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To cite this version:

Marco Taisch, Mohammadreza Heydari Alamdari, Christiano Zanetti. Manufacturing Service Innovation Ecosystem. 19th Advances in Production Management Systems (APMS), Sep 2012, Rhodes, Greece. pp.321-328, 10.1007/978-3-642-40361-3_41 . hal-01470637

HAL Id: hal-01470637

https://inria.hal.science/hal-01470637

Submitted on 17 Feb 2017

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Manufacturing Service Innovation Ecosystem

Marco Taisch[1], Mohammadreza Heydari Alamdari[1], Christiano Zanetti[1]

[1]Politecnico di Milano, Piazza Leonardo Da Vinci 32, 20133, Milan, Italy
{marco.taisch,mohammadreza.heydari,cristiano.zanetti}@polimi.it

Abstract. Due to the increasing global commercial competition, the current economic crisis and globalization, enterprises would like to shift from a pure product sales structure towards after-sales services and related activities. It is noteworthy that "profit generated by after-sale service is often higher than the one obtained with sales; the service market can be four or five times larger than the market for products" [1].
The purpose of this paper is to lay down the foundations for a governance framework, by using the models and methods which can support various levels of performance indicators in service, servitization, governance and innovation. The basic idea behind of a governance framework is to create a trust relationship between seller and buyer for covering the customer requirements.

Keywords. Key Performance Indicator, Servitization and ecosystem governance.

1 Introduction

Manufacturing companies which want to support the service life cycle need to improve the service structure by using complementary pillars like collaborative innovation, IT interaction and internet business infrastructure to characterize new service ecosystem. "Most important aim of this ecosystem is enabling companies to self-organize in distributed, autonomous, interoperable, non-hierarchical innovation ecosystem in tangible and intangible manufacturing assets" [2].
This paper introduces two main classes of scenarios, which are useful to reach the above-mentioned ecosystem features:

1- The Product2Service scenario, based on manufacturing of goods and selling of service, emphasize on selling long-life service instead of one-shot physical goods sale. This model helps to beat the low-wages countries competition by using intangible values like reliability, accuracy, innovation and social responsibility.
2- The product+service scenario is less radical, in principle, as manufacturers foresee the simultaneous offering of physical products and extended tailored service. In this case, both physical products and services contribute to the revenues; their balance needs to be adaptively determined and continuous innovation of service is key competitive advantages [2].

The new service ecosystem needs a governance framework to evaluate and defining performance measurements and service level, so to create a trust relationship among

seller and buyer, and support customer requirements and priorities. This paper stressed out on creating a set of Key Performance Indicators (KPI) and Service Level Agreement (SLA) for monitoring and controlling the procedures.

A Performance Indicator (PI) is a quantified data which measured the efficiency of decision variables in the achievement of objectives defined at a considered decision level and in coherence with the defined business strategy [3]. Meanwhile, a Service Level Agreement (SLA) is a technical contract between seller and buyer which is clarified service provider's duties and roles by setting boundaries, conditions, penalties and expectations. SLA sets a clear customer relationship and bridge a gap between user and service provider [4]. Service performance assessment and governance specifically addressed the KPIs and SLAs to the below mentioned levels:

1. Service as such;
2. Servitization process;
3. Ecosystem governance;
4. Innovation in ecosystem.

Refer to above mentioned levels, KPIs will be evaluated in Model Driven Service Engineering Architecture (MDSEA) method and its decomposition levels (BSM-TIM-TSM) which will be later explained, to assure that performance indicators have been properly identified through the organization [5]. In order to accomplish Servitization process, InnoScore model will be preferred to using for servitization assessment. InnoScore model is on the basis of the innovation capability.
Likewise, the term of Unified Governance Framework (UGF) will be intended to support Ecosystem governance, with a focus on how IT-related components can help the governance. It can be stated that ECOGRAI method [6] has been selected after evaluating some of the popular methods and tools to govern frameworks through performance indicators, essentially because ECOGRAI is based on recursive decision making process. This model is designed to aim at business control and development. And finally related KPIs classified by VRM (Value Reference Model) which provides pre-defined measurable indicators for value chain goals in several dimensions.
Consistent with our results classified KPIs will be tested in real condition for evaluating effectiveness at end-users pilot. As shown in the figure below, the relevant interaction among different modules have been highlighted for KPIs generation and management.

