The Value and Management Practices of Installed Base Information in Product-Service Systems

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Abstract. Increasing competitive pressures have pushed manufacturers to increase the value of their offerings through the provision of Product-service systems. This shift results in an increased complexity of offerings and a higher degree of risk and responsibility taken by manufacturers concerning product availability, performance and product-enabled processes.
The paper investigates the impact and potential benefits of installed base information management practices on the offering of Product-Service Systems. A case study concerning an underwater system in a cruise vessel is presented: the data collected were used to develop a simple decision analysis tree, which allows to estimate the value of installed base information in the studied case.

Keywords: Product-Service System, installed base information management, decision analysis method.

1 Introduction

1.1 Context and definition

In the last decades, growing competitive pressures and increased customer expectations have pushed western manufacturers to extend their offerings through the provision of value-adding services to their customers [1]. Operations management scholars have delineated three main rationales for this shift. First, manufacturers can gain a stable stream of revenue by providing services for their installed base [2]. Second, manufacturers can achieve a sustainable competitive advantage providing advanced services that aim to support their customers and product's enabled processes [3]. Third, customers are demanding more services and opportunities to reduce operational risks [3, 4]. The term Product-Service System describes the ever increasing integration be-

tween products and services and the shift from value in exchange to value in use [5].
However, evidence from research and business practice suggests that the transition toward the provision of PSS implies challenges that could neutralize the opportunities given by service offerings and even reduce firms' profitability and value [4, 6–10]. In this challenging context, the adoption of procedures and technologies aimed to collect, organize and exploit the information related to the installed based and the usage of products and services by the customers can act as enablers and means to overcome or mitigate the increasing risks for manufacturers [1, 2, 4, 9, 11, 12].

1.2 Objective

The study has two main objectives. The first one is to investigate how installed base information management (IBIM) practices impact on PSS delivery processes, while the second one is to quantify the value of installed base information (IBI) from the perspective of a customer. A survey has been conducted to gain an understanding on how the offering of different PSS types is linked with the typologies of data collected from the installed base, the collection methodologies and information systems. In order to achieve the second objective, a pilot case study was conducted through semi-structured interviews with a company using an underwater system in a cruise vessel.

2 Background

2.1 Literature review

Strategic aspects of servitization vs. IBIM
Ala-Risku defines "installed base" as *a collective noun for currently used individual products sold or serviced by the focal firm* [13]. This definition is most suited for our purposes than others found in literature – e.g. [2] for whom installed base is just a cumulative equivalent of market share – since it suggests that *every single product* sold and serviced by the firm can be a valuable source of information. In this study, we also define installed base information (IBI) as *all technical and commercial data related to installed base and needed for operation or optimization of industrial services*. Examples of IBI include as-maintained structure of a product individual, its usage, maintenance activities and the customer process the piece of equipment is located in.

Installed base information management (IBIM), instead, *represents the set of practices that companies adopt to collect, analyze, use and share data concerning installed products and their utilization*. For instance, the Rolls-Royce case, with its "Power by the hour" blueprint, provides an example of how the collection and analysis of IBI enables the provision of PSS and also the transition towards a new business model that meet customer needs [4, 10, 14]. In fact, Rolls-Royce has changed its business model from transactional to relational and delivers value in use instead of value in exchange. Thanks to the adoption of installed base information systems such as real-time remote monitoring technologies, Rolls-Royce has mitigated the increased operational risks that such a business model implies for the manufacturer.

The potential of IBIM for the provision of PSS has been recently addressed by [9] who claims that IBI collection systems and data analysis methods are to be considered respectively as fundamental resources and capabilities for manufacturers in order to successfully offering innovative solutions characterized by a strong relationship between products and services.

