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Towards a methodology to engineer industrial product-service system – Evidence from power and automation industry

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ABSTRACT

Manufacturing companies whose products have become increasingly commoditized are currently striving to identify innovative value propositions allowing them to re-position themselves in the market. This is gradually leading to a business shift from delivering traditional transaction-based, product-centric offering to the provision of integrated product-service systems (PSS). However, the number of companies failing in successfully pursue such a transition is still increasing. Consequently, Service Engineering (SE), a discipline concerned with the systematic development and design of services and product-services, is gaining particular interest in both the scientific and practitioner communities. This paper contributes to these fields by proposing a complete overview of the applicability of the *SErvice Engineering Methodology* (*SEEM*) in an industrial context. The SEEM aims at supporting companies approaching the introduction of PSSs in their portfolio and suggests a structured decision-making process to (i) define the PSS offering most aligned with company product(s) and customer needs, (ii) (re-)engineer the (existing) service delivery processes, and (iii) balance the external performance (e.g. customer satisfaction, delivery time, service cycle time) with the internal performance (i.e. efficiency) of the service delivery process. The noteworthy benefits achievable through the SEEM are illustrated through a real case at the industrial partner ABB – a multinational company providing power and automation solutions. The implementation of all the SEEM steps is thoroughly described, and the advantages experienced along with the difficulties encountered are highlighted. Managerial implications and the main gaps to address in future research are also discussed.

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Introduction

The recent economic crisis and the saturated and commoditized market have led manufacturing companies to rethink their traditional business and move beyond simply providing goods [1].

These global trends, together with increasing market saturation [2], make the companies aware about the strategic relevance of the provision of additional product-related services. This is perceived as a new source of value and competitive advantage by either reactively fulfilling explicit customers' requirements [3], or proactively providing them with new services or integrated product-service systems (PSS) [4].

Therefore, these companies have to focus on services or service-oriented products to succeed in the market. Thus, they need to carry on with their traditional product design approach and to integrate it with proper service design as a mean to develop a marketable PSS. In addition, companies need suitable models, methods and tools for collecting, engineering and embedding in a solution (bundle of product and service) all the knowledge that meets or exceeds people's emotional needs and expectations [5,6]. Up to now, manufacturing companies have focused their engineering capabilities on the pure physical product, neglecting the adoption of systematic engineering procedure for the development of the service components of an integrated solution. To this purpose, specific methods and models are required since, even if provided in conjunction with a product, services are characterized by high levels of intangibility, uncertainty and simultaneity [2]. In this context, Service Engineering (SE) has

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emerged as a discipline calling for the design and the development of product-related service offering adding value to customers.

In spite of the great success of the SE as an academic discipline, few of the methodologies available in literature can be directly adopted by companies for two main reasons. Firstly, most of the methodologies identified are too complex or too many methods are suggested (e.g. [7]). Secondly, the majority of them exclusively focuses their attention on designing solutions able to satisfy technically customer needs [8–14]. In any case, they do not consider company internal performance. Therefore, balancing the external performance (e.g. customer satisfaction, delivery time, service cycle time) with the internal performance (i.e. efficiency) during the delivery of a product-related service has been neglected in literature. To be sustainable in the long term, companies need a methodology able to overcome the previous mentioned gaps [15].

The *SErvice Engineering Methodology* (SEEM) has been introduced to fulfil this last challenge. *SEEM* proposes a set of methods that can be integrated with traditional product design and that can support companies in engineering and/or reengineering their offering. The SEEM structure supports in (i) identifying new product-related service concepts fulfilling customers' needs and (ii) identifying an efficient service delivery process balancing the company external performance and internal performance.

This paper aims at describing in detail the SEEM structure and at demonstrating its practical applicability through an implementation in a real industrial environment.

The paper is structured as follows: Service Engineering in the product service system context section presents a literature review on Service Engineering with a focus on the models and methods currently available. SErvice Engineering Methodology overview section describes the principal constructs of the methodology, while SEEM on practice – industrial case at ABB section provides a full overview of the deployment of the methodology in a real industrial environment. Discussion section summarizes the most relevant managerial implications while Conclusion section concludes the paper and proposes further research prospects.