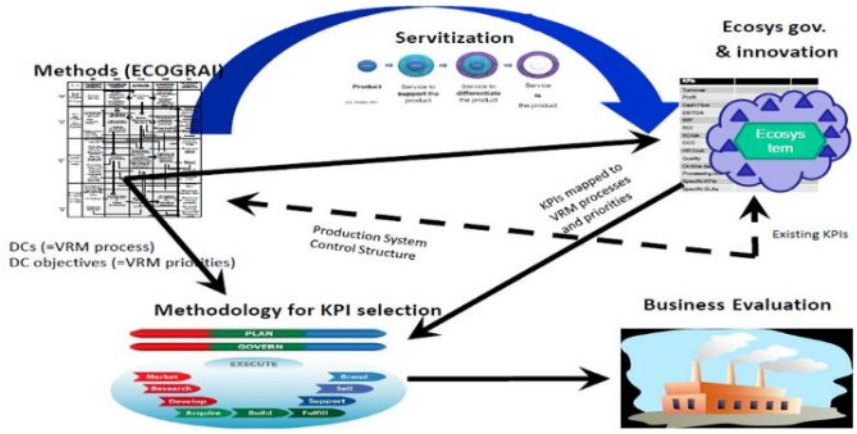

Fig. 1. KPI management method

The highlighted process in the above figure is started by designing and implementing the performance indicators by ECOGRAI model, this model generates performance indicator system (PIS) for industrial and service organizations. The basic idea behind ECOGRAI selection is that this model is based on decision making, furthermore this model is established by two main steps: design and implementation, in order to a coherent set of specification sheets explaining each Performance Indicators by design step then implementation step operating the PIS by business intelligence tools. The Whole of the mentioned process is done in six phases.

Once the KPIs have been defined by ECOGRAI, VRM model is used to classify specific KPIs to define, to prioritize and assess the PIs which are needed to govern every process. In addition, keeping in mind that servitization process specifically addressed the product shift to service by monitoring this transition. Furthermore classified KPIs should be used to monitor the service ecosystem both at design and run time; consequently, specific type of KPIs must be designed to cover the various stages of ecosystem.

Finally, the KPIs which are designed by ECOGRAI method and listed by VRM model should be tested in a real situation by End users for monitoring and evaluating the effectiveness. As shown on the figure 1, and refer to above mentioned illustration relevant stream of this literature mainly rooted on definition of sets and methods to manage the KPIs related to the service ecosystem.

2 Definition of PIs and KPIs and existing situation in companies

This paper stressed out on creating a set of Key Performance Indicators (KPI) for monitoring and controlling the procedures. Refer to the performance indicator definition which was mentioned in previous pages, there are several kinds of PIs that can be defined. The first kind is the PIs for results. These measure directly the achievement of objectives. Let's consider for an instance a total amount of turn over raised by service against overall organization revenue. The second kind is the progress PIs. These are measuring a progress in the achievement of the objective. For

example: total number of service occurrences per month and average service value vs. organization monthly objectives. So, these two types of PI's are complementary [7].

The second typology of PIs concerns the three steps of monitoring: (1) measuring the performance of a part of the system at the daily routine works which is called operational PIs, (2) tactical PIs used for measuring the middle term of current system operations (3) finally, strategic PIs used for measuring the performance of the whole controlled system.

3 KPIs and SLAs for service oriented production system

By defining the framework for service ecosystem modeling around three abstraction level which will be defined in later paragraphs, and in order to accomplish this framework a description of KPIs for service presented: Business Service Modeling (BSM), Technology Independent Modeling (TIM), Technology Specific Modeling (TSM) level is important thus giving the foundations to governance of the performance indicators within the ecosystem. In here below, brief definition of mentioned levels are considerable:

- Business Service Modeling (BSM), which specifies the models, at the global level, describing the running of the enterprise or set of enterprises as well as the links between these enterprises.
- Technology Independent Modeling (TIM), which is the model at a second level of abstraction independent from the technology used to implement the system.
- Technology Specific Modeling (TSM) that combines the specification in the TIM model with details that specify how the system uses a particular type of technology (such as, for example, IT platform, Machine technology organization structure or human profile).

So, based on the previous decomposition (BSM, TIM & TSM) it is necessary to ensure that at each level of decomposition, performance evaluation is possible. In order to verify the achievement of objectives and the use of action means or interoperable solutions. The framework of the performance indicators is shown in figure 2.

