVICE SYSTEMS

The business model proposed by a PSS is based on function-orientation [5]. Function oriented design is a strategy that involves the decomposition of a system into interacting units [1].

In a PSS, function-orientation decomposes the system into products and services that are integrated based on processes of servitization and productization. Servitization is a process that involves integrating services to products while productization closely links and incorporates products to services [1, 4].

In traditional business configurations, production and services are viewed as independent, unrelated concepts. In a PSS, this may not be the case. As noted in [6], production considers product characteristics such as dimensions and mechanical phenomena but incorporating services requires considerations for new characteristics such as time and interaction.

According to Morelli [6], a PSS must also be modelled as a 'social construct' or an organisation so as to deliver competitive and innovative customer solutions. The organisation for a PSS involves identifying actors, roles and scenarios that define the flow of material, energy (or work) and information. Furthermore, Manzini and Vezzoli [7] highlighted how a PSS could aid companies in forming new relationships and partnerships with customers and between other businesses. Becker, Beverungen and Knackstedt [8] supported this view and argued that the drive to implement a PSS could cause companies to collaborate in delivering ''product-service packages'. These packages are delivered according to pre-production, production, distribution, use and end-of-life phases or straight down the line according to service and product needs.

3 PRODUCT/SERVICE CHARACTERISTICS AND THE INDUSTRY CLASSIFICATION BENCHMARK (ICB)

3.1 Product Characteristics

A product refers to 'something sold by an enterprise to its customers' [9]. It is described as an artefact that is 'conceived, produced, transacted and used' due to the properties it possesses and the functions it performs [10]. Products are also defined by their attributes and levels [11]. Product attributes include the weight of an aircraft engine or the size of a medical device whereas product levels include flight speed and degrees of accuracy for a medical device.

Products can also be characterised as having functional and physical elements [9]. The functional elements refer to 'individual operations and transformations' which aids the functioning of the product on the whole e.g. "hold water" while the physical elements are the components, parts and subassemblies that are required for the product to perform its functions e.g. handle, base.

One school of thought believes that all products have intangible elements in them because the customer can not always experience every aspect of the product prior to purchasing it [12], however it can be argued that some products have a higher level of intangibility than others. Some products are highly dependent on technology especially information technology as an integral aspect of the product. This is seen in sectors like banking, consulting, IT solution providers etc.

3.2 Service Characteristics

From service and marketing literature, services are usually described as having four main characteristics: intangibility, heterogeneity, perishability and inseparability [13, 14, 15]. *Intangibility* means that services cannot be seen, heard, smelled or tasted. They could be difficult to ascertain mentally and they cannot be stored. *Heterogeneity* means that services may not always be standardized as there could be different aspects and elements to them. The performances of services vary so it might be difficult to assess them based on certain standards. *Perishability* implies services cannot be produced and stored to be used at another time. Failure to consume them once they are made available could result in a loss of the service capacity.

Inseparability of Production and Consumption means services are consumed at the same location where they are created. Usually, the customer has a closer interaction in the creation of the service e.g. a customer participates in the service offered by the hair dresser by selecting the desired hair style and staying to go through the process of achieving the desired style.

3.3 The Industry Classification Benchmark (ICB)

Background

FTSE Group and Dow Jones created a classification system called the Industry Classification Benchmark (ICB) in 2005 [16]. This classification system is based on over 60,000 companies and 65,000 securities worldwide from Dow Jones and FTSE Universes.

The ICB contains four classification levels: Industries (10), super-sectors (19), sectors (41), subsectors (114). The coverage of the classification facilitates global sector analysis. Figure 1 shows the industries and sectors of the ICB.

