

THE EXPERIENCE OF PRODUCT SERVICE SYSTEMS

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ABSTRACT

In this paper, we focus on how to design product service systems (PSS) that provide for coherent user experiences. Our research is part of a large Dutch research program (CRISP, www.crispplatform.nl) on PSS. We propose a framework for identifying real PSS by integrating perspectives from economics and design theory. Our framework suggests that the product and service elements of the PSS should be combined in a synergistic manner and geared towards the same set of user goals in order to create a coherent user experience. In addition, our framework proposes that the product and service elements of the PSS should have sufficient

autonomous value to be separately available on the market. We distinguish products and services from each other on the basis of aspects that have a large influence on designing PSS: products are mainly characterized by tangible elements and services by (a durable) interaction relation between consumers and producers. We empirically test our ideas among product and/or service development managers and in a later stage among designers. We conclude this paper with some guidelines how to define and design effective PSS.

Keywords: Product service systems, value creation, manifestations, interaction, user experience, synergy

INTRODUCTION

Increasingly, companies design and deliver combinations of products and services (i.e. product service systems, PSS) to gain competitive advantage (e.g. Antioco et al., 2008; Manzini & Vezzoli, 2003). PSSs involve offerings that include one or more product and one or more associated services. A well-known example of a successful PSS is the MP3 player of Apple, the iPod. Being able to download music on-line via Apple's music retail service iTunes (a service) substantially increases the value of and experience with an iPod (a product) for a user. The software (the music retail service) makes the hardware (iPod) more attractive for potential users.

The rise of PSSs is associated with and driven by different factors. First, due to the globalization of the economy, it becomes harder for Western-based companies to compete with lower-cost manufacturers from upcoming, mainly Asian, economies. Second, customers more and more ask for tailor-made solutions and personal experiences. This has been described as the Experience Economy: the recognition that products, services and PSS should provide the customer with an experience, instead of basic function fulfillment (e.g. Pine & Gilmore, 1999). PSS can bring products closer to the customer and enable customization and tailor made solutions to a larger extent than traditional products. PSS can thus create a personalized experience. Third, the digital revolution of the last two decades makes products and services more intelligent through use of ICT. Indeed, intelligence is a key enabler for many of the

more complex combinations of products and services, as is shown by the combination of iPod and iTunes that would not exist without ICT. Furthermore, some PSS have the potential to be environmentally benign and to bring about changes in production and consumption patterns that might accelerate the shift towards more sustainable practices and societies (Goedkoop et al, 1999; Manzini & Vezzoli, 2003; Mont 2002a; Mont, 2002b; Sundin et al., 2009; Tukker, 2004;). An example of a typical PSS that is environmentally benign is a company that provides the function of washing clothes rather than selling the actual washing machine; the user has to pay only for the number of laundry loads rather than purchasing the washing machine itself. Since there is an incentive for the user, the machines could be filled more efficiently thus decreasing the overall water and power usage (example taken from Sundin et al., 2009). Another example in this field is Barclay Bikes rental in London. You can rent and bring back bikes at any rental place in the city.

Despite the fact that more and more companies actually deliver a bundle of product and service elements, there is no coherent framework of how these are to be combined to optimize performance (Spring & Araujo, 2009) from an economic point of view. Nor is there a framework available that provides guidelines from a user (experience) point of view. Knowledge is thus needed on how to design and market PSS from both an user experience point of view and an economic point of view. Designing effective and affective PSS requires, first of all, a clear definition of PSS. Although there have been several attempts to define and classify PSS in prior research, these classifications in general have limited applicability. Classifications are, for example, geared towards the environmental impact of PSS (e.g. Tukker, 2004) or are focused on business-to-business settings (Ulaga, & Reinartz, 2011). In this paper, we develop a new framework that integrates perspectives from economics and design theory. To define PSS, we examine closely how the PSS creates value for the user.

An important distinction is whether the products and services that make up the PSS have 'autonomous' value for the user, meaning that they could be sold separately, as stand-alone offerings, on the market. This distinction helps to separate real PSS from

offerings that in essence are just products or services even though they do combine service and product elements.

Furthermore, in this paper we argue that coherent user experiences are particularly important for effective PSS. User experience has been defined as "the awareness of the psychological effects elicited by the interaction with a product, including the degree to which all our senses are stimulated, the meanings and values we attach to the product, and the feelings and emotions that are elicited" (Hekkert & Schifferstein, 2008). In the context of developing PSS, there is a need for knowledge regarding questions such as to what extent a given user experience must be provided by the product-part and to what extent by the service part of a PSS and how designers can make sure that the product and service part are coherent or consistent and to what extent is this important for user evaluations.