The proposed MDSEA framework defines KPIs for the service ecosystem governance then is analyzed in terms of implementation and monitoring. So, by focusing on KPIs definition in detail, it is defined related to the three kinds of components: IT, Organization and human resources. The criteria of these performance indicators will be related to traditional performances such as cost, quality, lead time, efficiency or other kinds of performances such as interoperability, flexibility, environment, etc.

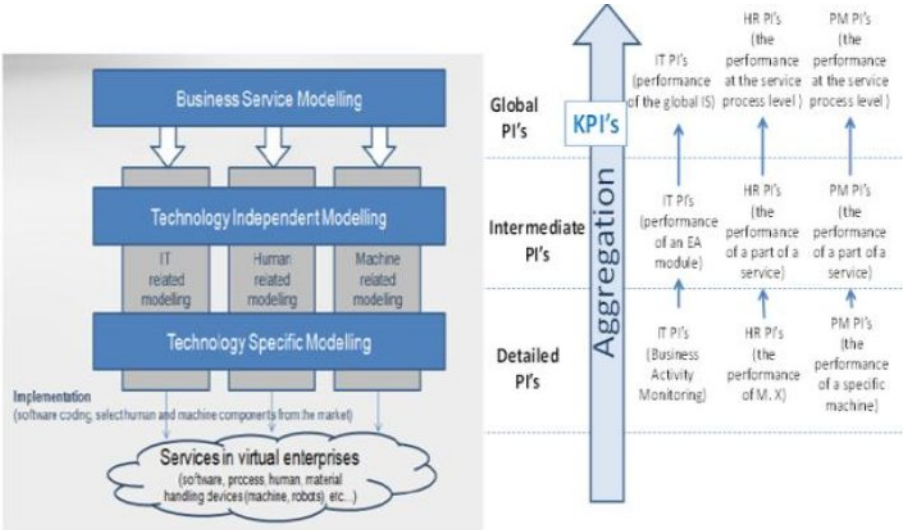

Fig. 2. Performance Indicator in the frame of MDSEA

4 KPIs and SLAs for servitization

"There is clear evidence that manufacturing firms are servitizing–either adding services to or integrating services in their core products" [8]. This concept clearly shown in figure 3, where servitiziation level goes from "tangible product" as lowest level to "product as a service" as highest level. In particularly:

- First level: the servitization process starts by adding a simple service to the product and the evolution shift from pure product toward Product+Service.
- Second level: it is an evolution of the previous one. The service is more elaborated and increases the differentiation.
- Third level: physical goods remain the property of the manufacturer and are considered as investment, while revenues come uniquely from the services.

Manufacturing companies need to evaluate their current level of servitization and then, recognize the requirements for moving to the upper level. Change management practices are needed to implement promoting the process.

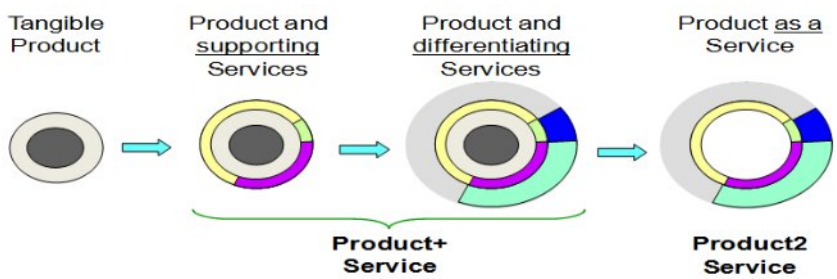

Fig. 3. Different level of servitization [9]

Servitization assessment

Several methods and frameworks were developed for evaluating the innovation capability in service. All selected methods like: IMP^{3}rove, DIUS and InnoScore have their own pros and cons, and it is quite difficult to say which one is the best ; nevertheless, in this paper we choose InnoScore-model which is oriented on the frequently used and accepted EFQM model [10]. With linking the consulting methods of the "InnoAudits" [11] and the innovation model of the Fraunhofer – Institute for Industrial Engineering and Organization it is developed a self-assessment tool.

