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Procedia CIRP 47 (2016) 412 – 417

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Product-Service Systems across Life Cycle

Transforming a traditional product offer into PSS: a practical application

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Abstract

In the last decades, companies have shifted from traditional business models based on selling products to product-service systems (PSS). Despite this tendency, there is a paucity of complete methodologies and tools to guide companies on how the transition should occur. To address this issue, the goal of this research is to present a complete framework to support manufacturing companies in the servitization journey. This novel proposal involves the application of design thinking to define the value proposition integrated with a PSS oriented business model creation, that goes beyond generic methods normally applied; and the specification of business process architecture to support PSS implementation. This research followed a prescriptive approach by means of action research technique. Key findings of the framework application are presented.

Peer-review under responsibility of the scientific committee of the 8th Product-Service Systems across Life Cycle

Keywords: product-service system; servitization; business model; design thinking; practical application; action research

1. Introduction

Manufacturing companies are challenged by increased global competition, faster technological improvements and a greater demand for product differentiation to meet new customer's needs and secure competitive advantage [1,2]. Thus, in the last decades companies have shifted from traditional business models based on selling products to PSS models [3–10]. By doing that, they aim to add value to their offerings through a user oriented [11,12] and integrated solution known as Product-Service System (PSS) [2,3,13–16].

The degree of transformation required for PSS business model transitions varies depending on the company's strategy and risk sensitivity [17]. One first scenario comprises both product and services components of the PSS as novelties [18,19]. In this case, product and services should be developed simultaneously from the beginning, which increases business risks [17]. A second scenario includes offering existent product and services, which results the minimum risk combination [17]. A third scenario considers a new product with an existent service platform [17]. Finally, a fourth scenario, which is the focus of this article, encompasses an existent and fully developed product combined with new services platform [4,6,10,19]. In such cases, the PSS development process focuses on the services. Nevertheless, the method should also evaluate if the product has necessary functionalities to enable the PSS offer or if it requires modifications (adjustments in hardware to enable automatic billing, installation of sensors to monitor customer's operation and enable predictive maintenance, or product modifications to satisfy customer's new requirements). Regarding this last fourth scenario, there are other two variations. Some companies may choose to operate only with PSS business model while others can operate both traditional and PSS business models in parallel. In other words, they can continue selling traditional products and the integrated product service solution concomitantly in order to expand their market share and gain access to new markets [6,20].

Peer-review under responsibility of the scientific committee of the 8th Product-Service Systems across Life Cycle
doi:10.1016/j.procir.2016.03.036

Independently of the degree of transformation, it is widely known that offering a PSS involves the proposition of a new business model, which is normally defined in the beginning of the development, or even in the front end of innovation (FEI) [5,9,19,21–23]. Business models are representations of the organization's logic to create and deliver value to customers [19,24–27]. Depending on the author, this logic may depict different elements, such as the company's strategic choices, operations and relationships. Generic methods for generating business models, such as the Canvas business model [24], deliver a simplified and aggregated representation of a business' logic with an insufficient level of detail for PSS development [18]. Thus, some authors suggest the use of specific methods that comprise greater level of details when developing a PSS business model [18,21]. Furthermore, designing a PSS business model, even in the case when the product component is already existent and fully developed, demands details about the service offer (such as business processes related to services, service level agreements, partnership agreements) that are not mature enough at the FEI phase. According to previous research [18], the PSS business model design may begin in the FEI, but the detailing should continue concurrently to the design of new services in the development phase (including the necessary new processes architecture for delivering the services). Regarding this perspective, methods presented in literature to design business models are useful to define an initial version, but they lack the appropriate level of detail for the purpose of a PSS offering [6,18]. Moreover, some authors indicate that literature is sparse in suggesting complete methodologies and tools to guide companies on how the transition should occur [3,4,6,28,29].

In regard to practical application, the number of studies focusing the transition from traditional to PSS business models is considered still limited [4,6,8,18]. Additionally, recent literature work [3] suggests that research community should take more prescriptively approaches in the change process and use techniques such as action research in order to actively support PSS practitioners in developing the tools and techniques that are still needed.

Hence, aiming to tackle some of the aforementioned gaps, the goal of this research is to present a complete framework developed by means of action research in order to support manufacturing companies in the transition from traditional product to PSS business model.

After the description of the research methodology (section 2), this article describes the methods constituting the proposed PSS transition framework and discusses the main findings of a practical application (section 3). Lastly, a section of final remarks is presented (section 4).