In the sections below, we will first briefly discuss prior literature on the perceived differences and similarities between products and services. We will then provide a theoretical framework on how to define and design PSS and give some empirical evidence that shows the relevance of the framework. In the last section we provide conclusions and give suggestions for future research.

THEORETICAL FRAMEWORK

IMPORTANCE OF PSS

The PSS concept has, in general, been discussed in terms of the manufacturing industry that shifts its business focus from designing and selling physical products only, to designing and selling a system of products and services (Manzini & Vezzoli, 2003; Ulaga & Reinartz, forthcoming). Vandermerwe and Rada (1988) introduced the term 'servitization' to refer to the increased offering of fuller market packages or 'bundles' of customer-focused combinations of goods, services, support, self-service and knowledge in order to add value to core corporate offerings. Clearly, one of the routes towards servitization are PSSs business models. However, service providers may also enter into PSS by adding products to existing services ('productization').

For manufacturers, bundling of products and services is advantageous because services tend to lock the user into a long-term relationship (Vandermerwe & Rada, 1988; Tukker, 2004). PSS either provide a means to differentiate from similar offerings, increasing the (perceived) value added of these offerings (Penttinen & Palmer, 2007; Oppedijk van Veen, & Schoormans, 1999), and/or provide a means to lower costs, of either the PSS providers themselves or their customers (Ulaga & Reinartz, 2011). PSS may result in increasing revenues as services tend to have higher margins and may result in a stable revenue stream throughout the life of a product (Cohen et al., 2006). For services suppliers, bundling of products and services is also beneficial because it can result, among other things, in more efficiency (reduction of costs), when direct, personal contact with customers is (partly) replaced by (intelligent) products, such as robots to assist care providers. Services then become less dependent on time and place (Oppedijk van Veen, & Schoormans, 1999). Another benefit is that by integrating product and service into a PSS, it is possible to make a service more tangible and easier to evaluate before purchase (Oppedijk van Veen, & Schoormans, 1999).

Irrespective of the benefits of PSS described above, as Ulaga and Reinartz (2011) point out, manufacturers that enhance the service component of their offerings are often not successful in terms of better financial performance (Stanley & Wojcik, 2005; Baveja et al., 2004). In part this is due to the fact that the business concept of PSS is still emerging (Sundin et al., 2009), making that best practices for the design of PSS have not yet been established.

DEFINING PSS

There is no generally accepted definition of PSS (Mont 2002a). A basic description of PSS is a system that consists of products and services that fulfill user needs (cf. Goedkoop et al, 1999; Mont, 2002b; Manzini & Vezzoli, 2003; Tukker, 2004;). Essential in PSS is the act of combining products and services. In existing literature products and services are in general considered to be different. The four main differences between products and services identified in existing literature are: intangibility, simultaneity, heterogeneity, and unstorability (or perishability) (Easingwood, 1986;

Jaw et al., 2010; Johne & Storey, 1998; Morelli, 2002; Nijssen et al., 2006). Intangibility or degree of material intensity refers to the fact that services are not material-based. Simultaneity deals with the simultaneous production and consumption of services. Due to this simultaneity, services tend to be heterogeneous. Heterogeneity makes that the service is likely to be experienced differently each time it is being consumed. Finally, unstorability or perishability relates to the fact that services only exist in time and not in space; thus they cannot be stored.

Shostack (1977; 1982) argues that all products and services consist of combinations of product and service elements and that the balance between those elements determines whether the combination is perceived as a product or service. However, for the development and marketing of effective PSS, it does seem beneficial to establish when a product with service elements or a service with product elements becomes a PSS. If one would define a product or service too broadly, many offerings may be labeled as PSS and the PSS concept loses its significance. Indeed, there would be no need to study how to design PSS since we could just apply our knowledge of designing goods or of designing services. One way to solve this is to apply the concept PSS only if the products and services that make up the PSS have 'autonomous' value for the customer, meaning that they could be sold separately, as stand-alone offerings, on the market. It may be that a good or service is specifically developed for the PSS and did not exist as an autonomous offering before the market introduction of the PSS. However, whenever the good or service has such customer value that in *theory* it could be sold separately, it still fulfills our criteria. For example, some services are needed during the purchase decision – e.g. to make the customer buy the offering – but in themselves do not possess enough value making that the customer is willing to pay extra for them. In a bookshop, when receiving advice as regards to the newest published books, this advice is taken for granted, with no autonomous value for the customer.

