PSS design process models: are they sustainability-oriented?

Marina de Pádua Pieroni*, Caio Augusto Nunes Marques*, Renato Nunes Moraes*, Henrique Rozenfeld*, Aldo Roberto Ometto*

* Production Engineering Department, São Carlos School of Engineering, University of São Paulo, Av. Trabalhador São Carlense, 400, CEP 13566-590, São Carlos, SP, Brazil

* Corresponding author. Tel.: +55 11 94150 2380; E-mail address: pieronimp@gmail.com

Abstract

Sustainable growth demands focus not only on the product and production processes, but also in promoting shifts in consumption patterns and lifestyles towards a circular economy. The adoption of Product-Service Systems (PSS) strategies appears as a promising solution. However, practical application of PSS sustainable approaches is still limited. This may be associated to the fact that a PSS does not guarantee environmental improvements if it is not specifically designed with this purpose. PSS design process models can play a relevant role in supporting companies in designing sustainable PSS when they incorporate activities, methods and tools to approach the sustainability dimensions. Not only the process models, but also the intentions of practitioners and their awareness towards sustainability during the design of a PSS influence the dissemination of sustainable PSS. The objective of this work is to investigate whether the existent PSS design process models support the design of sustainable PSS and whether practitioners employ sustainability-related activities when designing PSS. Nine process models were analyzed and the perspective of practitioners about considering sustainability issues when designing PSS were captured.

The collected data shows that only few of the analyzed process models actually propose activities, methods or tools to support a sustainable PSS design. This suggests an existing gap between literature and the practitioners' expectations of PSS design process models. Moreover, those activities, methods and tools are mainly focused on eco-efficiency and the social dimension is generally not covered.

Keywords: PSS; Eco-PSS; Sustainability; Circular economy; Process model.

1. Introduction

Sustainable development has become a recurrent issue in academic, civil society, business and government fields. Recent researches recognize that the dominant neoclassical linear industrial model, which is oriented to obtaining profit from the efficient allocation of resources in the market without necessarily regarding their exhaustible nature, is reaching its limits [1–4]. The approaches being used by society in the last decades to reach sustainability such as end-of-pipe solutions, cleaner production, eco-design, and product Life Cycle Management are mainly environmental oriented and focused on production processes [3]. This sustainability strategy - limited to the micro perspective of individual organizations and still very associated to neoclassical economics - is not enough if the projection of three billion middle class consumers joining the global market by 2030 is taken into account [1,3]. The migration towards a circular economy (CE) is seen as a solution for this future scenario and a more adequate strategy for achieving sustainable development [1,3,4].

The core of CE consists of closing the loop of material and energy flows in order to promote a regenerative industrial system [1,4,5]. CE operates around the linear logic regulating the economic model in light of nature’s limitations [4]. Differently from previous sustainability approaches oriented to resource management, CE proposes a radical innovation that surpasses production processes shifting the whole economic logic, lifestyles and consumption patterns [3,4]. Moreover, it affects different scales of society reaching single organizations and consumers (micro level), eco-industrial
organizations' capabilities, this gap related to sustainable PSS and regulatory systems. Regarding the aspect of such as current customer habits, organizations' capabilities, [9], this occurs because PSS are radical innovations, greater regarding sustainable PSS cases [2,9]. According to this concept is still limited [2,6,9,10]. This limitation is even knowledge accumulated in literature, practical application of increased in the last years [2,6,9]. However, despite all the number of researches in PSS field has considerably aspects [7,8].

Due to the economic, social and environmental potentials, the number of researches in PSS field has considerably increased in the last years [2,6,9]. However, despite all the knowledge accumulated in literature, practical application of this concept is still limited [2,6,9,10]. This limitation is even greater regarding sustainable PSS cases [2,9]. According to [9], this occurs because PSS are radical innovations, demanding huge challenges in different aspects of society, such as current customer habits, organizations' capabilities, and regulatory systems. Regarding the aspect of organizations' capabilities, this gap related to sustainable PSS may be associated to the fact that the PSS approach does not guarantee environmental improvements if it is not specifically designed with this purpose [2,3,8,9,11]. In other words, PSS is not a panacea for sustainability issues and is not necessarily more "circular" than product offers [2].

PSS design process models might play a relevant role by supporting companies in designing sustainable PSS. These models use different formalisms (such as graphical, textual, symbolic), elements and relationships to represent the PSS design process. They may be applied for different purposes such as planning and controlling the development of PSS offers [12]. The limitation of sustainable PSS diffusion may be related to gaps in the existent PSS design process models - such as possible lack of proper activities, methods or tools to guide the practitioners in designing a PSS with a sustainable approach - or in the practitioners' awareness of sustainability when applying those process models to develop PSS.

In this context, two research questions arose: “Are the existent PSS design process models able to support the design of sustainable PSS?” and “Do practitioners consider sustainability activities when developing PSS”? Therefore, this study has two objectives: (i) investigating whether process models recognize the sustainability potential and suggest activities, methods or tools to cover sustainability dimensions (economic, environmental and social) and (ii) and whether practitioners consider sustainability activities when developing PSS.

The research methodology is described in the second section of this paper. The third section presents the PSS design process models considered in the assessment. The fourth section discusses the outcomes of this research. Finally, the fifth section presents concluding remarks and insights for future researches.

2. Research methodology

Initially, a theoretical analysis of the PSS design process models focusing on the sustainability dimensions (economic, environmental and social) and therefore, similar PSS activities among the process models were identified as a preparation for the empirical analysis. Finally, an empirical analysis by means of focus group was conducted with practitioners in order to understand what they expect from process models concerning the sustainability perspective.

2.1. Theoretical analysis of the PSS design process models

At first, nine PSS design process models were selected from literature as depicted in Table 1.

<table>
<thead>
<tr>
<th>Process model</th>
<th>Author</th>
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<tbody>
<tr>
<td>Fast-track design process – PM01</td>
<td>Alonso-Rasgado and Thompson [14]</td>
</tr>
<tr>
<td>Integrated product and service design processes – PM02</td>
<td>Aurien et al. [15]</td>
</tr>
<tr>
<td>Design of eco-efficient services methodology – PM03</td>
<td>Brezet et al. [16]</td>
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<tr>
<td>APSIT method – PM04</td>
<td>Kar [17]</td>
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<tr>
<td>The Kathalys method – PM05</td>
<td>Luiten et al. [18]</td>
</tr>
<tr>
<td>The Design Process for the Development of an Integrated Solution – PM06</td>
<td>Morelli [19]</td>
</tr>
<tr>
<td>Detailed IPS’ development process – PM07</td>
<td>Nguyen et al. [20]</td>
</tr>
<tr>
<td>Service Model – PM08</td>
<td>Sakao e Shimomura [21]</td>
</tr>
<tr>
<td>Methodology for Product-Service System (MEPSS) – PM09</td>
<td>Van Halen et al. [22]</td>
</tr>
</tbody>
</table>

This selection was based on previous literature works from Clayton et al. [23] and Vasantha et al. [24], whose reviews approach the assessment of process models to design and implement PSS. Those two works were considered as foundations for this research because they were recently published in reference journals. Besides that, they used strict selection criteria for the assessed methodologies, such as: models should be complete and approach all phases of a PSS development process [23]; and models should focus in the PSS field, be detailed, previously applied in practical cases, published in referred journals with adequate citation, and applicable in complex development business to business...
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