2. Research Methodology

This research follows a prescriptive approach, adopting an action research technique to propose a framework to help companies in the transition from traditional product to PSS offer. This method was chosen, because as already pointed by Baines et al. [3] most papers about PSS are descriptive and based on case studies. Like him, we also believe that researchers have an opportunity to be more active in developing actions rather than simply providing an analysis on the outcomes of others, hence prescriptive researches should be more explored.

The action research approach is a scientific method characterized by the cooperation of researchers with collaborators from industries in order to develop the solution to a scientific and organizational problem. Two main differences of action research when compared to case studies are: (i) the solution or parts of it are developed during the research; and (ii) the researchers have an active role in the solution execution [30]. This study adopted the action research method proposed by Coughlan and Coghlan [30], which consists of a four-step cyclical process: diagnosing, planning, taking action and evaluating action. After each evaluation, a new cycle may start if necessary.

This work is being conducted since September 2015 with the collaboration of a dental and hospital equipment manufacturer. This company (here after named Diagnosis CO for confidentiality purposes) has a diverse portfolio, but the family of products selected to become PSS is diagnostic imaging equipment. Those are high cost products manufactured and sold by Diagnosis Co predominantly by means of B2B transactions. Diagnosis CO is a mid-sized company employing over 450 persons. The company has strong competences in product development and manufacturing. Diagnosis CO decided to focus on a PSS strategy after losing sequential opportunities to entry new market segments due to customers' economic restrictions on making high investments to buy the equipment. Moreover, they intended to have recurrent revenue with the PSS strategy.

As we adopted action research approach, besides guidance and coordination, the researchers also actively participated in the execution of framework activities. Our team was composed of four professors, two PhD researches and four MSc. researches. The company structured a project team constituted of the Market Intelligence Manager, the Engineering Manager and the Post-Sales Manager. The President, the Sales Director and the New Business Director were involved in specific project gates to validate decisions and approve the project continuation.

A first cycle of the action research until the business model configuration was already deployed and it is the focus of the following sections.

3. Results and Discussion

3.1. PSS Transition Framework Overview

The proposed Framework (Fig. 1) aims to guide companies on their transition to PSS business models, when they identify servitization as an opportunity and strategic solution to their business. It is important to highlight that the representation and phases of the framework were defined during the project development. It was grounded on two important considerations. The first consideration is that the PSS business model dimensions - here considered as customer segments, value proposition, channels, customer relationship, processes, partnerships, resources, revenues and costs - cannot be completely detailed in the FEI phase.