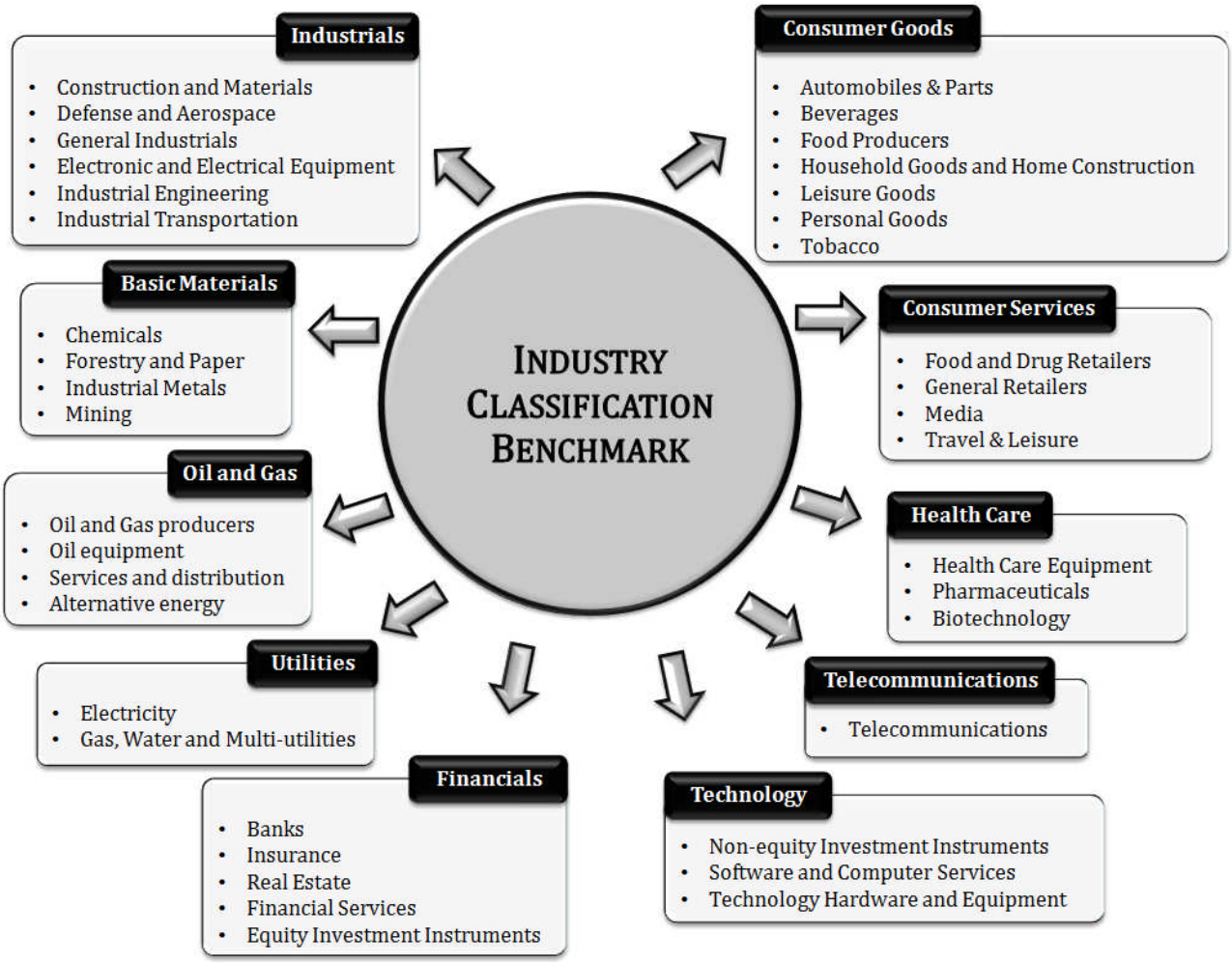


Figure 1: The Industry Classification Benchmark showing industries and sectors

A classification of industries enables practitioners to systematically arrange cases in terms of their similarity [17]. It constitutes a first and generic initiative to conduct scientific inquiry. By substituting structural knowledge for exhaustive information, the diversity of real-life phenomena is condensed into a smaller number of salient classes that can be benchmarked.

Smith et al. [18] identify the benefits of benchmarking as: showing an organization how to better meet customer needs, identifying an organisation's strengths and weaknesses, stimulating continuous operational improvement, and offering a cost-effective way of collecting innovative ideas.