In design practice and theory a distinction is made between the 'interaction' with and the 'manifestation' of the offering (e.g. Hekkert & van Dijk, 2011). The

term 'interaction' describes how the offering interacts with the user and the term 'manifestation' describes the actual form or expression of the offering. Products and services differ both in terms of basic manifestation and in terms of basic interactions. In the case of a PSS, a user thus interacts with at least two different types of manifestations or entities: a product and a service. To differentiate between manifestations, we can use the degree of tangibility or degree of material intensity of the manifestations. Being tangible or intangible in turn has a strong influence on the type of interaction a user has with the offering. In the case of a manifestation with high material intensity (a product), interaction is mainly physical in nature (a user can touch, smell, see and hear the product). Interaction is also in general rather 'static'; the type of interaction a user can have with the product is determined beforehand and in general cannot change over time. The interaction with the iPhone from a physical point of view is for example relatively stable over time, where interaction is guided and confined by one big knob on the iPhone, a few little ones on the side, and a touch screen of credit card format. In the case of services, interaction is mainly 'non-material' and dynamic. Even though a blue print can be made of the different stages in a service, the interaction cannot be 'pre-programmed' since services are co-created with users and these users and the circumstances in which the services are provided may change every time a service is delivered. This 'real', dynamic interaction between producer and consumer means that they adapt their decisions and behavior to each other in a way that cannot be completely pre-programmed and this real interaction has to create additional value – as perceived by the consumer.

In our matrix displayed below, we include this aspect of intangibility or non-materiality (vertical line). Goods may possess aspects that are intangible or services may have tangible aspects. However, not all intangible aspects of a good may contribute to the economic value of that good nor may all tangible aspects of services add economic value. For example, customers who go to a hairdresser may not necessarily value the service of hairdressing any better (and thus may be, for example, willing to pay more) if they receive a free hair comb.

The importance of tangible/intangible value-determining characteristics is not sufficient to make an economically sound distinction between goods and services. The second essential criterion is the degree to which (repetitive) interaction between producer and customers contributes to the value of the good (vertical axe). Important is that interaction can take place over different points in time of a PSS life cycle. Interaction in general takes place before or during purchase, but may also take place after purchase. Indeed, one of the main motives of PSS providers to offer both products and services is that PSS allow for more long-term relationships between supplier and customer.

The matrix shown below shows both dimensions. The use of arrows in the matrix indicates that the dimensions are not dichotomous (e.g. a good scores either high or low on intangibility; a good asks either for no or high interaction) but continuous (a good can score according to all different kinds of degrees on the degree of intangibility and interaction needed). An offering that scores low on both dimensions is a straightforward good - say a stapler or a pizza - in the lower-left quadrant of the matrix; an offering that scores high on both dimensions is a straightforward service – for example, psychotherapy in the upper-right quadrant. In the upper-left quadrant there are offerings the value of which mainly has to do with intangible characteristics – for example a musical performance on a CD – though interaction between producer and customers is minimal. In the lower-right quadrant are offerings the value of which mainly has to do with tangible characteristics, but that need producer-customers interaction to really create the value – for example a meal in a good restaurant.

To consider something a PSS it should consist of a) more than one good/service that has a (potential) separate final market and b) it should come from different quadrants of the 2 x 2 matrix. If the offerings come from the lower-left and upper-right quadrants of the matrix - then one has the most 'pure' product service system with the original component offerings contrasting maximally.

The two dimensions identified above, that is, degree of tangibility and degree of interaction, to identify 'real' PSS, are not valid from an economic perspective, but also from a design perspective. Indeed, when designing PSS, main challenges for designers include creating coherence between the tangible aspects of the product –at which, traditionally, industrial designers were focused at - and the non-tangible aspects of the services and, on the other hand, designing user-friendly (repetitive) interactions between producers and consumers. Below, we will elaborate more on how to design effective PSS.

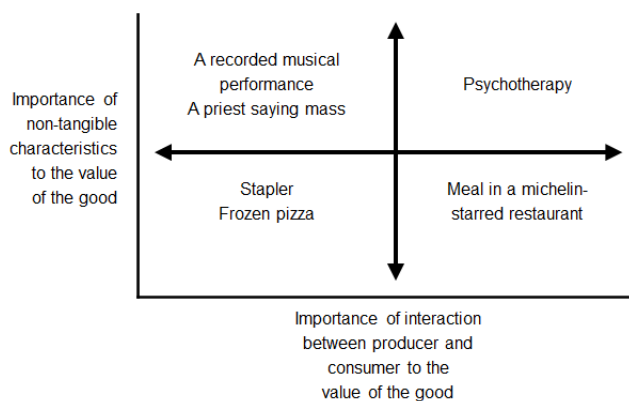


Figure 1. Product-service 2 x 2 matrix

DESIGNING EFFECTIVE PSS

Existing literature gives some initial insights in how to design effective PSS. Based on this literature, below we will provide some guidelines that seem particularly important to design effective PSS, without having the ambition to be exhaustive.

