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Industrial Transition through Product-Service Systems: Proposal of a Decision-Process Modeling Framework

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Abstract. In this paper, we attempt to explain that Product Service Systems (PSS) are not based solely on technical and functional aspects, but that organizational and collaborative aspects are also involved. Thus, we propose a servitization analyzing approach that highlights the need to manage the complexity of the iconic functional and decisional areas related to this strategy. We propose a transition process conceptual model adapted from a modeling framework for business decision-making processes (GRAI framework and tools).

Keywords: servitization; transition; decision; ecosystem

1 Introduction

Current trends of economic and population growth have been exerting pressure on the environment. The actual business environment overview is characterized by market volatility and instability. Increased competition is about to weaken the sustainability of classic differentiation strategies based on product innovation, technological empowerment or lower prices [1]. Since then, differentiation based on product and prices are presently less significant factors, while service competencies are becoming core differentiators in business relations [2]. Therefore, during the last decades, we have witnessed a paradigm shift through the development and spread of servitization and Product Service System (PSS) concepts. A product-services system (PSS) is implemented as an innovation strategy that shifts the focus of a business from developing and selling physical products to developing and selling a system of products and services capable of fulfilling specific demands of clients [1]. But also, turning to this new paradigm requires questioning business interaction within a defined ecosystem and, organization' roles and goals.

We develop in this paper three main parts. First, we introduce the basic concepts of the servitization process. The objective of the second part is to illustrate our approach of servitization modeling, for which we propose a generic decision model construction. In the third part, we apply and validate this approach through a case study of a manufacturing company in a servitization process.

2 Servitization: Transformation of the Economic Relationships within Business Ecosystem

The main objective of this section is to present servitisation from a decisional point of view: servitization can be understood and formalized as a complex decision process of enterprise transformation, which changes several aspects of its economic relationships within a business ecosystem. We present below key dimensions of this decision process. To extend a systematic approach to strategy, we adopt Moore's vision of a company viewed not as a member of a single industry but as part of a business ecosystem that crosses a variety of industries [3].

In this paper, we express an analytical vision of servitization through focusing on a specific focal company interacting with its ecosystem. This transitioning focal company is considered as the central network productive node and as the main driver of the PSS offer. This transformation affects the company on different levels: through its strategy, its internal processes and competencies, as well as its external network relationships. In fact, servitization leads to rethink the enterprise positioning within its ecosystem, the various parties involved with it and the different relationships between parties. This research work aims at modeling and controlling the decision-making process deployed by the company along the servitization transformation project.

Transitioning to servitization is defined as a decision-making process, which generates information and knowledge progressively through temporal sequences according to each specific context. This is the system adopted by an organization to move from a current economic model (product-oriented offer) towards a servitized economic model (integrated product and service offer). A PSS business model is often accompanied by new types of partnerships among stakeholders such as producers, retailers, customers and end-of-life managers with connected economic interests and shared vision of desirable outcomes for 'system resource optimization' [4]. Broadening PSS thinking beyond focusing on an individual product to a wider social-technological system that incorporates multiple actors, perspectives, and approaches may simultaneously increase customer satisfaction, profits and eco-efficiency [5].

We propose to decompose the global servitization process in 3 decisional issues which cover key dimensions of the business transformation:

1. The product service system (PSS) technical design;
2. The PSS business model transformation;
3. The organizational changes, required to support the PSS implementation.

Each of these decisional issues contributes to redesign the positioning of the focal company in its ecosystem with different interaction levels. Indeed, the first decision issue represented emphasizes the services' intangible nature, service delivery requires then a delicate process of value proposition [1]. The second issue encountered in the servitization process is to predict the market behavior vis-à-vis this new offering. Therefore, servitization leads to consider a new form of competition outside the usual expected rivals within an ecosystem [6]. In addition, the third issue considers the adaptation of organizational structures and processes necessary to ensure congruence between their resources and capabilities implementing this new strategy [7].

Thus, the transformation of a manufacturing company to a product service organization confronts a set of challenges that we summarize in the three problematic domains underlined. These domains are also included as areas having different

functional characteristics of complementarity. In addition, they can play a role of catalyst in the dynamics of the transition process: the company often initiates the transition by using one of the domains as an entry point.