Sectors and Subsectors

The ICB as shown in Figure 1 classifies industries into oil and gas, basic materials, industrials, consumer goods, health care, consumer services, telecommunications, utilities, financials, and technology.
The ICB is further classified into sectors for instance in the case of the oil and gas industry, sectors include oil and gas producers, oil equipment, services and distribution and alternative energy.
The ICB also enables companies to acquire information with regards to related products/services in each sector. For instance, for the consumer goods industry, some of the products/services include automobiles, auto parts, and tires.

Benefits

Three main benefits are associated with the use of the ICB [16].
The first benefit of the classification involves its use as an efficient and effective approach to collate data in a single source, which enables to undertake, cost and time efficient sector search. Secondly, it Improves sector analysis, as it provides a standardized base for analysis, stock selection, and performance measurement.
Thirdly, it offers accurate and timely maintenance of data that reflects global industrial landscape.

4 EXAMPLES OF PRODUCT-SERVICE SYSTEMS ACROSS INDUSTRY SECTORS

Using the ICB classification, the current state of PSS across industry sectors will now be captured by way of examples (See Table 2).

Malakata [19] described PSS provision for **financials**. Where banking sectors usually provided customers with financial products like loans, now additional online services were provided through the use of information communication technology. This helped to deliver PSS solutions comprising Internet banking and international cash transactions through electronic cards to customers.

Within the **health industry**, an example of PSS provision is seen in glucometers which provide patients with information about their blood glucose concentration and the solution provider would provide technical support if the glucometer was faulty. Ajai et al. [20] stated that this PSS was product oriented since the focus was on delivering a functional glucometer. The authors proposed a result-oriented PSS where the results from the glucometer can be sent to health professionals remotely, who could interpret the results and provide advice to the customer on how to improve their health condition through a wireless communications link based on the results obtained.

In terms of **consumer services**, a group of companies comprising a meal producing firm, a software company, the local social services and the local market traders, worked together to provide healthier food options to consumers (elderly and less favoured people and company employees) in a local Spanish town. This involved a change from the former system of delivering food to individual homes at specified times (which were an environmental issue) to a system of ordering food online which was quicker and offered a wider choice. The meals were delivered to a market and another specified location where the consumers could come and get the food and also buy some fresh fruit. This PSS solution resulted in a significant change in the logistics and a reduction of environmental impacts and costs. It also led to a higher level of satisfaction as it enhanced the consumers' social life and improved the state of their health [21].

Tasaki [22] proposed a quantitative method for accessing the level of material use in the **utilities** industry for current Electrical and Electronic Equipment (EEE) systems in Japan and for a hypothetical EEE type PSS. The value proposition is based on reuse and leasing services for equipment such as electric cables and electric meters for extending equipment life and use.

INDUSTRY	PRODUCT		SERVICE	PRODUCT-SERVICE SYSTEM SOLUTION	REFERENCE
	TANGIBLE	INTANGIBLE			
Basic material	Commodity, speciality chemicals	-	Procurement, delivery, inspection, inventory, storage, labelling and disposal	Improved processes in acquiring value from the use of chemicals which derives cost saving	[27]
Consumer goods	Car	-	Leasing	Convenient transportation	[23]
Consumer services	Food	-	Taking and delivering orders	Improved feeding and health	[21]
Financials	-	Loans, mortgages	Online services	Business leverage	[19]
Health care	Glucometer	-	Upgrades/replacements	Improved health care	[20]
Industrials	Spares	Availability data	Maintenance	Availability of equipment	[24]
Oil and gas	Crude oil and natural gas	Financial incentive-supporting payment	Transportation, storage, marketing	Convenient oil and gas availability and delivery	[26]
Telecommunications	Set up boxes, routers	Operating systems, music catalogue	Electronic publications, home shopping,	New business configurations to meet customer needs	[25]
Technology					
Utilities	Electric cables, electric meters	-	Equipment leasing and reuse	Reduction in material use and waste generation	[22]

Table 1: Examples of product-service systems across industry sectors

Using the quantitative method Tasaki demonstrated how the PSS approach could reduce material use and waste generation for less environmental burden.

Rexfelt and Ornas [23] conducted a study to find out the opinion of individual consumer about a car-lease in PSS **consumer goods**. The result of the study revealed that consumers' choice of a PSS provision was guided by individual interest. In this case, most consumers were generally interested in a car-lease; however those without drivers' licenses were not interested in the car-lease.

