# Characterizing Product-Service Systems in the Healthcare Industry – an Internal Stakeholder Perspective

M. H. Yip[1], R. Phaal[1], D. R. Robert[1]

[1]Centre for Technology Management, Department of Engineering, University of Cambridge, U.K.

(mhy29@cam.ac.uk)

*Abstract* - **This paper presents a preliminary product-service system (PSS) classification framework, which challenges the existing schemes that have not distinguished between service and intangible product. Two recently completed cases in the health information and communications technology (ICT) sector have revealed new dimensions for PSS classification from the perspective of internal stakeholders, that is those within the company who are directly involved in the new PSS development. These new dimensions are volume, value, and quality. Volume is the relative number of product / service elements in the PSS. Value is the relative product / service contribution to the worth of the PSS. Quality is the features, knowledge, skills and attitudes that affect the successful usage of the PSS.**

**The findings also suggested that a PSS configuration might remain constant when the product and service proportions change. The results from these two cases have provided important directions for further work in PSS classification.**

*Keywords* – **Product, Service, PSS, NPD, NSD, Stakeholder, ICT, Healthcare**

## I. INTRODUCTION

Healthcare providers in Western Europe have been experiencing huge pressure to contain healthcare costs while having to provide for the high standard and longer healthcare requirements of an aging population. Hospitals see the need to invest in new medical equipment and efficient healthcare services [1]. In this context, this research project explores what factors govern the engagement of stakeholders in the early stage of new product-service system (PSS) development for a better perceived outcome in the healthcare industry.

One important aspect of this research project is to understand the range of PSS. Here, PSS is defined as a commercial offering consisting of a collection of elements of products and/or services that fulfill a customer's needs [2 - 4]. This paper focuses on discussing how PSS may be characterized. A proposed PSS classification framework was tested in two case studies. The findings have revealed interesting perspectives of internal stakeholders. In this paper, people working in the company that develops the new product-service system are internal stakeholders, and those outside the company are external stakeholders.

After a brief explanation of the research methodology in section II, a review of literature in product & service, PSS & servitization, and stakeholders' engagement in new product / service development (NPD/NSD) is given in section III. Section IV presents the proposed PSS classification framework, while Section V presents the findings and discusses the implications. Section VI summarizes the limitations and the future work planned.

## II. METHODOLOGY

This research employs a multiple-case research approach. A case, the unit of analysis, is defined as a development project for a new PSS or a new service augmenting an existing product. From the literature review a conceptual framework was drafted and revised following 25 pilot interviews involving four cases, ten internal and three external stakeholder groups. Following the revised conceptual framework, potential variables to be examined were identified. Upon analysis, case selection criteria and a semi-structured interview protocol were refined. Four iterations of cases are planned. The two cases discussed in this paper are part of the first iteration.

## III. LITERATURE REVIEW

### A. Product & service

The preferred definition of product and the four commonly quoted characteristics of service that claim to differentiate services from goods, namely intangibility, heterogeneity, inseparability and perishability [5], could be traced back to Adam Smith and Jean-Baptiste Say in the 18th century, Nassau Senior in the 19th century and Joan Robinson in the 20th century [6 - 8].

The perspective that a tangible object is a product or otherwise a service, has been adopted by many researchers throughout the last five decades [2, 3, 9 - 12]. However, using "tangibility" as the demarcation can be confusing, as there are objects that are goods but intangible, such as the digital recording of a musical performance [6].

Economists emphasize that a good "exists independently of its owner and preserves its identity through time" [6]. In contrast, service production requires both producer and consumer to be present at the same time and location [6]. Service is an act that is performed and brings about changes to the condition or state of people and objects [2, 13 - 17].

A number of product classification schemes, such as durable / nondurable, industrialized / commoditized, and differentiated / customized can be found in the marketing community [18, 19]. Service classification is more

complex. Discrete categories such as owned / rented, reversible / irreversible, as well as dimensions such as degree of customer contact, complexity, and labor intensity have been proposed in the 1960s to 2000s to classify service [20].

### B. PSS & servitization

PSS, a concept from Northern Europe is closely related to the US term "servitisation" [21]. Both terms could be interpreted as belonging to the same phenomenon [21]. The strategic move of manufacturers to provide customer-focused offerings comprising products *and* services is called servitization [10].