In the following sections, we present a way to model this complex decision process and to provide diagnosis tools dedicated to a better management of servitization.

3 A Modeling Framework for the Servitization Decision-Process

In reference to a state of the art in Enterprise decision-making modeling [8], we have selected the formalized modeling proposed in GRAI method as the most appropriate to our research problem. GRAI method is a decision-making modeling framework that focuses on businesses in general and specifically on production systems [9]. Additionally to the decision-making orientation, the contribution of GRAI is also due to its ability to represent the complexity of servitization process, through a systemic view of the process. To represent the complexity of a decision process, GRAI grid considers simultaneously distinct functions of the system through functional areas, and, a notion of decision-making levels characterized by the concept of decisional horizons. Additionally, interacting among decisions is represented with coordination mechanisms among the different decision centers considered in the GRAI grid. GRAI modeling framework can then be applied to represent the servitization decision-making process in a systemic multi perspective approach.

We model this decision making process through three basic concepts:

- Macro-process (MP): corresponds to a functional decisional domain, and comprises a coherent set of decisions on an overall goal. In addition, each MP includes specific types of actors within an ecosystem.
- Critical Decision Process (CDP): represents all decision-making processes involved within a macro process, whose output is likely to have a significant impact / importance on the overall transition process.
- Decision Activity (DA): represents a basic/elementary decision. In a decision-making process of transition, a set of decision-making activities (DA) represents the finest decomposition level of each critical decision making process (CDP).

These concepts will be used later in the servitization modeling process. We specify below the servitization decision model using 2 formalisms proposed by the GRAI method: the decision-making grid system and the decision-making networks. In this paper we illustrate only the decision-making grid.

3.1 Constructing the GRAI Grid for Servitization

An overview of this decision model is provided by a GRAI grid adapted to servitization process. This grid allows classifying specific functional transition areas, and decisional horizons: it requires specifying two axes (vertical and horizontal) of the GRAI grid.

3.1.1 Vertical Axis: Three Decisional Horizons

The vertical axis in the GRAI grid is linked to the decision's horizon: long, medium and short term. This aspect of the decision clarifies crossing from high strategic-decisional level to tactical and operational ones. This distinction allows:

- To define the strategic objectives considered by the manufacturer through the servitization transition on a long-term horizon ensuring the sustainability of the firm and minimizing the harmful effects on the environment.
- To establish the necessary resources to make the transition on a medium-term horizon for achieving the above objectives. Essential resources relate to capabilities, business networks and internal and external skills necessary to achieve this strategic change.
- To perform processing operations on a short-term horizon to achieve the strategic servitization objectives. Here, the target is about to define the specific action plan in terms of operational decisions, guided by performance indicators that can ensure a good consistency between the strategic objectives and the available resources.

This characterization of the decision-making process sheds light on the transition process advancement in time and the strategic objectives decomposition into operational objectives.

3.1.2 Horizontal Axis: Three Macro-processes

According to GRAI approach, this axis is related to the decision's specific functional domains. We identify functional areas in the decomposition of servitization on three Macro-processes (MP) representing the three problematic issues in a manufacturer servitization process introduced above. These MP comprise the horizontal axis in the GRAI grid:

1. MP1: the product service system (PSS) technical design;
2. MP2: the PSS business model construction;
3. MP3: the Organizational changes, required to support PSS implementation

These MP aim at explaining the problematic complexity of a servitisation transitioning planning. They are also included as areas having different functional characteristics of complementarity and which involve different linkages to the ecosystem's actors. In fact, servitization requires an effort that moves beyond the capabilities of the only transitioning business, it involves complex coopetitive links between different actors; it involves an entire business ecosystem. Planning the PSS value design, the production forces and the commercializing requires understanding its firm's ecosystem ability and capacities to maintain sustainable working flows. In order to achieve its goals, a transitioning company should accommodate to its ecosystems' specificities, they are larger, more diverse, and more fluid than a traditional set of bilateral partnerships. By leveraging ecosystems, companies can deliver complex solutions while maintaining corporate focus [10].