As for **industrials**, the defence and aerospace industry sector is experiencing a major transformation from a product centric business motive in to one that focuses on the delivery of service [24]. This has typically been achieved through availability contracts, which consider the delivery of product through spares, and intangible product delivery is concerned with the data (e.g. performance, component availability) that is helpful in planning for the future of the given equipment. Furthermore, service relates to aspects such as health checks, training, on-call response and maintenance. As an outcome the customer is assured of attaining equipment availability over a long duration (e.g. 10-30 years).

Citing examples in the **telecommunications** and **technology** industries, Wirtz [25] discussed how the need to deliver integrated product and service offerings has triggered acquisitions and mergers in some major firms such as Microsoft, AT&T and Time Warner. From the context of PSS delivery, the reasons for these mergers and acquisition reflect themes identical to the PSS approach. For instance, in the case of the merger involving AOL and Time Warner, a new business model was created that allowed Time Warner to market its products with integrated services offered by AOL's online business. Wirtz also noted that as a result of these mergers and acquisitions, new business configurations are required to meet customer needs and demands brought on due to a change of ownership.

Tukker and Tischner [27] discussed the main areas of services that are related to chemicals within **basic materials**. Services include precise product selection, procurement, materials and maintenance management, process engineering, waste minimisation, environmental compliance assistance, health and safety training, laboratory services and identification of opportunities for continuous improvement. As a result of the integrated product and service delivery the customer benefits from improved processes in acquiring value from the use of chemicals which derives cost savings.

Neely [26], aims to capture the financial consequences of the servitization of manufacturing. The paper defines implications of findings with regards to a number of companies including PetroChina Company Limited, which operates in the Oils and Gas industry. A list of products and services that the company provides is explained. The main product output concerns crude oil and natural gas. On the other hand, intangible product which facilitates the product and service transaction is related to financial incentive that supports payment by the customer. Services cover aspects related to transportation, storage and marketing. This example within the **oil and gas** industry could be considered as a PSS, because it combines products and services to deliver value to the customer. The output is the availability of oil and gas at the convenience of the customer.

5 APRROACH FOR PRODUCT-SERVICE SYSTEMS DELIVERY

This section presents an approach for the delivery of a PSS. It is focused on two main dimensions so as to identify possible means and ends for delivery.

At the organisational level, industry relationships and company networks within and between industry sectors are proposed as possible means for PSS delivery.

At the solution level, product-service systems packages for the co-creation of value are proposed for configuring and integrating products and services.

5.1 Industry relationships and networks for delivery

There are several actors that collaborate in networks for the delivery of a PSS. As shown in Figure 2, PSS delivery involves one or more customers and some solution providers (companies).

The customer could be an individual consumer or a company. A customer and the solution providers could collaborate to jointly design and deliver the PSS which is known as value co-creation [28]. Also two customers could cooperate with each other to co-create value (with solution providers). The main solution provider is Company A who deals with the customer directly. It is supported by a network of suppliers who are companies B, C and D. These actors can interact in different ways to generate different scenarios which are described below.