Service Engineering in the product service system context

Designing and developing a PSS is a complex task due to the long and unpredictable lifecycle and the number of interactions among the actors involved and the constituting components [16–18]. In fact, while in the area of product design a plethora of methods is widely accepted by the research community, in the area of pure service and product-related service design such robust and common approaches are not available. Consequently, when compared to physical products, services are generally under-designed and inefficiently developed [19]. The need of methods in the area of service design is increasingly being recognized as relevant by designers, engineers and managers to create a successful solution, even though the knowledge on how to develop a service and who should design it is still marginal [20]. This is the main motivation behind the continuous growth of Service Engineering (SE) as a technical discipline. Based on the definitions provided by Bullinger et al. [21] and Shimomura and Tomiyama [13], SE can be termed as a technical discipline concerned with the systematic development and design of services, aiming at increasing the value of physical artefacts. It is a rational and heuristic approach based upon the discussion of alternatives, goals, constraints and procedures, through the adoption of modelling and prototyping methods. Accordingly, the aim of SE is to increase the value of service offering by improving the service conception, service delivery and service consumption through the adoption of proper engineering methodologies. The development of a Service Engineering methodology implies the definition of *development process models*, describing the steps needed to engineer a service, and *concrete methods*, defining how to perform the model phases [21].

As stated by Kimita et al. [22], several authors developed design methodologies for PSS under the Service engineering umbrella [13,23–26]. These researchers struggled with the definition of models and methods either to engineer the service component of a PSS or to integrate the traditional product design and the service design through the development of a solution.

By analyzing the most relevant works in PSS and SE fields [7–14,27–33] two gaps have been identified: (i) they focus mainly on customer perspective and (ii) they lack of critical and in depth evaluation of PSS performance in practice [15,34]. Recently, some authors tried to overcome these gaps testing their methods in industrial setting [15,34–40]. However, they all have a strong customer orientation in relation to the design of the PSS service components. Yoon et al. [41] consider both the customer and the company perspective but their work is limited to the PSS evaluation without considering its design. Also Pezzotta et al. [42] identify a way to consider both the customer and the company perspective; however, the framework they proposed has not been validated in a real industrial environment.

To overcome the identified gaps, this paper proposes a methodology validated at industrial level balancing the company external performance with the long term business sustainability. For this purpose, a development process model and related concrete methods have been selected based on the literature analysis on both SE and PSS design.

Summarizing the most widespread models [7–13], four main common phases can be highlighted:

(1) customer analysis: identification of customers' features and needs;
(2) requirements analysis: definition of product or service requirements addressing customers' needs;
(3) PSS design: identification and design of solution(s) satisfying customers;
(4) PSS test and implementation: test the performance of the identified solution and implement it.

Concerning the methods, a wide range of authors has proposed alternative methods to carry out the above-mentioned phase. Table 1 lists these methods along with the phase where they have been adopted.

Most of the PSS design and SE literature highlights the relevance of deeply analyze the customer explicit or latent needs. However, only few methodologies in these fields clearly state how to collect, analyze and summarize those data. As reported in Table 1, the Persona Model results as the most adopted method due to its ability to summarize in a visual way the data collected thought market segmentation surveys or interviews.

The identification of the PSS that can really answer to customer needs is carried out in the second phase. Among the different methods, most of the methodologies adopts Quality Function Deployment (QFD), since it represents a structured approach to define customer needs and translate them into product-service functions [49], and Functional Analysis/FAST – Function Analysis System Technique, which allows to translate the functions expected by the customer into functionalities and the technical solutions [14].

The third phase deals with the PSS design. Here, service blueprinting is the most used method since it allows representing the service delivery process from the customer perspective highlighting the physical elements that can be perceived by the customer, and the activities where customer gets in touch with the service provider [58].

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