3.1.3 Critical Decision Processes and Decision Centers

In the GRAI modeling framework, decision-centers represent the intersection between a functional decision area and a decision's horizon. To identify servitization DC, we consider that they are directly linked to the concept of critical decision-making processes (CDP) introduced above.

We have made a specific literature review on each MP to identify the critical decision-making processes nested within it. For clarity, in this paper, we limit our explanation to the MP2: Business-model transformation, and the associated DC (the approach is the same for the 2 others MP).

To decompose MP2 into several CDP, we adopt the following Business Model definition [11] articulated through three dimensions:

1. The value proposition: it describes the "what?" and reflects the offer attractiveness to the customer. It includes the target market segment, and the proposed offer.

2. The value architecture: it describes the "How?" and is defined as the set of the implemented tasks by the company to achieve delivering the value proposition to the customer. It includes the internal value chain definition of the company and its value network.

3. The profit equation which explains the origin of profitability by combining the revenues, costs and capital employed. It reflects the economic viability of the BM.

These 3 BM dimensions induce the creation of 3 CDP, which will also correspond to decision centers. Then, we decided to add a fourth dimension in the above definition, which is the deployment of the BM, describing the implementation of the BM on the market in terms of operational decisions.

Finally we thus consider four critical decision-making processes; each of them corresponds to a specific DC. Within the structure of the GRAI grid (see Figure 1), the first dimension corresponds to a long-term horizon, and embodies strategic decisions while the second and third correspond to a medium-term horizon, they embody tactical decisions. Finally, the fourth dimension corresponds to a short or very short term that embodies operational decisions.

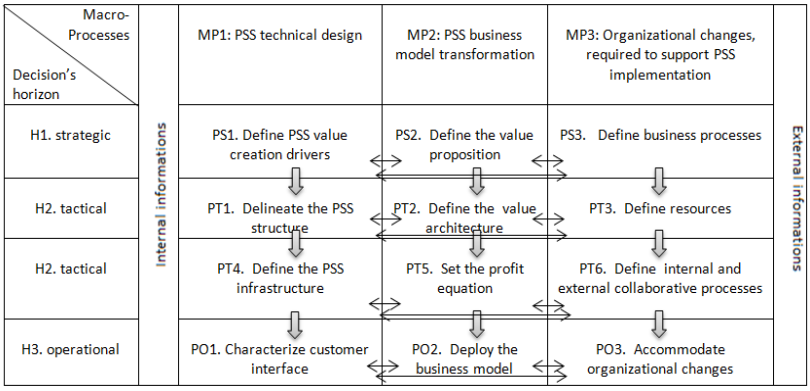


Fig.1. Generic servitization transition decisional model

3.2 Illustrating the Servitization GRAI Grid

From the foregoing, we explained the followed process to build the framework in analogy with the GRAI modeling logic and to reflect the evolution of the servitization decision-making process.

The construction of the GRAI grid (Figure.1) allows visualizing the flows trade between different decision centers vertically and horizontally. These trade flows are primarily informational (thin arrows) and decisional (thick arrows). This model allows understanding the complexity of the overall transition process, identifying different backgrounds decision attached to them and delineating the functional areas in MP. In addition, the GRAI grid differentiates the granularity level of the decision-making process from strategic to operational objective level and from general to particular within each DC.

Moreover, analyzing the sevitization GRAI grid situates inherently the ecosystem's importance in the approach. Indeed, the focal enterprise linkages with its ecosystem appear at two levels: the first level concerns the informational domains (internal and external) and its influence on the collaborative mechanisms of the transitioning firm. The second level concerns more specifically the composition of each CD, from this point of view, we consider the importance of taking into account the main actors of an ecosystem. In that sense ecosystem plays a relevant role in orienting the global orientation of a servitization trajectory.