Impact of IBIM on service processes (service provider perspective)

Despite these multiple evidence and practitioners growing interest in the management of information generated during products' lifecycle [15], a preliminary literature analysis unveils the lack of a comprehensive approach in studying the IBIM phenomenon [13], since several studies focus on technological aspects rather than managerial ones. Indeed, there is a paucity of studies investigating the relationship between IBIM practices and operations management activities related to the provision of PSS as well as investigating how IBIM enables the transition towards relationship-based business models. A few exceptions can be cited. [16] analyzes how the exploitation of IBI positively impacts on the spare parts forecasting and management performance. [10] focus on how product condition monitoring technologies such as Product Health Monitoring can facilitate the transition to service-based business models allowing manufacturers to handle increased risks.

This study is aimed to contribute in filling such a gap in the literature. One way to address the issue is to understand how making the benefits of IBIM tangible to customers can impact on the PSS offering and the overall business relationship between the PSS provider and its customers.

3 Methodology

3.1 Case study

We conducted an explorative and descriptive case study [17] on a remote monitoring service provider and a cruise line company. The interviews were recorded and transcribed for analysis. Access to the cruise line company was through the service provider and we interviewed operations manager at the customer. Where feasible, data were double-checked from other informants of the service provider. At the end, all data was validated by presenting it to the service provider business development management.
Data collected have been the input to estimate the value of IBI, assessed through the decision analysis method [18]. The method is based on statistical and probabilistic mathematics and utilizes a decision tree to illustrate available decision options and monetary rewards and losses connected to each option. When comparing each option, *expected monetary value (EMV)* is computed multiplying the payoff (monetary return) of an option by its probability.

3.2 Survey

An exploratory survey has been conducted using on-line questionnaire on a sample of medium and large companies that operate in Italy, about their IBIM practices. Respondents (29) are mainly service managers, CEOs or technical managers. The questionnaire, developed from the analysis of literature, has been structured as follows:

- A first set of questions aims to evaluate firms maturity in terms of PSS provision and concerns firms' perception of the importance of competitive factors (price of the offering, innovation of the offering, personalization of the offering, during-the-sale services, after-sale services and the total cost of ownership), percentage of turnover gained from services, composition of the service portfolio and accounting nature of the service business unit.
- A second set of questions aims to delineate installed base information management practices in terms of typologies of data that are collected from the installed base. Considered typologies are resource consumption, product functioning parameters, product use configuration, level of utilization of the product, product geographical positioning, customer satisfaction about the product and technical assistance, history of maintenance activities. The se-

cond question of this set deals with data collection methods (e.g. collection on paper, manual insertion in information system or automated). Once collected, data can be handled and managed using different information system such as custom database solutions, ERP (Enterprise Resource Planning), CRM (Costumer Relationship Management), PLM (Product Lifecycle Management) or PDM (Product Data Management).

- A third set of questions investigates both the benefits from IBIM practices as well as the obstacles to its adoption.

4 Findings

4.1 Quantifying value of installed base information

A recurrent theme across companies is: *how to quantify value of IBI?* The case company wanted to quantify the value of IBI in order to answer two major questions. First, how much a service provider should invest in IBI collection, management and related IT tools? In practice, the value could be used in investment calculations of IT tools and the justification would come from increased internal process efficiency, or better maintenance scheduling, for example. Second, how to communicate the value of IBI to customers e.g. to support the sales of remote monitoring-type of services? Remote monitoring data may indicate in advance if some major problem is developing, and corresponding corrective activities can be performed during planned dry dockings, instead of leading to unplanned dry-dockings. The cost of an unplanned dry-docking to the cruise line customer usually ranges between $1 to 3 million, but can be as high as $7 million. The analyzed customer had 29 unplanned dry-dockings in 10 years with 4 vessels. Based on this data, the probability of a vessel to have an unplanned dry docking during a one-year period is (29/10)/4= 0.725.

