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Product-Service Systems across Life Cycle

# SErvice Engineering Methodology and Energy Services: applicability analysis and case study

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**Abstract**

In recent years, the economic and financial crises have been slowing down the growth of international markets. The resulting necessity to increase competitiveness has forced manufacturing industries to rethink their offer portfolio, also implementing servitization strategies. In particular, given the dramatic raise of customers' awareness as regards environmental and energy problems, the energy industry is also considering the provision of Product-Service System (PSS) solutions (i.e. the bundle of energy services to energy efficiency related products) as a profitable alternative. However, the design of PSS and in particular of the service content of the offer is a challenging activity, mainly due to the fact that services are by definition characterized by high level of intangibility and perishability, and to the fact that standard tools and methodologies for service engineering are not available. The SErvice Engineering Methodology (SEEM) [1] aims at supporting companies in these design and implementation phases. The methodology is in its development phase and its applicability in industry has been mainly tested in one specific context. This paper deals with the application of SEEM in the context of Energy Services (ESs) where the design phase can be much more complex than in other areas due to the variety of industries offering this kind of services and to the number of stakeholders involved during the service provision. In particular, this paper refers to a specific ES (the provision of data elaboration and analysis to energy consumption monitoring and control purposes) marketed together with energy meters. The general aim of this work is to provide a first analysis and a general understanding of the applicability of this existing methodology to the ES field by the mean of a real case study. In the paper, main steps of the application of the SEEM to the case study are described and discussed, to highlight main criticalities. In the end, a critical analysis is provided in order to put the basis to generalize the insights of this work to additional Energy Services.


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*Keywords:* Service Engineering; PSS Design; Energy Services

## 1. Introduction

During the last decades, the spread of Energy Services (ESs) [2] and Energy Service Companies (ESCos) [3,4] has gradually changed the way energy is provided to manufacturing companies [5], increasing the amount and enhancing the quality of services offered, generally resulting in the adoption of more sustainable and resource-efficient practices [6,7]. The continuous quest for new sources of revenues [8] that has recently caused many product based companies to shift toward service provision [9,10] has also entailed an increase in the attractiveness of this new business for many companies producing and selling energy-related products. As a result, energy-related Product-Service Systems (PSS) (i.e. the bundle of ESs to energy efficiency related products) [11] are nowadays offered by many companies, afferent to different industries, in different forms and with different types of contracts [12]. Such fragmented servitization scenario prevented the development and the diffusion of a standard and wide recognized framework and/or methodology to support companies systematically


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engineering and re-engineering their energy service offering. In the PSSs context, some proposals for methodologies with practical mechanisms allowing an easy and effective design and development of a solution are available (such as MEPSS [13], Service CAD [14], SEEM [1,15] and those proposed by Aurich et al. [16], Alix [17], Maussang et al. [18],Trevisan et al. [19] and Pezzotta et al [20]). Among them, no one has been designed or even just applied to ESs, apart from [19]. Therefore, the goal of this paper is to analyze and discuss the applicability of the SEEM [1] to energy-related PSSs through its implementation in a real industrial case. The PSS under investigation relates to the provision of data elaboration and analysis to energy consumption monitoring and control purposes (service), marketed together with energy meters (product) and data analysis software (infrastructure). This energy-related PSS business area has been selected because it presents several peculiar features which might be the most challenging to be implemented with a PSS design methodology. In particular:

- it is usually offered by companies with very different core businesses;
- customers' needs and the service delivery process are highly dependent from the customers' segment and their maturity level in energy management [21];
- the PSS provider might or might not directly own the manufacturing of the product;
- the service delivery process involves many partners and external stakeholders and its results are highly affected by their performance as well as by external factors;
- the engineering and provision of this service requires the cooperation of several functions within the customer's company (energy management, maintenance, production planning, etc.)

The case study has been carried out in collaboration with a company whose name and data will not appear in the paper for privacy reasons, and that will be called ABC in the rest of the paper. The company ABC has been selected mainly because of its long experience in the business, the variety of customers it deals with and its strong commitment in satisfying their needs. Furthermore, the ES analyzed is particularly relevant for ABC because the revenues related to its provision are the major percentage of total income which also drives ABC to further expand in the near future in this business area.

The remainder of this paper is structured as follows. In the next section, the theoretical concepts of the SEEM methodology are briefly recalled. The third section illustrates the implementation of the methodology in the case study. In the final part of the paper, a critical analysis of the case study is conducted, highlighting issues raised concerning the applicability of the methodology to the ES analyzed.

## 2. SEEM description

SEEM aims at supporting companies in making the shift to a service-dominant logic as well as re-engineering an already servitized business. In particular, SEEM focuses on supporting

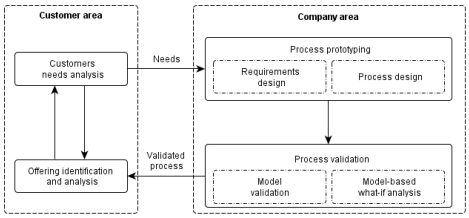


Figure 1 SEEM framework [1]

PSS re-engineering while balancing the value perceived by customers with the internal efficiency and productivity of the service delivery processes. To this purpose, as represented in Figure 1 SEEM is divided in two main areas.

- Customer area that aims at collecting customer's needs and at comparing them to the existing company service portfolio. On this side, SEEM foresees the adoption of methods such as market research, customer's interviews or focus group to collect information.

- Company area that, starting from the need identified in customer area, suggest the design of a PSS solution and of an efficient service provision process associated to it. In this area SEEM includes the following methods:
  - Service Requirement Tree (SRT), a functional analysis that, starting from an identified need(s) allows the identification of i) Wish (how the customer wish to satisfy its needs); ii) Design Requirements" (DR) (how the company can satisfy customer needs and whishes) that are possible PSS solutions capable of satisfying customer's needs and ii) "Design Specifications" (DS), representing the main activities and resources associated to each DR.
  - Quality Function Deployment (QFD) [1] to define the importance of each solution (DR) and connected activities and resources (DS) in satisfying customer needs. This is supposed to put prioritization among DRs and DSs.
  - Blueprint [22] is adopted to represent the service provision process of the selected alternative. In order to understand how much the process is able to satisfy the customer's need, the connection between the DSs of the SRT and the activities of the blueprint is also included.
  - Business process simulation is used as a final step to validate the proposed process and to identify additional and more efficient configurations.

  For further details on the methodology please refer to [1].

In the next section, the application of SEEM in energy services is described in deeper details. It is important to highlight that currently only the first steps of the SEEM have been implemented in the industrial case (i.e. the process has been mapped in the blueprint but it has not been simulated). The implementation of these steps has been useful to make first qualitative considerations concerning the SEEM applicability to ESs. Future works will complete the applicability analysis