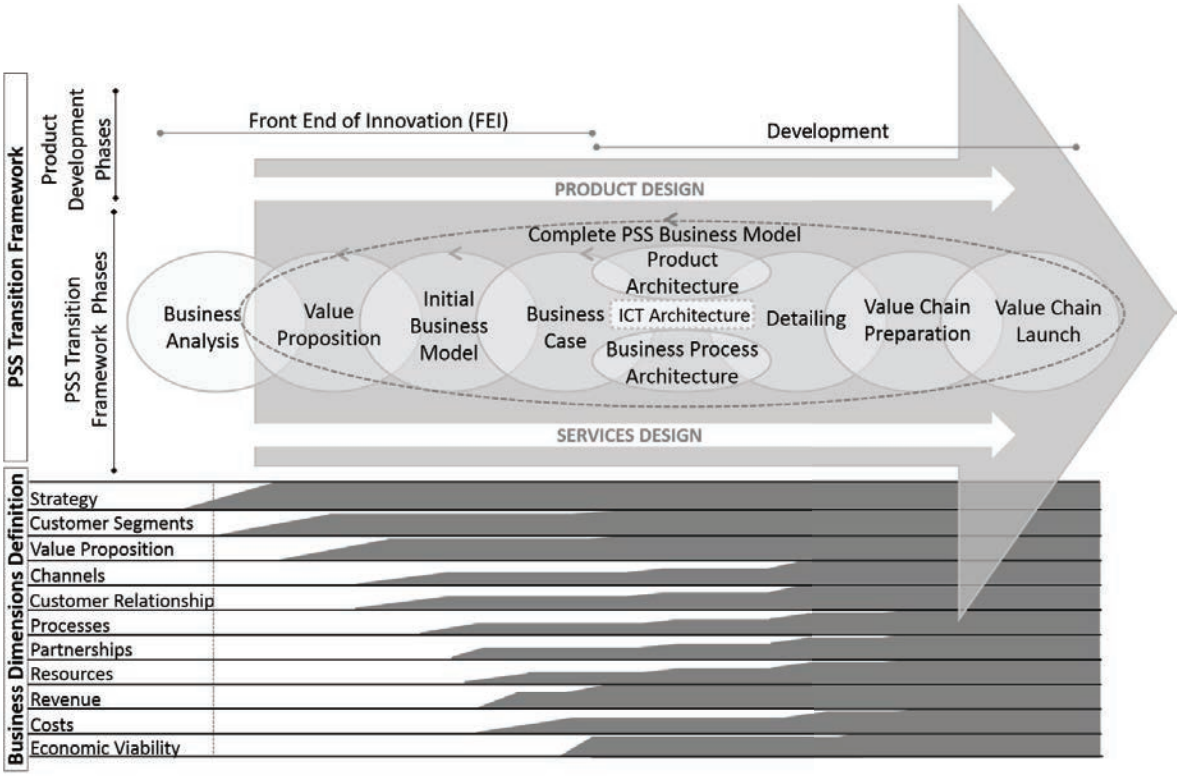

Fig.1 - PSS Transition Framework

As presented in Fig. 1, almost all dimensions are detailed by a certain extent (which varies according to each dimension) in the Initial Business Model phase, which is still in the FEI phase. However the detailing of some dimensions, such as customer relationship, channels, processes, partnerships, resources, costs and revenues, continues in the following phases and some of them even invade the development phase.

The second consideration is a consequence of the first one. Once the business model dimensions cannot be totally defined at the Initial Business Model phase, then the PSS Business Model definition surpasses the FEI phase. In fact, it comprises different levels of abstraction and its detailing continues until the end of the development phase, when the PSS is launched. Therefore, the definition of a PSS Complete Business Model demands a group of methods instead of simplified, specific and separate methods usually presented in literature (such as the Canvas [24]). In this study, the phases are circular and iterative (see the return arrows in Fig.1) and in each one many methods are applied to deliver the PSS Complete Business Model. As indicated in Fig. 1, the proposed PSS Transition Framework is constituted of nine phases described in the following section.

3.2. Specific Phases, Methods and Tools

The first phase of the PSS Transition Framework is Business Analysis. It aims to understand the company's current business model, its strategic alignment and the challenges of the context in which it operates. To do that, an assessment of the current Business Model is performed by means of specific questionnaires directed to different publics. Those questionnaires encompass internal aspects, based on a SWOT analysis, and external aspects, based on the Business Model Generation methodology [24], which proposes the understanding of some topics before a business model is created. The external aspects explore four main areas of the environment: key trends (regulatory, technological, cultural), macro-economic forces (global market conditions, commodities), industry forces (value chain, stakeholders, competitors) and market forces (segments, needs). This stage demands active participation and face-to-face interviews with different people inside the organization and possibly some external players (such as clients, competitors, suppliers). The results of the Business Analysis phase are: the understanding of the PSS transition context and the consolidation of main challenges that the company faces.

The Business Analysis phase is depicted in the beginning and is not related to the circular and iterative cycle of the framework, since it represents the acknowledgement of the company's current situation. The company may take the decision to skip this phase if the existing business model is already well known.

The second phase of the Framework, Value Proposition, aims to understand customer segments and develop the PSS value proposition. PSS should offer a customer centric perspective [11,12]. Thus, we selected Design Thinking (DT) to define the value proposition, since it is an effective user-centered approach that has been tested and approved by many practitioners and authors, such as Brown [31] and Liedka and

Ogilvie [32]. As the fundamentals of DT methodologies are similar, we adapted the Bootcamp Bootleg methodology proposed by the D.School [33], with which we have had previous practice, to the context of this research. Its first stage goes through understanding customers and stakeholders in order to generate empathy and identify problems related to their experience with the product. This first stage allows the project team to define which shortfalls shall be solved as a value proposition. Then, a new stage begins where the team ideates solutions for the selected problems. The best ideas are combined into concepts that are tested by the customers and improved according to their feedback. It should be highlighted that this process is not linear, as it is possible to iterate among the stages according to the project progress. The final results generated in the Value Proposition Phase are: the customer segment definition, the PSS Value Proposition, extra new ideas regarding the product and the service that were not considered in the Value Proposition. The results of this phase are the content of the first two dimensions of the PSS Initial Business Model: customer segment and value proposition.

The third phase is named Initial Business Model. It aims to generate different options of PSS business models based on the customer segments and PSS value proposition previously defined. As already mentioned in section 3.1, this framework considers that the PSS business model has different levels of abstraction. Therefore, it must yield more details about the business dimensions than generic models commonly presented in literature – such as the Canvas business model [24]. Hence, a new tool based on the structure of the Canvas business model [24] along with a PSS Business Model Configurator from previous research [18] is proposed in order to guide the detailing of each dimension by means of their attributes. As indicated in Fig.1, different business dimensions have different degrees of detail at this stage. This is expected and acceptable, once some information is still not available in this stage. Therefore, the results of this phase are: the initial business model propositions with sufficient definitions for the project economic viability assessment and initial business process architecture, partnerships and resources.