In Fig. 1, a decision tree allows to compare two options for potential customers of remote monitoring services. In the upper branch, the customer purchases a vessel without remote monitoring leading to an annual dry docking probability of 0.725, each dry docking bearing a cost of $2 million (an average of the observed 1 to 3 million $). In the lower remote monitoring branch, annual estimated price of remote monitoring services $ 300 000 is counted in first. Then the original dry-docking probability of 0,725 is reduced due to remote monitoring capability of detecting 80% of developing faults in advance. The

figure of 80% is not the actual detection capability of the remote monitoring, but an illustrative number to demonstrate the use of the method.

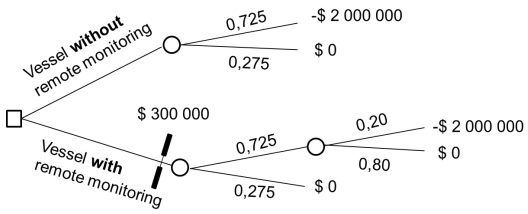

Fig. 1. Decision tree of purchasing a vessel with or without remote monitoring service.

Following the final cost of each branch and its probability, resulting expected monetary value of each option yields:

$EMV_{without}$=*0,725 * (-$ 2 000 000) + 0,275 * ($0) = -$1 450 000*
EMV_{with}= *0,725 * 0,20 * (-$ 2 000 000) + 0,725* 0,80 * ($0) - $300 000 = -$590 000*

With these parameters, the annual added value of the information gained by remote monitoring is the difference $1 450 000 - $590 000 = $860 000.

4.2 Preliminary survey findings

The sample size does not allow to perform inferential analysis, however some interesting evidence about IBIM practices emerged from descriptive analysis. First, we found that in general after-sales services is considered the most important competitive factor. However, the companies that implement new service-led business models, such as the pay-per-use, consider the total cost of ownership as the most important factor.

The second finding relates to the research gap highlighted in the literature review. In fact, only 17% of respondents indicate the adoption of new service-led business model as a "benefit" of IBIM. Such firms collect higher range and volume of data from products (e.g. geographical position, work hours, number of working cycles, typology of activities, functioning parameters such as vibration or temperature and resources consumption).

The third finding concerns information collection methods and systems: automated systems are still scarcely diffused being adopted by 2 out of 29 respondent. While several firms that implement traditional business models are still collecting data using paper, all the firms that implement service-led busi-

ness model have adopted information systems to support the data collection. Most respondents (69% of the sample), instead, rely on ad hoc solutions such as spreadsheets or in-house developed databases. Information systems as ERP, CRM and PLM have lower adoption rates, 41% for both ERP and CRM and only 7% for PLM. However, firms that implement service-led business models declare doubled CRM and ERP adoption rates and a three times higher PLM adoption rate in comparison to company that implement traditional business models (60% against 37% for ERP and CRM, and 20% against 4% for PLM).

5 Conclusions

This paper presents the preliminary results of an ongoing empirical research that aims to understand the role and impact of IBIM practices as a driver in the transition towards PSS offerings. Although at this stage no definitive conclusion can be drawn from this study, the main points emerging are the following:

i.) the role of IBIM as an enabler in the transition from product to services is still under-investigated in the literature from a business strategy perspective, but also in term of value for the customer it can generate, or in the way it can influence service delivery processes;

ii.) the survey findings suggest that IBIM can be an enabler in the transition towards service-based business models, or at least that companies that implement service-based business models rely (also) on IBIM practices supporting the development and provision of their offerings;

iii.) IBIM is not relevant only for the company delivering the PSS, but rather it can increase the value of the PSS for its customers. Quantifying (with simple enough but robust methods such as decision analysis applied in the case study) the value the customer can gain from IBIM makes tangible the impact of PSS, and supports communication of the new business models towards customers.

6 Acknowledgments

The research presented in this paper stems from the activity of the ASAP Service Management Forum (www.asapsmf.org), a research and dissemination initiative involving researchers from five Italian universities and several com-

panies, about product-service systems, servitization of manufacturing and service management. The authors also wish to thank researchers in the Future Industrial Services (FutIS) research program in Finland for collecting data for the case study.

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