In literature, PSS have been defined as systems that create more customer benefits than if the goods and services were available separately (e.g. Shankar, Berry, & Dotzel, 2007, p. 2). From a business perspective, it indeed seems only beneficial to invest in PSS if indeed the product-service system, at least in the perception of the client, adds more value than when the good and service are sold separately on the market. To design a PSS that, in the perception of users, better satisfy needs and wishes than stand-alone products and services, the product and a service to be combined should be complementary to each other and should be combined in such a fashion that synergy is created. Synergy is created when things work in concert together to create an outcome

that is in some way of more value than the total of what the individual inputs is

Companies that combine a product with a service into a PSS should thus make sure that users experience the value added of this combination. . To personalize experiences is one of the areas in which this can be achieved. Unfortunately this is not always the case. For example, as demonstrated by Ulaga and Reinartz (2011) in the case of PSS that ensure proper functioning of the seller's good during all stages of its lifecycle (i.e. product lifecycle services such as maintenance contracts or take-back agreements), the services provided are typically considered a 'must have' by customers and thus these consumers show low willingness to pay extra for such services. In other words, the services do not provide much extra value for the users; the services only make sure that the product is performing its intended tasks and there is no real synergetic PSS system in which products and services enhance each other's value.

The current trend is that manufacturers or service providers combine their existing offerings with either new or existing products and services. PSS are not yet that often developed 'from scratch'. However, in order to develop hybrid offerings in which product and service elements interact synergistically for value creation, rather than in a mere additive manner, this may be required.

Indeed, as found by Ulaga and Reinartz (2011), managers consider realization of such synergy in PSS creation a major challenge. Managers stressed the need to adopt a systematic approach in PSS development, where the service component needs to be incorporated early in the NPD process, even before the actual design of the product. Thus PSS built up from the ground allow for the design of physical features that synergistically interact with the service elements of the offering (Ulaga & Reinartz, 2011). This enables effective differentiation and opportunities for cost reduction for the supplier (e.g. the design of machines that allow for remote, off-site maintenance).

For a PSS to be effective, it seems furthermore essential that products and services are combined in a coherent fashion and provide a 'synergetic' user

experience, making that both manifestations enhance each other. For example, the Nespresso PSS system: both the coffee machine and the coffee cup service – in which cups are sent by mail rather than being available in supermarkets – express ‘exclusivity’, which is how apparently Nespresso wants to position itself in the market. Coherence and a synergetic user experience require first of all that the different parts of the system adhere to the same strategy as regards to user experience.



Figure 2. The Nespresso coffee cups

This is harder to realize than one may think at first glance. In a PSS often multiple organizations with their own interests and own brand identity participate (e.g. Krups with Nespresso, Apple with Vodafone and the creators of applications). In the case of a PSS that is offered by one organization, development often not takes place by one designer or business unit but by multiple ones (e.g. a product designer and a service designer), each of which can have their own interpretation or conceptualization of the PSS in terms of user experience. To create a coherent, synergetic user experience, it seems however essential to have everyone adhere to the same set of goals.