The Business Case phase aims to assess the economic viability of the different PSS Initial Business Model propositions.in order to select the best configuration. This phase is also considered part of the Complete Business Model (Fig.1), once it integrates further details (Fig.1) and connects the two business dimensions revenues and costs that are located in the bottom of the Canvas framework [24]. The tool used in this stage is a specific framework for assessment of product and service development projects based on previous work [34]. The starting point is the checklist of variables that the company provides in order to feed the framework. The results of this step are the economic viability indicators of each business model configuration for the PSS, such as the Net Present Value (NPV), Internal Return Rate (IRR), Payback Period, Return on Investments (ROI), Profitability Index and Breakeven Point. These results will enable the board members of a company to take the decision if the PSS solution should or not be implemented regarding an economical perspective. Furthermore, when more than one PSS Business Model proposition exists, this phase will determine the best configuration concerning the company's interests. It may be pointed out that the cash flow creation for the calculation of the aforementioned indicators is not trivial due to services' revenue and costs uncertainties.

The phases Process Architecture and Product Architecture may be defined simultaneously. The Information and Communication Technology (ICT) Architecture represents the computational solutions that support the services of the Process Architecture and may demand connections to the Product Architecture features (such as sensors and smart objects in the Internet of Things). The practical application of PSS considered in this study was constituted from a fully developed product. In such cases, the Product Architecture and the processes related to the product delivery (such as production and distribution) are already defined. Therefore, the focus should be on the detailing of the Business Process Architecture related to services and the ICT Architecture. However, it is recommended to evaluate if the product itself fits the PSS purpose, once normally minor hardware modifications are necessary (such as installation of sensors and billing software). This phase is also considered part of the Complete Business Model, because it enriches and further details the dimensions customer relationship, channels, processes, partnerships and resources (Fig.1). Thus, the results of this phase are: processes to enable the services components, responsible areas, partners, necessary resources (systems and materials) and main performance indicators for each process.

In the Detailing phase the processes of the PSS are completely detailed and modeled. Then, an implementation plan is prepared and final deployments are conducted in the Value Chain Preparation phase. Finally, the implementation is completely executed, which culminates with the PSS Value Chain Launch.

As depicted in the framework, the design of the new PSS is a circular and iterative process (see dotted lines with reverse arrows in Fig. 1) regarding the phases Value Proposition until Value Chain Launch. This means that outputs of later phases may demand changes and revision of previous phases.

3.3. Key Findings of the Action Research

The discussion of results would require more details, but due to length constraints only main findings and highlights of phases one, two and three are presented.

The Business Analysis was conducted by means of eleven interviews with stakeholders from inside and outside the company (more than five internal business areas and a key customer were interviewed). As final results, a suggested family of products was confirmed as the PSS pilot and a gap for maintenance services in the sector was highlighted. This phase was fundamental to align basic market opportunities (such as the demand of the sector for training services and preventive maintenance), barriers (such as some conflicts of interests with current clients), and weaknesses (the sector fails offering corrective maintenance services and is still informal). Those outputs were important initial guidelines for the Value Proposition phase planning.

As for the Value Proposition phase, during the application of the Bootcamp Bootleg methodology more than thirteen

interviews with different stakeholders related to the existent diagnostic imaging equipment were conducted (current clients, possible future clients, competitors' clients, bank institutions). The objective of such interviews was to map customer segments, understand the users' needs, and identify the users' problems that still demanded solution. As a result, two customer segments were selected.

The mapped users' needs enabled the generation of more than a hundred ideas to improve the customer experience related to the equipment. After clustering them by similarity, they were reduced to eighty ideas. From that number, 35 ideas directly related to services and PSS were selected. The remaining 45 ideas related to hardware improvements were documented and delivered to the Engineering Manager, since general hardware improvements not directly related to PSS correct functioning were not the scope of the project. Due to the great number of ideas it was necessary to prioritize them according to their relevance regarding the PSS launching and their complexity. This process resulted in an implementation roadmap of the proposed solutions. This step was not previously planned and was an outcome of the action research, which was very appreciated by the company. It was essential for the understanding of the PSS value proposition and the generation of prototypes for testing the solution. Besides, the company could not implement the great amount of new services to be offered at once. Hence, this step was incorporated to the Transition PSS Framework that we propose.