Before the term PSS was commonly used, as early as 1972, Levitt proposed the concept of "a bundle of goods and services" [19] and "augmented products" [22]. The concept of a product-service ratio was first proposed in the 1970s [2], and that the product-service ratio alters with the changes in technology, society and people's needs was proposed later in the 1990s [3].

The three traditional classifications of PSS, namely product-oriented PSS, use-oriented PSS and result-oriented PSS, were first proposed by Hockerts and Weaver in 2002 [23]. Two additional forms were later added: integration-oriented and service-oriented PSS [23]. Table I compares three PSS classifications proposed [3, 4, 23]. Drawing from the reviewed literature, it appears that there is confusion between intangible (digital) product and service behind the definition of result-oriented PSS and the change of system.

### C. Stakeholders' engagement in NPD/NSD

In this research, Freeman's stakeholder definition [24] is adopted: A stakeholder is defined as any group or individual who can affect or is affected by the new PSS. This definition is more encompassing than other proposals, such as Donaldson and Preston's that limits stakeholders to the legitimate claimants of a company [25]. Therefore, Freeman's definition best fits the purpose of this research.

Of the reviewed literature of stakeholders' engagement in NPD/NSD, two frameworks are particularly relevant: Lagrosen's [26] and Gummesson's [7]. Lagrosen has proposed different timing and duration of customers' involvement in NPD with respect to the depth of the relationship between the manufacturer and the customer. Gummesson's [7] model helps service designers better understand customers' needs by considering customers' service encounter experience.

In terms of the outcome of involving stakeholders in NPD/NSD, there is a lack of studies of stakeholder groups other than customers [27]. Some studies have shown that customer involvement has led to NPD/NSD success [28, 29]. Other studies have revealed improvement only in internal operational measurements but not market performance [30]. There are also other studies that showed customer involvement has no impact at all [30].

In conclusion, there is no consensus among the reviewed studies on the impact of stakeholders' engagement in NPD/NSD [27].

## IV. A PROPOSED PSS CLASSFICATION

The review of literature has identified that the earlier, and rather outdated, references to product as a tangible object, may have clouded the understanding of the characteristics of PSS. Therefore, a new PSS classification is proposed for testing in case studies. The framework (Fig. 1) is a continuum from all-product content to all-service content. Along this continuum, how the product and service configurations might change were considered. Four PSS configuration diagrams of a product content of 100%, 75%, 25%, and 0% were proposed. This framework focuses on the characteristics of the elements within the PSS and challenges some of the existing classification schemes [3, 23].

It is important to note that this proposed framework is developed based on a clarified definition of product and service. Products display the characteristics of independent existence and can be stocked without changing their identity [6]. A service is the application of

TABLE I
A COMPARISON OF PSS CLASSIFICATIONS

| Goedkoop, van Halen, te Riele, Rommens [3] | Neely [23] | Mont [4] | Examples in literature |
|---|---|---|---|
| Product-Service (Ps) – services are connected to products | Product-oriented | Point of sales services | Personal assistance in shops |
| | | Maintenance services | Installation service |
| | | Revalorization services | Service to take recycle products |
| | Some form of Integration-oriented | | Asset utilization advisory service |
| Service-product (Sp) – service provider hands products to customer | Result-oriented | Result-oriented | Credit card (replaces cash) |
| Service-product (Sp) – service provider adds product as a production aid | Some form of Use-oriented | Use-oriented | ATM |
| Product-Service (PS) – products and services are developed in combination | Service-oriented | Products Services Combinations | Intelligent vehicle health management |
| Change of system – a new system that substitutes a whole system | Result-oriented | Result-oriented; Products Services Substitutions | Electronic money |
| | Other forms of Use-oriented Integration-oriented | | Lease of equipment Service provided by manufacturer that is unrelated to the product |

Product / Service content

100% product                                                                                          100% service

Configurations of PSS



| Customer pays for the right of use and bears the risk of product unavailability | Customer pays for the right to use and the availability of the product | Customer pays for the provider's knowledge & skills, which may or may not be provided via a product | Customer pays for the provider's knowledge & skills and for the right of use of products |

Contrast with Neely's [20]

| Result-oriented PSS | Product-oriented PSS Use-oriented PSS Integrated-oriented PSS Service–oriented PSS | Integrated-oriented PSS Service-oriented PSS | Result-oriented PSS |

Contrast with Goedkoop, van Halen, te Riele, Rommens [3]

| | Ps | PS | Sp |

Example need to fulfil:
"I want to make sure that if someone calls me and I am not available, I still know what the caller calls me for."