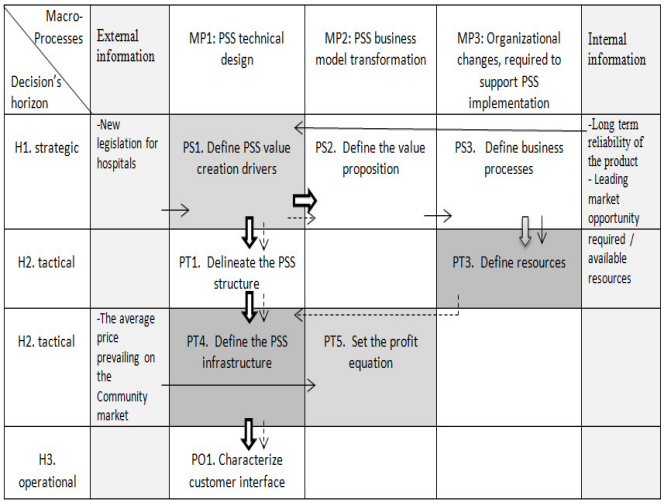
4 Case Study: Ecobel

4.1 General Presentation of Ecobel

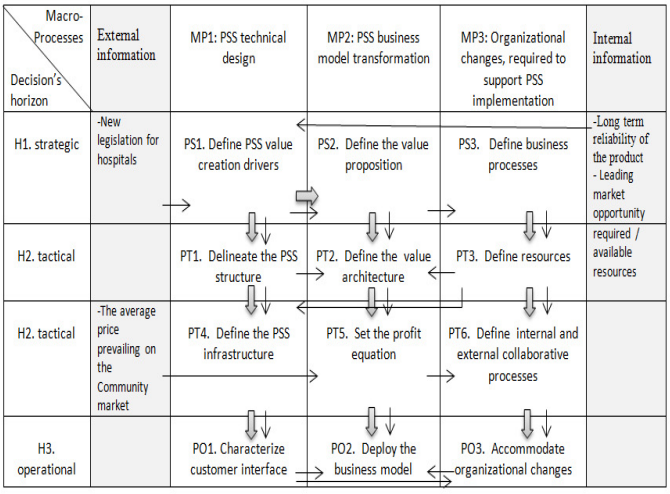
To concretely illustrate our approach, we propose an application on a case study of a French SME named Ecobel. The company's main activity is the manufacturing, sale and installation of shower heads based on an innovative technique that allows water savings and protecting from legionella. The company accounts in its current market basically establishments receiving general public. Ecobel is planning to adopt a servitization model for its offering, so the company has initiated a debate on the implementation of a servitization strategy and decision-making process. This case study has aroused our interest because of its positioning in the transition process. Indeed, Ecobel currently offers two models: the classic offer selling only the product of showerhead and the integrated PSS offer selling PSS: showerheads reliable over 5 years. The PSS offer includes service contracts of regular maintenance and periodic exchanging of the product of showerheads with a visual identification. Ecobel's leader highlights the difficulty of placing it on the market. The main barriers to the commercialization of the proposed PSS lie in the difficulty of its value measuring and to convince potential customers of it. Ecobel remains cautious about the development of servitization model on its entire range.

4.2 Instantiating the GRAI Grid on Ecobel: A Comparison Between the Reference Model and the Current Model

We undertook a process of qualitative data collection through 3 semi-structured interviews with ECOBEL's leader over a period of 3 months. This data collection has allowed instantiating the generic GRAI grid transitioning process relatively to ECOBEL.



GRAI grid Ecobel "current model"



GRAI grid Ecobel "reference model"

Fig. 2. Comparison of Ecobel's GRAI grids "reference model" and "current model"

Using a comparative approach, we performed the instantiation of the GRAI grid in two stages. We carried out the construction of the GRAI grid specifically to the firm's decision-making process. This *current model* translates the followed servitization approach of ECOBEL. Then this tracking model is compared to a *reference model* built to ECOBEL's data but anticipates a servitization path which is finite and consistent. The instantiation of the generic model refers to ECOBEL's characteristics to define the decision consistency over the grid's lines and the decision concordance over the grid's columns. In a hypothetic-deductive approach, *the reference model* represents the "supposed to be followed" trajectory, as shown in Figure 2.

