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Towards a framework for lean operations in product-oriented product service systems

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ABSTRACT

More and more companies are beginning to move beyond manufacturing as a sole source of profit by offering integrated bundles of physical goods and services. This phenomenon has become popularly known as servitization, or the establishment of product–service systems (PSSs). Additionally, since the success of the Japanese after WWII and the subsequent popularization of the term "Lean Production" in the 1990s, lean too has almost become a nirvana for the majority of producers. Lean has also found its way into service operations, yet there is an apparent lack of knowledge when it comes to combining the successes associated with lean thinking with the potential of PSSs. Therefore, in this paper, we make use of two best-in-class lean companies that are recognized for excellence in both product and service offerings in order to analyse PSS operations in light of lean thinking. As such, we adopt a multiple case study approach in order to propose a framework for lean *product-oriented* product–service systems.

Introduction

The current situation that manufacturing firms are facing is characterized by fierce global competition and the saturation and commoditization of their core product markets [1–3], with consequential negative effects on product sales and margins [4,5]. In addition, customer needs and expectations are becoming more complex and comprehensive [6,7], often based on what a product does for the user, not on the product itself [8–10].

The combination of these factors has pushed companies to move beyond manufacturing towards the service domain [3,5,11], and the old dichotomy between product and service has been replaced by a product–service continuum [11]. This phenomenon, commonly termed as servitization of manufacturing, represents the evolution of companies' business models from a "pure-product" orientation towards integrated product–service systems (PSSs), based on the provision of integrated bundles consisting of both physical goods and services [12,13].

There are several reasons why PSS business models are attractive for manufacturing firms, as summarized by Mathieu [7] and further refined by other authors (e.g. [14,15]). These benefits can be grouped into three main categories: financial, strategic and marketing. Furthermore, potential environmental benefits of decoupling ownership of assets and use through the introduction of product–service combinations are often mentioned in literature [8].

However, besides these benefits, the actual implementation of PSS involves several challenges [16]. It is not enough just to innovate what a business offers to its customers by introducing new services and solutions, but further changes in all areas of a company's business model are required, in an organic, structured and coherent fashion [17]. As argued by several authors (e.g. [18–20]), different stakeholders and business units may be involved when products and services are combined, increasing the complexity of internal and external configuration. Companies must change the way they operate, since a number of interdisciplinary and cross-functional processes must be established, affecting existing organizational structures and processes. Moreover, delivering value through PSS may demand a network of external partnerships, where all but core-competences can be outsourced [7,21,22].

Unless the servitization strategy is designed and implemented correctly, the results can be counterproductive and even detrimental to the success of the business. This has led a number of companies to experience what is known as the "service paradox" [23], where a growth in service fails to meet its intended

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objectives. In order to overcome or avoid the service paradox, companies involved in delivering service components must boost the sovereignty of their service offerings through the development of a common service awareness along the service chain, as well as scale-up service activities by adopting suitable practices and tools [24] and establishing suitable means of communications to facilitate information sharing and processing [25].

The adoption of lean thinking could support companies in increasing the efficiency and effectiveness of their PSS design, development, management and delivery. Moreover, the deployment of the lean philosophy could enable the alignment of value-adding activities with the customer value-stream [26], not only supporting enterprise knowledge transfer through exploiting the capabilities of those involved, but also increase the communication across functional boundaries [27] and finally, decentralize the decision making process, fostering a dynamic process of change to ensure a robust, flexible, adaptive and responsive enterprise [28].

Although the philosophy and practices associated with lean production have been around for many years (e.g. [29,30]), and have been applied in a number of settings including both discrete- and process manufacturing environments [31], product development [32] and to some extent services [33], the combination of lean and product–service systems has not yet been explored. As argued by Chase and Erikson [34], there is a subtle mix of organizational structures that are appropriate to a PPS provider that are different from those associated with either a more traditional product manufacture or a pure service provider.

Therefore, the purpose of this paper is to compare and contrast both the lean and PSS approaches, in order to develop a framework for lean product–service systems (Lean PSS). In particular, the work, drawn upon two case studies, aims at shading light on the question: "How can lean thinking be applied to PSS operations?"