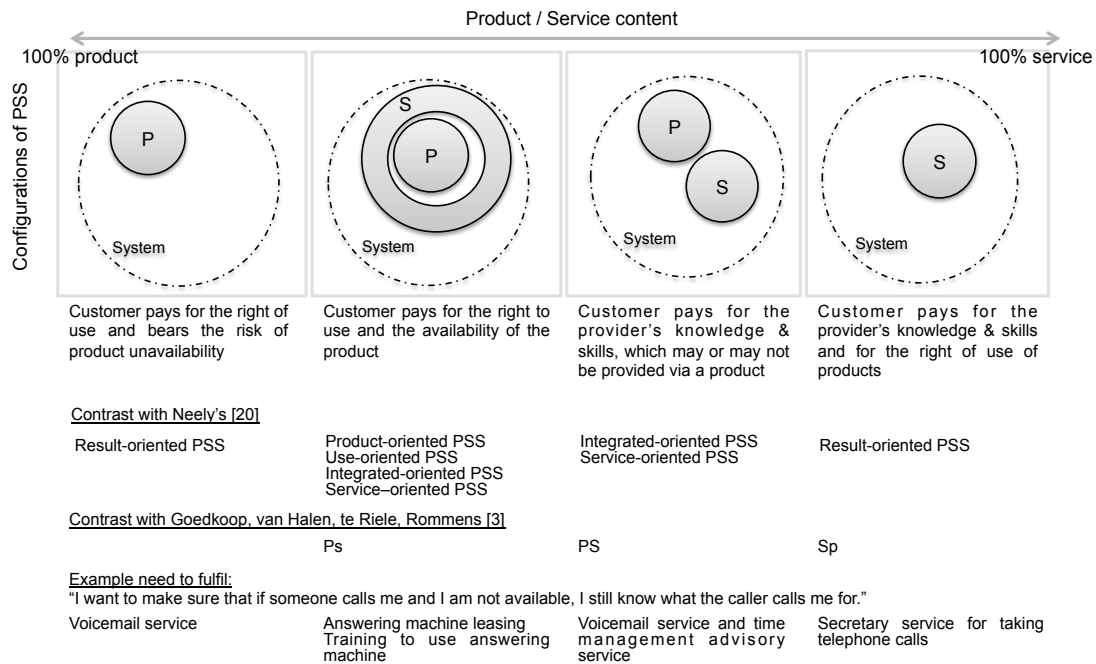| Voicemail service | Answering machine leasing Training to use answering machine | Voicemail service and time management advisory service | Secretary service for taking telephone calls |

Fig. 1. The PSS classification framework (pre-case-study's proposal)

specialized competences to bring about changes to people or things, where the existence of service cannot be independent from the interactions between the producer and the consumer [2, 15, 16, 32]. These definitions of product and service have led to the classification of, for example, a voicemail "service" as an intangible product instead of a result-oriented PSS as in the classification scheme of Neely [23].

## V. FINDINGS AND DISCUSSIONS

The two cases investigated are two new PSS developed for UK NHS hospitals. Both new PSS were developed by a small multinational company that has been developing health information and communications technology (ICT) products and consulting services for healthcare organizations in Europe and Australasia. Table II provides more details about the cases and the informants.