The instantiation of the generic model highlights ECOBEL's closer exchanges of information and decision-making between decision centers (DC). The analysis of the current and reference models can be addressed on three levels:

1. Structure of the grids: the objective is to highlight the apparent differences between the *reference model* and the *current model* of servitization. The comparison of the two grids underlines the absence of certain DC in the current model. As the absence of a set of information and knowledge would have a significant impact on the overall missing critical processes, we consider it as a total failure of missing DC. In addition, although some CDP are actually represented in the *current model*'s grid by their current DC, this does not automatically imply the efficiency of their results. In fact, some DC reflect a failure in their elemental composition in terms of decision-making activities. We consider this as a partial failure that spreads through generated information and decisions flows. Shades of color saturation mentioned in the *current model* then allow assessing the level of failure of the present DC. To locate the origin and degree of a DC failure, we should return to the networks that constitute the GRAI DC, which is not presented in this paper.

2. Information system: represented through the flow of internal and external information in the grids. Information orients the servitization decision-making system. The lack of certain information's elements can cause the DC malfunctioning. In fact, every DA generates a stream of data elements necessary to achieve the next activity. This interdependence produces the spread of possible malfunctions through the information exchanged.

3. Horizontal and vertical exchanges between DC: aiming to highlight the consistency and concordance linking between DC. The DC' vertical exchanges analysis, on a specific MP of the grid among three horizons, clarifies consistency between the decisional centers. The DC horizontal analysis brings information about exchanges between the three functional designated areas on a specific horizon (line of the grid), and clarifies concordance between DC.

The exploratory case study of Ecobel, allowed a concrete illustration of our approach to modeling servitization transition process. GRAI tools instantiated on Ecobel's features enable visualizing the composition of the GRAI grid. Then, the comparison between the reference model and the current one allowed us to highlight the origins of the difficulties in advancing the servitization process of this firm.

5 Conclusion

This research work emphasizes the systemic nature of servitization process. The analyzing approach proposed aims at decomposing the complexity of servitization decisional process and then at facilitating its management by the manufacturer. The complexity of the decisional servitization process impacted by the ecosystem dynamics may discourage the decision makers, because of too many risks to consider. Thereby this research work introduces a perspective of servitization process diagnosis for manufacturing companies. The objective is to emphasize and explain decision-making process potential failures and inconsistencies in order to avoid managerial risks.

References

1. Baines T, Lightfoot H, Peppard J, Johnson M, Tiwari A, Shehab E, et al. Towards an operations strategy for product-centric servitization. International Journal of Operations & Production Management. 2009 05;29(5):4.
2. Gebauer H, Kowalkowski C. Customer-focused and service-focused orientation in organizational structures. Journal of Business & Industrial Marketing. 2012 11;27(7):527-37.
3. Moore JF. Predators and prey: A new ecology of competition. Harvard Business Review. 1993 May;71(3):75-86.
4. Xing K, Ness D, Lin F. A service innovation model for synergistic community transformation: Integrated application of systems theory and product-service systems. J Clean Prod. 2013 3;43(0):93-102.
5. Tukker A, Tischner U. Product-services as a research field: Past, present and future. reflections from a decade of research. J Clean Prod. 2006 08;14(17):1552-6.
6. Vandermerwe S, Rada J. Servitization of business: Adding value by adding services. European Management Journal. 1988 0;6(4):314-24.
7. Oliva R, Kallenberg R. Managing the transition from products to services. International Journal of Service Industry Management. 2003 04;14(2):160-72.
8. Dahmani S, Boucher X, Besombes B, Peillon S. La trajectoire décisionnelle de servicisation: Proposition d'un cadre de modélisation décisionnelle. Congrès International de Génie Industriel (CIGI) 12-14 June 2013 la Rochelle
9. Doumeingts G, Ducq Y, Vallespir B, Kleinhans S. Production management and enterprise modelling. Comput Ind. 2000 07;42(2-3):245-63.
10. James Williamson P, De Meyer A. Ecosystem advantage: How to successfully harness the power of partners. Calif Manage Rev. 2012 Fall2012;55(1):24-46.

11. Moingeon B, Lehmann-Ortega L. Genèse et déploiement d'un nouveau business model : L'étude d'un cas désarmant. (french). M@n@gement. 2010 10;13(4):266-97.