After the ideation, the project team generated a low-resolution "prototype" of the PSS offer for testing the concept with six possible clients. This activity was very important to guarantee that the user's needs were captured and translated as value in the PSS and also to adjust and fine tune the offer. Although the Value Proposition phase was time consuming, it contributed to the understanding of the customers' needs and the clarification of incorrect perceptions that the company had about its clients. The company's team testimonies showed that they would propose a different and incomplete value proposition solution if not for this phase. However, they also pointed that too much time was consumed in prototyping and in their opinion that should be simpler. A limitation of this phase was that the sample of interviews and tests were narrow in number and in geographical coverage, due to the company's availability restrictions.

The Initial Business Model phase was conducted in two workshops. The first workshop focused on detailing the right side of the Canvas business model, which consists of analyzing the customer segments and value proposition (outputs of Value Proposition phase), and defining customer relationships, channels, and revenues. The second workshop aimed to detail the left side of the Canvas, which is composed of processes, resources, partnerships and costs. The core of the left side is the definition of processes, which depends on previous configurations of the right side. As a result, two business models were generated being one for each selected market segment. A good practice conducted in this phase was to present pre-selected possibilities of attributes for each dimension. That spared time and made the dynamic more efficient. Two interesting findings from this stage are aligned with servitization literature:

Finding 1: Diagnosis CO decided to maintain its actual business model running in parallel with the PSS business model. This is consistent to the fact already presented in literature that a PSS development does not exclude traditional business models. As a matter of fact, the word transition could be better placed by "expansion" of offerings [6,20].

Finding 2: as highlighted in previous research [4], Diagnosis CO also decided to open a spin off to launch the PSS business model. The novelty is that their primary motivation to separate units was to avoid direct competition with their actual clients. Despite that, they also found important to avoid resistance from the current product sales team (one of the main reasons indicated in literature).

The Initial Business Model phase supported the company in defining and assimilating the details of the PSS services components (such as frequency of preventive maintenance, frequency of customer proactive contact, conditions for product retrofitting). After that, they could estimate the efforts in terms of processes and organizational changes to enable the PSS. Furthermore, it brought to light legal and tax issues that should be approached in order to allow the PSS launching. A limitation of this stage was that the legal and tax specialist could only join the team at the last moment. The participation of such role is important from the start of this phase in order to avoid unnecessary work, once improper assumptions were made at the beginning.

The revenue and cost dimensions were only partially defined during the Initial Business Model, since the phases are iterative and the detailing of these dimensions is part of the next phase: Business Case. The participation of a tax and legal specialist is essential in Business Case phase.

Another limitation of this study is related to the trigger to implement a PSS. Different circumstances may be the trigger for the PSS design initiative inside a company. This article focuses only on the case when the company actively decides to offer the PSS after perceiving a market opportunity. Another trigger to start a PSS would be a direct request from a customer. In this case, the customer may suggest an initial concept of the PSS value proposition, which may change the way in which the framework is applied. As we did not obtain evidences to test this last case in the action research, the topic remains as an opportunity for future researches.

Based on our research method, action research, the framework is being updated during the development. The version presented in this paper is what we have obtained so far. At the end of this empirical application, the framework may be slightly different. After a stable version of the framework is reached, the research methodology will be changed to case studies in order to try to falsify the framework in the hypothetical-deductive approach. The findings of next phases and action research cycles will be presented in further publications.

4. Final Considerations

This study provides insights of practical application to support companies in the transformation from traditional product to PSS business models. Its main contributions to academy and practitioners are:

- The proposition of a complete framework, from ideation to implementation, in order to transform the offering of a product into a PSS;
- The introduction of a new concept for outlining business models integrated in a comprehensive methodology that involves design thinking, business case and business process architecture methods;
- The description of a practical oriented prescriptive research.

The framework introduced in this paper still requires further development and empirical tests. Next steps of research aim to conclude the action research cycles. Afterwards, case studies will be performed to evaluate the applicability of the methodology in different industry contexts and improve the framework.

Acknowledgements

This work was supported by São Paulo Research Foundation (FAPESP) under the processes 2015/00291-0 and 2013/14549-4. The opinions, hypotheses and conclusions or recommendations expressed in this material are responsibility of the authors and do not necessarily reflect the views of FAPESP.

The authors would like to extend sincere thanks to São Paulo Research Foundation (FAPESP), Brazilian Counsel for Scientific and Technological Development (CNPq) and the Higher Education Personnel Improvement Coordination (Capes) for supporting this research.

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