TABLE II
DETAILS OF THE TWO CASES

| Case | Description of the case | Roles of informants |
|---|---|---|
| Case A – new PSS triggered by a UK NHS Hospital's tendering process | | |
| Status: | Customer acceptance (launch) in May 2012 | Informant 1[a]: Technical – product development |
| System: | Part of the nursing operations in a hospital | Informant 2: Technical – product development and service development |
| PSS Type: | Service wraps around product | |
| Case B – new PSS developed for and piloted with a UK NHS Hospital | | |
| Status: | Market launch in 2010 | Informant 1[a]: Technical – product development |
| System: | Part of a network of systems that provides acute patient care in a health environment | Informant 4: Commercial & Management – product & service development |
| PSS Type: | Service wraps around product | |

[a] Informant 1 was interviewed for both Case A and Case B

The proposed PSS classification framework (Fig. 1) was shown to the informants during the semi-structured interviews. The informants were asked to select the configuration that best represents the new PSS in their case. Afterwards, the informants were asked to comment on the use of product / service ratio as a method to classify PSS.

### A. Configurations of PSS

In both cases, the informants have selected the second diagram from the left in Fig. 1 as the configuration that best represents the PSS. In Case A, Informant 1 described the PSS as service wrapping around the product. He said service is the configuration and the implementation of the product. There is no service that sits alongside and does not relate to the product, as suggested in the third diagram from the left in Fig 1. Informant 2 described the PSS as product surrounded by a set of services, and suggested overlapping the product and service shapes to represent the interdependency between the two (Fig 2.).

For Case B, both informants described the PSS as having service around the product. The service elements are product-related such as the configuration and implementation of the product, rather than broader services such as re-engineering or change management.

Apart from the position of the shapes representing the product element and the service element, the sizes of the shapes were also debated during the interviews. The informants perceived that the size of the shapes represents different aspects of the PSS. These aspects are described in subsection B below.
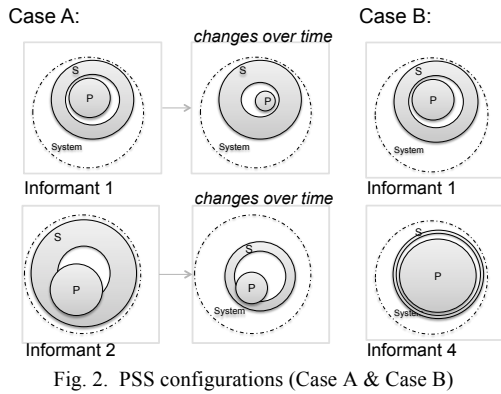
Fig. 2. PSS configurations (Case A & Case B)

### B. Dimensions of PSS

The volume, value, and quality dimensions have emerged from the interviews to describe the product / service content of a PSS.

The volume dimension came out when the informants deliberate over which configuration diagram best represent the PSS. The perceived relative volume of product and service in a PSS is proportional to the number of product and service elements identified. The value and quality dimensions emerged from the comments of Informant 4. He said, "...*the product circle much bigger, and have the services slimmer. The value or the mix is dominated by product, not service... That doesn't mean important, nor how many... That services ring has to be very high quality to allow the larger product piece to be successful.*" The quality dimension was further explained to include skills, experience, and attitudes, which impacts on how successfully the PSS are adopted by users in the environment where the PSS operates.

While Informant 1 and 2 regarded the sizes of the product and service shape represent the relative volume, Informant 4 perceived sizes as a representation of the relative value and quality.

### C. Changes in configurations of the PSS

The original proposal put forward by the researcher (Fig. 1) has suggested the configurations of PSS changes with the ratio of product and service content. However, the findings have suggested the change of product / service content is independent of the change of PSS configurations. This means that each type of PSS may change along the scale of product / service content, without changing the basic configuration that represents the product and service characteristics in the PSS.

This realization comes from Case A, where both informants expressed their views of how the PSS configuration may change in a subsequent sale. The changes in configurations described are shown in Fig. 2. The views of the two informants were different, with Informant 1 seeing a fatter service ring and Informant 2 seeing a thinner service ring in a subsequent sale. From how the informants described the changes, it seems that Informant 1 viewed the software backend development (non-configuration) as a product element, while Informant 2 viewed the software backend development as a service element. Nonetheless, both informants have indicated that a PSS configuration may change over time. As a result, a modified framework for the PSS type that has service wrapping around product ("service-around-product") is proposed (Fig. 3).

## VI. LIMITATIONS AND FUTURE WORK

Only two case studies were completed at the time of writing this paper. Although new dimensions of PSS have emerged and modifications to the proposed PSS classification framework are revealed for testing in the future iterations of case study, these findings are far from conclusive.