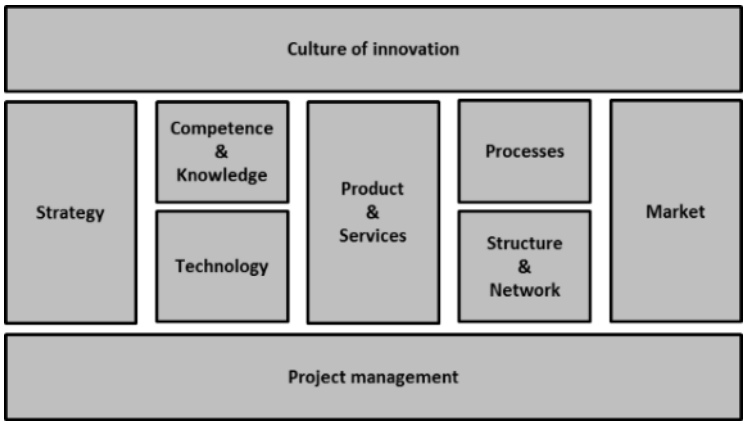

Fig. 4. The nine areas of InnoScore [12]

InnoScore method is implemented as a web based benchmarking platform [13], and made by nine different area where create the Meta-Model to measure and assess the innovation capability. These areas are shown on the above figure.

5 KPIs and SLAs for service governance

A good starting point for elaborating service governance can be borrowed from monitoring efficiency and effectiveness of each service activities like customer service satisfaction, flexibility, service performance and customer satisfaction toward the network. Governance is a generic topic and able to support all the aspects of service activities from environment level as primary stage till external events as extremity stage; nevertheless, for making a coherent monitoring which can covered all relevant activities of service, we need to define Unified Governance Framework (UGF) to support the entire space of enterprise governance. The main parts of UGF are a component model which is formed by grouping of relevant functions and capabilities into components, this model communicate over relatively well-defined interface [14]. The core of UGF is the highest-level components and clearly shown in figure below.

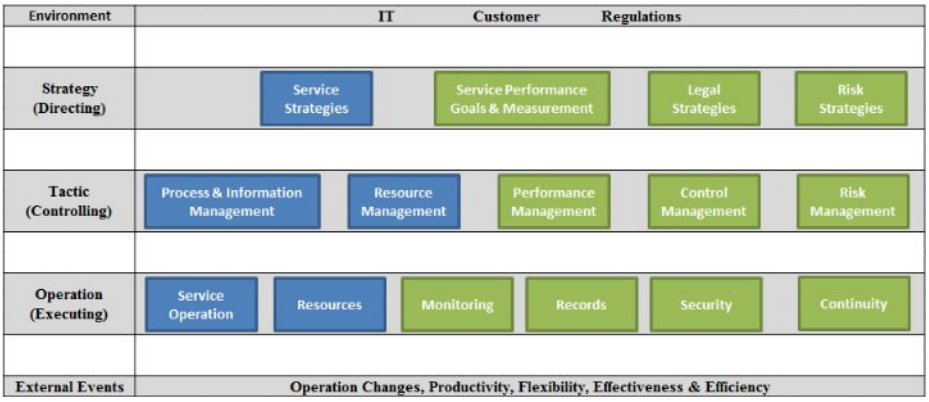

Fig. 5. UGF component model

The basic idea behind UGF is focusing on enterprise governance, like clarifying and describing governance components more deeply than the rest of the enterprise. In the figure 5, the normal enterprise capabilities are summarized in strategy layer. On the contrary in the tactical layer, the normal enterprise capabilities are defined in terms of process and information management and resource management. Finally the normal enterprise capabilities are evaluated in a similar way at operation layer.

As a summary, if we focus on dynamic UGF view, a combination of a top-down measuring model and bottom-up KPIs analysis will be necessary to manage service within the ecosystem.

6 KPIs and SLAs for Innovation ecosystem

In the previous chapters different perspective on KPIs and SLAs in Service ecosystem were described. But in this chapter we focused on specific performance indicators that can be used to describe and assess innovation process in service ecosystem. Indeed at first step innovative PIs should follow the criteria which are generated by ECOGRAI method for designing and implementing the PIs and then VRM model classify and list the PIs to use them in real situation for testing by end users. There is broad range of approaches to classify indicators which are related to innovation; on the other hand, the common elements of these approaches can be presented like: PIs based on condition, output, input and interaction.

Meanwhile, in the VRM model innovation is only process beside various other processes and there is only a very limited set of indicators that are more related to the output than to the process.

7 Conclusion

Finally, this paper tries to provide assessment for creating comprehensive KPIs and SLAs to measure actors' performances in various stages by following the mentioned methods. These methods including (1) ECOGRAI model which is established to design and implement KPIs (2) VRM method defined to classify the KPIs refer to service ecosystem (3) the InnoScore method used for servitization assessment (4)

UGF framework for monitoring service activities. This evaluation creates conditions to have disclosure and sharing resource within an enterprise network, creating trust among actors and exchanges based on the value added into the different processes and enterprises.

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