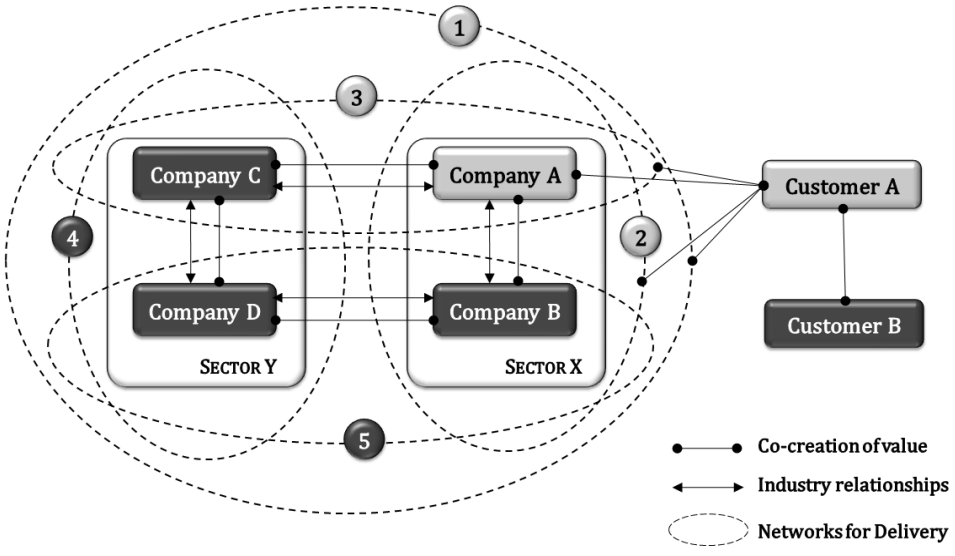


Figure 2: Product-service system relationships and networks.

Scenario 1 Industry Networks

The customer(s) could interact with the network of solution providers to create a demand for a PSS solution as well as plan and deliver the PSS solution with Company A being the main point of contact. This could occur in a B2B or B2C (Business-to-Consumer) context. In the B2C context, factors influencing consumer's acceptance of PSS include, perceived advantages compared to alternatives, perception of fixed and variable costs, insight in total life-cycle costs, uncertainty, risk, and relationship between customer and supplier [23]. Some of these factors are also applicable to a B2B context including uncertainty, risk, net present value and earned value [24]

Scenario 2 Intra-Sector Networks

Companies providing products and services could also interact to deliver a PSS solution which adds value to the customer. For example, Company A could work together with Company B within the same sector (consumer goods – automobiles and leisure products) to provide PSS solution to the customer(s). Also the same Company A could collaborate with Company C from a different sector (for instance consumer goods and consumer services– automobiles with travel and leisure services) to provide PSS solution to the customer. Company A being the main PSS solution provider, could also interact with its suppliers, companies B, C and D to co-create value for the PSS solution.

Scenario 3 Inter-Sector Networks

A cross-industry relationship can also occur when Company A interacts with Company C from a different sector to deliver a PSS solution to the customer(s). Company C could be supported by company D through a partnership agreement to provide them with knowledge, infrastructure or expertise to aid the delivery of the PSS. Within another sector, Company A could also be supported by company B through a partnership agreement or a merger to support the delivery of the PSS to the customer.

Scenario 4 Indirect Inter-Sector Networks

Companies C and D can interact to deliver a PSS within the same sector. While these companies can collaborate to support the final PSS, Companies C is higher up in the supply chain for the delivery of the PS as it has a direct relationship with Companies A who is the main PSS provider to the customer.

Scenario 5 Indirect Intra-Sector Networks

Companies D and B can also interact to support the delivery of the PSS to the customer(s). While both firms are at the lower end of the supply chain to deliver the PSS, they provide resources such as knowledge, infrastructure or capital investment to companies C and A which is highly valuable in the delivery of the PSS solution. Companies A interacts with Company C from a different sector to deliver a PSS solution to the customer. Company C could be supported by company C through a partnership agreement to provide them with knowledge, infrastructure or expertise to aid the delivery of the PSS. Within another sector, Company A could also be supported by company B through a partnership agreement or a merger to support the delivery of the PSS to the customer. There is a potential for individual companies or all the companies to interact to co-create value for the PSS solution, although this may not the case in current practice.

5.2 Delivery Packages

Products and services are combined in packages that vary in content depending on the needs of an industry or sector, whilst the outcomes or benefits of a PSS are manifold, as represented in Figure 3. This variation may be captured by shifting the level of combination between product (tangible and intangible) and service. For instance, in the case of integrating an intangible product with service the utilities industry offers examples by integrating operating systems or music catalogue with services such as electronic publications and home shopping. On the other hand, an example that involves the integration of a tangible product and service relates to the consumer services, where food is through a PSS delivered to the customer. As for the example of integrating all three contents, the industrials for example, the defence and aerospace industry sector provides the example of availability contracts, which involves a physical product core (e.g. tank), however, due to performance requirements additionally the intangible product content is delivered (e.g. availability or equipment related data), while the performance requirements are further supported through the delivery of services (e.g. maintenance).