In both cases, the PSS discussed can be described as "service-around-product", and the product element is an intangible product (software). Both PSS were first developed for a hospital in the UK NHS. Moreover, the manufacturer is a small multinational firm. Furthermore, only internal stakeholders of the two cases were interviewed. The findings might be limited to this type of PSS, manufacturer, and customers. The dimensions and configurations proposals may only be relevant to the viewpoint of internal stakeholders.

In addition to PSS classification, there are three other areas that were explored during the interviews but only limited cross-case analysis could be performed and therefore not reported in this paper. These areas are the emerging classifications of stakeholders, the dimensions and degrees of "newness" of a new development, and how the types of PSS and degree of "newness" relate to stakeholders' engagement in the development process.

Further case studies are to be conducted with different equipment / software manufacturers and different types of PSS, in order to further explore PSS dimensions, as well as other aspects mentioned above.
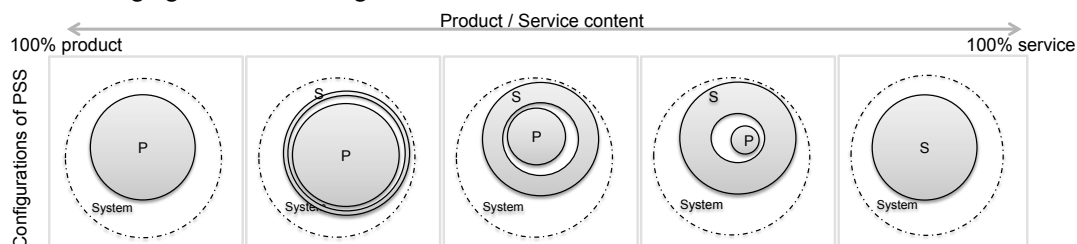


Fig. 3. Continuum of product / service content for the PSS type "service around product" (post-case-study's proposal)

# REFERENCES

[1] The outlook for medical devices in Western Europe. (2012, April 23). PR Newswire.

[2] G. L. Shostack, "Breaking free from product marketing," *Jrnl. of Marketing*, vol. 41, no. 2, pp. 73-80, 1977.

[3] M. J. Goedkoop, C. J. G. van Halen, H. R. M. te Riele, P. J. M. Rommens, "Product service systems, ecological and economic basics," *Economic Affairs*, 1999.

[4] O. Mont, "Clarifying the concept of product-service system," *Jrnl. of Cleaner Production*, vol. 10, no. 3, pp. 237-45, 2002.

[5] S. L. Vargo, R. F. Lusch, "The Four Service Marketing Myths: Remnants of a Goods-Based, Manufacturing Model,".*Jrnl. of Service Research*, vol. 6, no. 4, pp.324-35, 2004.

[6] P. Hill, "Tangibles, Intangibles and Services: A New Taxonomy for the Classification of Output," *The Canadian Jrnl. of Economics/Revue canadienne d'Economique*, vol. 32, no. 2, pp. 426-46, 1999.

[7] E. Gummesson, "Relationship Marketing in the New Economy," *Jrnl. of Relationship Marketing*, vol. 1, no. 1, pp. 37-57, 2002.

[8] R. F. Lusch, S. L. Vargo, M. Obrien, "Competing through service: Insights from service-dominant logic," *Jrnl. of Retailing*, vol. 83, no. 1, pp. 5-18, 2007.

[9] R. C. Judd, "The Case for Redefining Services," *Jrnl. of Marketing*, vol. 28, no. 1, pp. 59, 1964.

[10] S. Vandermerwe, J. Rada, "Servitization of business: adding value by adding services," *European Mgmt. Jrnl.,* vol. 6, no. 4, pp. 314-24, 1988.

[11] U. de Brentani, R. G. Cooper, "Developing Successful New Financial Services for Businesses," *Ind. Marketing Mgmt*, vol. 21, no. 3, pp. 231-41, 1992.

[12] E. Nijssen, B. Hillebrand, P. Vermeulen, R. Kemp, "Exploring product and service innovation similarities and differences," *Intl. Jrnl. of Research in Marketing*, vol. 23, no. 3, pp. 241-51, 2006.

