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## Evaluating new concepts of PSS based on the customer value: Application of ANP and niche theory

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## ABSTRACT

Product-service systems (PSSs) have been highlighted as a prevailing trend for manufacturers to survive the modern era of tough competition in their industries. Despite the importance of the customer in such systems, previous studies offer little in terms of evaluating new PSS concepts from the customers' perspective. To fill this academic lacuna, this paper proposes a method for evaluating such concepts that focuses on their acceptability to customers. The proposed approach is based on customer perceptions of value throughout the customer experience cycle: customers' acceptability results from their comparison of new PSS concepts with existing products. This approach successfully employs the analytic network process and niche theory to quantify customers' perceptions of their experience of PSSs. A short case study shows the usefulness of the proposed approach, which is expected to aid manufacturers adopting PSS strategies.

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### 1. Introduction

Manufacturers in fierce competition in traditional industries are increasingly striving to distinguish themselves from their competition by adding services to their product offerings; this movement has generated a new style of offering termed the 'product-service system' (PSS). Global leaders—such as GE, IBM, Nokia, and Xerox—who at one time seemed to be sticking with their successful business models, now no longer sell only traditional products; the shift towards PSSs seems to be perceived as one manufacturers can no longer chose to resist. The power of the PSS as a survival strategy, sharpening manufacturers' competitive edges, derives from its ability to meet customers' underlying needs, with the main purpose of delivering greater customer satisfaction (Mont, 2002a, 2002b; Vandermerwe & Rada, 1988).

Many studies have looked at the importance of this prevalence of PSSs in manufacturing, and empirical studies have mostly addressed their concept, characteristics, and implications (Sundin, Lindahl, & Ijomah, 2009). More recently, research has

focused on their practical employment and, especially, on companies' decisions to make the organizational shift from manufacturer to integrated offering provider (Gebauer & Friedli, 2005; Mathieu, 2001; Oliva & Kallenberg, 2003; Tukker & Tischner, 2004), which entails significant cultural and organizational challenges (Baines, Lightfoot, Benedettini, & Kay, 2009; Brax, 2005; Mont, 2002a, 2002b).

But customers also face challenges in the shift to a PSS, as the integrated offering of products and services often requires them to change their consuming behavior (Mont, 2002a, 2002b; Manzini, Vezzoli, & Clark, 2001; UNEP, 2001), which can make them one of the obstacles to manufacturers' ability to develop PSSs. Therefore, the acceptability of a PSS to customers must be systematically evaluated as part of the process of developing new offerings before their implementation. Recognizing the importance of the customer in the manufacture's decision regarding PSSs, previous studies have suggested a method to measure customer satisfaction and/or to manage customer value in the context of PSSs (Taabodi & Sakao, 2011). Firstly, with regard to customer satisfaction, the existing studies aimed at designing PSSs effectively and efficiently, considering customer satisfaction for design alternatives. For example, Kimita, Shimomura, and Arai (2009) proposed a method for estimating customer satisfaction, utilizing a value function called the satisfaction-attribute function, as an attempt to help designers compare PSS design solutions in the conceptual

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stage. Similarly, Geng and Chu (2012) developed a new importance-performance analysis (IPA) using the Kano model and decision making trial and evaluation laboratory (DEMATEL) for customer satisfaction evaluation supporting PSS design. IPA divides attributes into four groups depending on their performance and importance to customers and is used to prioritize attributes for improvement and to make quality-based marketing strategies. By applying the Kano model and DEMATEL to IPA, it becomes possible to consider the nonlinear impact of PSS quality attributes and causal relationships among these attributes.

Another category of research has focused on customer value as an antecedent of customer satisfaction. Kowalkowski and Kindström (2009) proposed a structured, 3-layered hierarchy of value criteria for PSS design, consisting of product-based, service-based, and relationship-based values. They also proposed a visualization strategy framework for PSS development, emphasizing the importance of value visualization as a way for firms to communicate and demonstrate the value of their PSSs. In a similar vein, Bertoni, Bertoni, and Isaksson (2013) have described an approach that displays the value contribution of hardware within a PSS offer using color-coded 3D computer-aided design (CAD) models. Other researchers have adopted the concept of customer value for the design and the development of PSSs. They purpose to identify how products and services should best be bundled in the design and development of a company's value proposition. For example, Pezzotta, Pionto, Pirola, and Ouertani (2014) introduced the service engineering methodology (SEEM) that supports companies for in servitizing their business model either by the engineering of a new product-related service or by the reengineering of already-available offerings. Xing, Wang, and Qian (2013) proposed a sustainability-oriented value assessment model to support PSS development based on life cycle thinking.