The remainder of this paper is structured as follows. The next two sections present firstly our selected research design and the methodology employed for the research and secondly the theoretical background of the study. In Case studies section we present our case study data, before we present the theoretical framework for Lean PSSs in The theoretical framework section. Finally, our conclusions, limitations and suggested areas for further work are presented in Conclusion, limitations and further research section.

Research design and methodology

Since this study focuses on a how-type question about a contemporary phenomenon not yet thoroughly researched, a case-based approach was selected as the most appropriate methodology [35]. As argued by Voss et al. [36], the first vital step in designing case research is the definition of the conceptual framework. Such a framework explains, either graphically or in a narrative form, the main aspects that have to be studied [37] and it helps researchers to: (i) shape the initial research design, (ii) measure constructs more accurately, and (iii) have a firmer empirical grounding for the emergent theory [36]. The development of the research conceptual framework was based on literature review within operations strategy and management in the PSS field, as well as lean production and service.

Cases were selected based on carefully defined criteria. As the research sets out to investigate the application of lean in the PSS domain, firstly we identified a population of potential case companies that have a well-known history of using lean production, e.g. best-in-class lean firms (we selected best-in-class lean firms due to the theory building nature of the investigation). We then selected cases from this population based on replication logic, again due to the fact that we adopt a theory-building approach. In order to develop a framework for lean PSS operations, we aimed for literal replication (i.e. prediction of similar results). A shortlist of case companies were contacted in an attempt to gain access, and the selection procedure finally resulted in two best-in-class lean case companies.

During case studies, data were gathered in the field. The methods, instruments, procedures and general rules to be followed in carrying out the data collection were included in the case study protocol, obtained by synthesising the conceptual framework into semi-structured interviews (the protocol was first tested and refined through the use of an additional pilot case study in order to strengthen construct validity).

The onsite interviews were carried out by two of the authors in order to increase the reliability of the study, and interviewees included a number of management personnel at both of the case companies, e.g. lean manager, service manager, quality manager, logistics manager, and/or operations manager.

Supplementary methods of data gathering were also used in order to triangulate the data obtained from the interviews, also strengthening the construct validity of our study. The other methods adopted include analysis of company documentation, as well as direct observation through tours of the facilities, which provided an opportunity to verify and clarify the data collected during the interviews.

The case studies allowed the identification, evaluation, and matching of patterns as they emerged from within-case analysis in accordance with a theory building approach [35,38], that prescribes firstly to become familiar with each case as a separate entity in order to identify case specific patterns, and then to make cross-comparison to identify common patterns. The results were finally used to build the theoretical framework related to operations strategy for lean PSS.

Theoretical background

This section describes current theory regarding the developments in PSS Operations strategy. In order to form a suitable lens of analysis, this section also provides an overview of the evolution of lean thinking in both the manufacturing and service contexts.

Operations strategy for product–service systems (PSSs)

Even if discussions about servitization and its impacts on how a business operates have attracted increasing consideration among scholars and practitioners, little attention is dedicated to understanding how organizations and processes for traditional manufacturing should be rethought to enable the efficient and effective design, development, management and delivery of PSS [11]. In particular there is a lack of studies which have examined the implications of servitization on operations management and the revisiting of traditional operations management tools, techniques and frameworks [39] with a new PSS perspective.

A few exceptions can be found in literature. The first paper by Johannsen and Leist [40] explores the possible application of a six sigma improvement program in the context of integrated solution, with a focus on the "Define" phase. Olhager and Johansson [41] analyse long term capacity management decisions for integrated manufacturing and service operations. The proposed framework is based on long-term capacity management for manufacturing operations (chase/level and lead/track/lag decisions), afterwards adapted to service operations (front/back office operations). Datta and Roy [42] discuss key operations strategy dimensions and how they contribute to the successful delivery of PSSs through the investigation of two case companies providing engineering service contracts. The key elements of operations strategy identified by the authors are: contract definition, operations strategy of the service provider, service delivery strategy and customer operations.