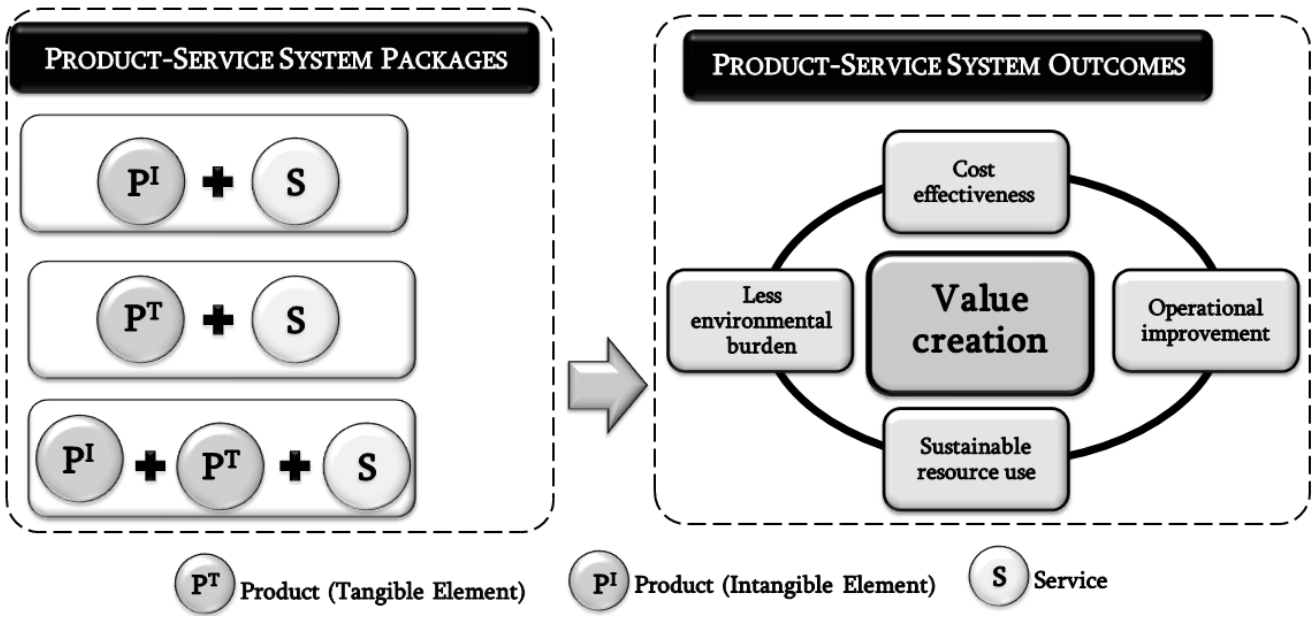


Figure 3: Product-Service System Packages and Outcomes.

In terms of the outcomes of these packages, a PSS is delivered with the objective of achieving the desired value proposition. Thus, the ultimate goal centres on value creation for the customer. The value creation may vary across industries driven by differences concerning customer needs (e.g. cost, environmental or performance driven challenges). However, there are many more potential benefits that a PSS can offer, driven by the orientation of an industry towards environmental burden reduction, enhancing efficiency in processes or both. Although the two due are correlated aspects, the outcomes do not have to in the same manner. Furthermore, these approaches may in common produce cost effectiveness and sustainable resource use. Thus, the outcomes of PSS are rather interlinked, whilst involving social as well as motives that benefit companies. In alignment to the listed potential benefits of PSS there is a need to consider risks that arise from developing delivery packages. These may have an influence over achieving customer needs. The sources of risks in PSS, in integrating product and service, may originate from the supply chain (e.g. delivering spare parts), internal operational effectiveness (e.g. communication between departments), or the customer (e.g. equipment misuse).

6 FUTURE RESEARCH NEEDS AND CHALLENGES

The delivery of products and services that meet customer needs is a complex task that involves considerations for a wide range of issues such as affordability, production schedules and product storage. These considerations are required to ascertain that the customer can support projects through whole life cycles [29]. In industry, the need to balance commercial value for companies and added value for customers is also a major factor that encourages integrating products and services.