Despite the usefulness of these approaches, however, there is still a lack of studies regarding market acceptance of PSSs (Rexfelt & Hiort af Ornäs, 2009) and few efforts have been made to understand customer behavior in the context of PSSs (Schenkl, Rösch, & Mörtl, 2014)—for example, a preference of PSS offerings over product offerings. The promised acceptance of a PSS is based on the assumption that customers want the benefits of a product without owning it (Manzini & Vezzoli, 2003). Therefore, the values expected from PSS offerings compared to product offerings are essential to investigate to understand customer behavior.

To meet this research need, this study proposes a method of evaluating the PSS concept from the customers' perspective, addressing customers' acceptance of PSSs by examining both the context of customers' decisions and the composition of providers' offerings. First, in terms of *the context of customers' decisions*, customers compare the PSS concept with the existing product. Second, in terms of *the composition of offerings*, a PSS is an integrated offering of products and services. In other words, customers who are offered a new PSS have accustomed themselves to using products they own to gain the functions they target, so a customer's decision as to whether to accept a PSS is the choice between the new PSS and the existing product. However, since the composition of a PSS inevitably involves delivering core functions by integrating products and services, directly comparing new PSS offers with existing products will often be difficult. Accordingly, evaluating a PSS concept in terms of its acceptability to customers requires a relative approach. Such offerings are bound to be heterogeneous, so the approach must consider customer value rather than the specific attributes or functions of the offer's different elements, as the ultimate purpose of those offerings is to deliver customer value across their whole experience cycle (i.e., the whole time in which they use the product-service combination). The idea that underlies the proposed approach is that the more customer value

during the whole customer experience cycle that is delivered, the more customers will prefer the combined PSS offering.

To quantify and thus compare customers' perceptions of offerings' comparative value across their experience cycle, after describing the concept of a new PSS-based offering and the existing product offering in terms of the customer experience of each, we use the analytic network process (ANP) and niche theory. As one of the most widely used multiple criteria decision-making (MCDM) methods, the ANP is capable of dealing with measurements of customer value and customer experience that are qualitative, heterogeneous, and above all, interrelated. Considering that the customer values at different stages of the experience cycle may be interrelated to one another, the ANP is suitable as a main method to select the two alternatives—the PSS-based offering and the existing product offering. On the other hand, niche theory is a valuable method for analyzing customers' preferences for new offerings given its ability to examine the competition between two offerings via customer survey. In this way, it brings customers directly into the alternatives selection process. By combining the two methods, the customer-value based evaluation process becomes simple enough for customers to give feedback, while the complex interrelationships between customer values in different stages of experience cycles are taken into accounts in the evaluation.

Theoretically, this is one of the earliest attempts to combine the ANP and the niche theory. Actually, ANP has been combined with other decision-making tools such as quality function deployment (QFD), SWOT, technique for order of preference by similarity to ideal solution (TOPSIS), DEMATEL to make the best use of it (Büyükoçkan & Çifçi, 2012; Sevklı et al., 2012; Wu, 2008; Yang & Tzeng, 2011). By integrating the ANP and the niche theory, this study not only exploits the advantageous features but also remedies the shortcomings of each method. Practically, we expect our approach to aid manufacturers that are still focused on product attributes in understanding customers' perceptions about services or integrated forms of product-service offerings so they can adopt a PSS successfully.

The paper is organized as follows. After the theoretical and methodological perspectives which form the background to this research are briefly discussed in Section 2, our proposed five-stage approach is detailed in Section 3. Section 4 introduces our case study, which illustrates the proposed approach, followed by the consideration of various implications, after which Section 5 concludes the paper and discusses its contributions and limitations.

## 2. Background

### 2.1. Theoretical background

The PSS has been generally accepted as a new offering in which products and services are systematically integrated. Value in the PSS is created not by the customer purchasing the product but by it fulfilling their needs/wants: for example, not purchasing a car, but obtaining a mobility function, emphasizing the 'sale of use' rather than the 'sale of product.' Therefore, this study defines PSSs as a new type of delivery functions, which have been delivered to customers as a purchased product in the traditional business model, aiming to achieve sustainability and customer satisfaction by systematically integrating various elements with products.

Many definitions of PSSs indicate their purpose cannot be separated from that of *customer satisfaction* or *creating new value to the customer*. More explicitly, the importance of the customer is highlighted in Wise and Baumgartner's suggestion that manufacturers need to go downstream "towards the customer" and look at their value chains "through their customer's eyes" (Wise &

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