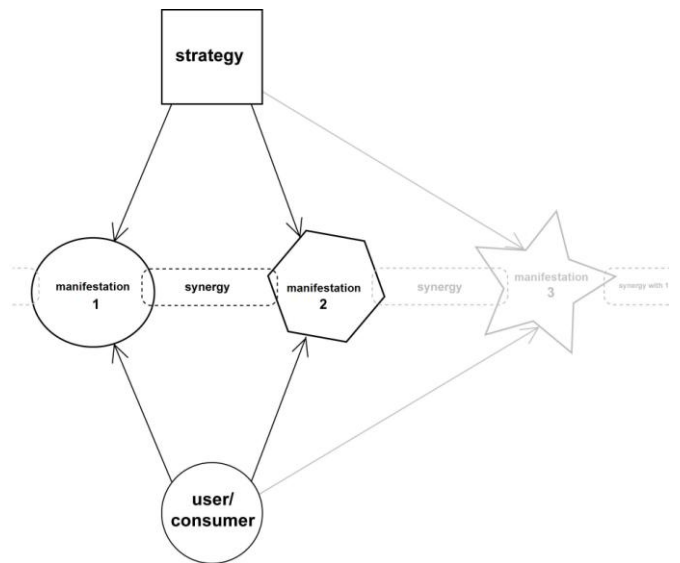


Figure 3. Product-service System

METHOD

SAMPLING AND DATA COLLECTION

To test the proposed 2 x 2 product-service matrix (Figure 1) we sent an online survey to product and/or service development managers who are members of a Dutch association for product and service development (PDMA). We were only interested in the practitioners who indicated that their organization currently offers or is planning to offer a PSS. The total response was N=38 (44%). From our analyses, we excluded the eight respondents that indicated that their organization is not offering or planning to offer a PSS. Therefore, the final number of respondents was N=30.

In our survey, we asked respondents questions to assess whether value creation by means of adding tangible elements to an offering and value creation by means of (repetitive) interaction moments were more important in the case of products or services. Respondents could respond using a five-point scale (1 = *Only important for products* to 5 = *Only important for services*). Finally, we asked the respondents to indicate whether their company offers a PSS and whether the product and service elements are also available separately in the market.

RESULTS

Table 1 provides descriptive statistics and correlations for the relevant variables used in this study. The means show that the tangible elements for value creation are more important for products than for services (i.e. the mean is closer to zero than to five). In addition, the means of the value creation through interaction moments and repetitive interaction moments show that this is more important for services than for products. Out of the respondents who indicated that their organization currently offers or is planning to offer a PSS, 60% indicated that the combined product and service elements are also available separately on the market.

The results show that there is indeed a significant difference between means of the importance of value creation through tangible elements and (repetitive) interaction moments. This means that the respondents in our sample identify tangible elements as more important for products than for services in terms of characteristics that create value. The other way around counts for (repetitive) interaction moments, which are identified as more important for services than for products in terms of characteristics that create value.

Variables	Mean	s.d.	Correlations								
			1	2	3	4	5	6	7	8	
1. Age	42.20	8.00									
2. Gender	1.03	.18	-.22								
3. Product/service elements separate available on market	1.53	.82	-.07	.12							
4. Importance value creation through tangible elements for products vs. services	2.13	.63	-.20	.26	.26						
5. Importance value creation through interaction moments for products vs. services	3.33	.71	-.01	.18	-.26	-.18					
6. Importance value creation through repetitive interaction moments for products vs. services	3.55	.91	.03	.01	-.30	-.01	.57*				
7. Importance value creation through tangible elements for PSS	3.66	1.08	.34	.06	.10	.49*	.02	-.16			
8. Importance value creation through interaction moments for PSS	3.80	.82	.18	.05	-.09	.33	-.06	.12	.32		
9. Importance value creation through repetitive interaction moments for PSS	3.90	.67	.14	.03	-.02	.28	.08	.23	.15	.41*	

n = 30, ** *p* < .01

Table 1. Descriptive statistics

To investigate whether the differences in means are significant, we conducted a paired samples t-test. Table 2 provides the results of the paired samples t-test.

	Mean difference	<i>t</i>
1. Tangible elements Interaction moments	1.20	- 6.38**
2. Tangible elements Repetitive interaction moments	3.42	- 6.81**
3. Interaction moments Repetitive interaction moments	0.22	- 1.44

n = 30, ** *p* < .01

Table 2. Paired samples t-test to measures differences in means for importance value creation

In the upcoming months we will send a similar survey to product and service designers to examine not only the importance they attach to value creation through tangible elements and (repetitive) interaction moments in the case of products, services and PSS, but also examine more in-depth the type of interaction and user experience they prefer to create in the case of products, services, and PSS.

CONCLUSION

From the viewpoints mentioned above we can say the following:

Boundary conditions for a PSS

- A PSS consists of at least two different types of manifestations.
- These manifestations have their own specific form (visual, 2d, 3d, digital) and interaction.
- Between those manifestations or entities, synergy must be present to make the PSS most effective.
- The PSS is coherent in terms of adhering to a consistent strategy and a consistent set of user goals and expressing one coherent identity.
- The PSS has a durable and dynamic relation with the user.

FUTURE RESEARCH

We need knowledge to answer questions such as to what extent a given user experience must be provided by the product-part and to what extent by the service part of a PSS and how designers can make sure that the product and service part are coherent or consistent and to what extent is this important for user evaluations. Part of this knowledge will be generated by means of a survey to be held under product and service designers in the upcoming months. Results will be discussed on D&E conference.

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