For the delivery of integrated products and services in a PSS, networks in industry can aid companies in entering partnerships to better meet customer needs. An industrial classification such as the ICB when applied in the context of a PSS offers opportunities for data collation and sector analysis. This enables a company to form links with other industrial partners for PSS delivery so as to share information, manage supply chains and improve delivery performance.

Furthermore, product and service characteristics can be analysed by a company and used for configuring product-service ‘bundles’ or ‘packages’ for creating value. The packages selected by the company may be based on capability of the company, market trends, industry forecast or even available resources. This could enable companies to scope, manage flows and interactions, and carry out design and delivery functions for a PSS.

6.1 Product-Service Systems Scoping

As mentioned earlier, the organisation of a PSS involves the identification of possible *scenarios* for actors and their roles. The actors involved in a PSS design and delivery are usually the customer, solution provider as well as the supply chain. The role of the customer is crucial in the design of PSS in terms of identifying a need (customer requirement) which creates the demand as well as the procurement and support (financing) of the PSS, usually after delivery. The financial ability of the customer to afford the PSS solution throughout its lifecycle is of important consideration when scoping the PSS [29]. The customer can also collaborate with the solution provider to co-create value in the PSS solution. The solution provider is also an important actor that may assume the role of capturing and transforming the user requirement into design requirement for implementation in the PSS solution. This is illustrated in Figure 2 where Company A the solution provider, works in partnership with Companies B, C and D to deliver a PSS solution to the customer. Companies B, C and D are suppliers to Company A and their role is also important in providing expertise, know-how and other resources required to deliver the PSS solution to the customer.

Also scoping for a PSS involves considering the *context* for business operations (B2B vs. B2C). Generally more research has been done to capture the scope of PSS within the B2B [23]. Existing research focuses on organisations’ view of PSS while there is a need for more empirical studies into the view of individual consumers about PSS. Existing research has revealed some important factors for consumer acceptance of PSS which includes, perceived advantages compared to alternatives, perception of fixed and variable costs, insight in total life-cycle costs, uncertainty, risk, and relationship between customer and supplier. While the factors that influence the affordability of an individual consumer would differ from those influencing the business customer, [29] suggested that a common factor to both categories of customers is their income or revenue. In order to design a PSS solution that would deliver value to the customer and provide suitable financial return to the solution provider, it is important to ensure that the scope of the PSS encompasses the customer need as well as the customer’s affordability.

As shown in Figure 1, the ICB approach classifies companies (PSS solution providers) into various industries and sectors. Based on this classification an overview of the scope of PSS has been provided in Table 1. Consequently, PSS solutions can be provided in every industry mentioned within the ICB and it would be useful for PSS providers to investigate the nature of PSS solutions within and outside their sectors. This would expand their scope and help to identify synergies in operations as they collaborate to provide higher value to the customer, improve their own business processes and facilitate knowledge sharing to help generate better financial return.

6.2 Intra- and Inter-Sector Flows and Interactions

Using the approach provided in Figure 2, a PSS could be designed and delivered by a single company or based on relationships between companies. In addition, relationships to deliver a PSS may be formed between two or more companies within a single industry sector or across two or more industries.

Subsequently, rules and policies that govern the *flow* of materials, products, services and information between these companies are an important issue that require research within the context of a PSS. As an example, information flow research for inter-sector flows could consider how business and technical information are accessed and exchanged between companies and customers in a PSS.

Furthermore, considerations for communication and information flow could also be made prior to entering industry relationships with companies. These considerations are important to ensure product-service systems are correctly configured to deliver customer solutions. For instance, if two companies A and B decide to form a partnership, common representations and communication schemes are required. If company A applies face-to-face interaction and company B relies on electronic mail to communicate with customers, then a consensus must be made as to a common means for interacting with customers. A failure to reach a consensus could result in a conflict of interest or conflict between organisations and personnel.

Another possible area for future research could look at the factors that determine how companies within the context of a PSS, *interact* within and outside their sectors. Possible topics may consider factors such as organisational culture [30], self-organisation [31] and organisational learning [32]. Organisational culture refers to ethics, habits and behaviour patterns of organisational members. These ethics, habits and behaviour are motivated by the configuration of the organisation and contribute to the performance of the organisation. Self-organisation describes a constantly changing and modification process that allows a system to internally maintain its structure. Organizational learning describes the learning process of individuals within an organisation whereas a learning organisation means the ability of an organisation to learn as a total system.