[13] J. M. Rathmell, "What Is Meant by Services?" *Jrnl. of Marketing*, vol. 30, no. 4, pp. 32, 1966.

[14] Baines, T.S. *et al.*, "State-of-the-art in product-service systems," *Proc. of the Inst. of Mech. Eng., Part B: Jrnl. of Eng. Manufacture,* vol. 221, no, 10, pp. 1543-52, 2007.

[15] T. P. Hill, "On goods and services," *Review of Income and Wealth*, vol. 23, no. 4, pp. 315–38, 1977.

[16] C. J. Lovelock, "Classifying Services to Gain Strategic Marketing Insights," *Jrnl. of Marketing*, vol. 47, no. 3, pp. 9-20, 1983.

[17] T. Tomiyama, "Service engineering to intensify service contents in product life cycles*," Proc. 2ⁿᵈ Intl. Symposium on Environmentally Conscious Design and Inverse Manufacturing (EcoDesign 2001)*, Shangdong, China, pp. 613-8, 2001.

[18] P. Kotler, "A Generic concept of Marketing," *The Jrnl. of Marketing*, vol. 36, no. 2, pp. 46–54, 1972.

[19] M. Bell, "Some strategy implications of a matrix approach to the classification of marketing goods and services," *Jrnl. of the Academy of Marketing Science*, vol. 14, no. 1, pp. 13–20, 1986.

[20] C.-H. Liu, C.-C. Wang, Y.-H. Lee, 2008, "Revisit service classification to construct a customer-oriented integrative service model," *Intl. Jrnl. of Service Ind. Mgmt.*, vol. 19, no. 5, pp. 639-61, 2008.

[21] Baines, T.S. *et al.*, "The servitization of manufacturing: A review of literature and reflection on future challenges," *Jrnl. of Manufacturing Tech. Mgmt.*, vol. 20 no. 5, pp. 547-67, 2009.

[22] T. Levitt, "Marketing success through differentiation of anything". *Harvard Business Review*, vol. 58, no. 1, pp. 83–91, 1980.

[23] A. Neely, "Exploring the financial consequences of the servitization of manufacturing," *Operations. Mgmt. Research*, vol. 1, no. 2, pp. 103-118, 2009.

[24] R. E. Freeman, *Strategic Management A Stakeholder Approach*, Marshfield, MA: Pitman, 1984.

[25] T. Donaldson, L. E. Preston, "The Stakeholder Theory of the Corporation: Concepts, Evidence, and Implications," *Academy of Mgmt Review*, vol. 20, no. 1, pp. 65-91, 1995.

[26] S. Lagrosen, "Customer involvement in new product development: a relationship marketing perspective," *European Jrnl. of Innovation Mgmt.*, vol. 8, no. 4, pp. 424-36, 2005.

[27] M.H. Yip, R. Phaal, D. R. Probert, "Value co-creation in early stage new product-service system development," *Proc. of the 3rd Service Design and Innovation Conference (ServDes. 2012)*, Espoo, Finland, 2012.

[28] E. von Hippel, "The dominant role of users in the scientific instrument innovation process", *Research Policy*, vol. 5, no. 3, pp. 212-39, 1976.

[29] C. Herstatt, E. von Hippel, "From experience: developing new product concepts via the lead user method: a case study in 'low-tech' field," *Jrnl. of Product Innovation Mgmt.*, vol. 9, pp. 213-21, 1992.

[30] P. Carbonell, A. I. Rodriguez-Escudero, D. Pujari, "Customer involvement in new service development: an examination of antecedents and outcomes. *Jrnl. of Product Innovation Mgmt.*, vol. 26, pp. 536-50, 2009.

[31] M. M. Smirnova, D. Podmetina, J. Väätänen, S. Kouchtch, "Key stakeholders' interaction as a factor of product innovation: the case of Russia," *Intl. Jrnl. of Technology Marketing*, vol. 4, no. 2/3, pp. 230-47, 2009.

[32] S. L. Vargo, R. F. Lusch, "Evolving to a new dominant logic for marketing," *Jrnl. of Marketing*, vol. 68, no. 1, pp. 1-17, 2004.