6.3 PSS Design and Delivery

A main goal of a PSS will be to make use of available resources to attain and maintain the competitiveness of the company. This is because, no matter which industry is considered the design and delivery of PSS requires consideration for the integration of products and services to for the life cycle of the product. Furthermore, the drivers of adopting product-service systems across industry is also constant, which include ecological or environmental motives, or economic (e.g. competitive advantage and profitability) or social reasons (e.g. generation of knowledge). Other factors that affect the delivery of PSS solutions to customers include: affluence, education, technology, value of time, customer expectation, and competition [33].

It is also interesting to note that conceptually the steps to integrate products and services are similar. For instance, for services, typically, the design process begins with concept development, which is followed by system design, testing and implementation. On the other hand, product design begins with identification of customer needs, followed by specification of requirements, concept design and detailed design that ends with testing [34].

In terms of PSS design and delivery, differences across sectors may arise from a number of areas.

Firstly, the degree of product and service *content* may vary driven by customer needs. This requires adaptation of the material (e.g. components) that is considered, as well as the degree of customer willingness to transfer responsibilities to suppliers in the operational phase. This relates to the customers ambition to transfer risks and uncertainties, which hinder the performance of the PSS delivery. The sources of uncertainties may relate to the customer (e.g. requirements) as well as supply based issues that may be related to internal (e.g. processes) or external (e.g. supply chain) matters to industry. This challenge is particularly driven by the dynamic nature of drivers that affect the delivery. Thus, there is a need for processes that enable continuous management of uncertainty in PSS delivery, while the design process needs to consider scenarios that build flexibility to the delivery. Consequently, PSS processes will need to support the identification, prioritisation and management of uncertainties. At this point, recognition of differences between sectors will be necessary, in order to customise approaches.

Differences between PSS design and delivery across sectors could also arise from a *financial perspective*. For instance, the price of the product and service combination and the means for funding varies across sectors depending on the characteristics of the products and services in the PSS solution. This influences the development of the PSS in terms of the time it takes to build and the quality of the parts that are used.

Another difference between PSS design and delivery across industries and sectors relates to the *length of the life cycle*. For instance, there are differences between the nuclear industry and automobile industries driven by the length of the life cycle. The interaction across the supply network is also an area that differs across sectors. This involves understanding the structure of a sector (e.g. monopoly). Such information could act as guides for understanding the interaction over the life cycle of products. This may influence issues such as capability, obsolescence. A final difference across sectors may arise from the abilities to achieve flexibility in delivering customer needs along the product life cycle. This means that some industries are less flexible (e.g. defence) compared to others (e.g. automobile), due to financial and technical constraints.

7 SUMMARY

A product-service system (PSS) is a business model that offers a generic approach to delivering products and services in configurations that provide functionality, availability or results to customers. This delivery process is dependent on the characteristics of the products and services provided. Using the Industry Classification Benchmark (ICB), examples of products, services and product-service systems across industry sectors were highlighted.

Driven by this classification, this paper has attempted to propose an approach to aid the delivery of product-service systems across industries and industry sectors. The approach is made up of two main parts. First, a description of industry relationships and networks that define at an organisational level, how actors, roles and scenarios can be configured to deliver a PSS. Secondly, an outline for delivery packages that detail how products and service can be combined for PSS solutions.

Possible areas and challenges for future research were identified and discussed in terms of: differences arising from the scoping of activities for PSSs, intra- and inter-sector flows and interactions, and design and delivery of product-service systems across industries and industry sectors.

8 ACKNOWLEDGMENTS

The authors would like to extend their sincere thanks to the EPSRC, for its support via the Cranfield IMRC, towards the work carried out in the preparation of this paper.

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C. Durugbo, O. Bankole, J.A. Erkoyuncu, A. Tiwari, J.R. Alcock, R. Roy, E. Shehab. Proceedings of the 2nd CIRP ISP2 Conference, Linköping, 14-15 April 2010, pp535-542.

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