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Installed base information management with industrial service operations

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Abstract

Industrial services have been recognized as a lucrative source of revenue, and many capital goods manufacturers are increasingly getting involved with the aftermarket in their industry. The manufacturers typically have distinct support systems for their customer relationship management, equipment deliveries, service operations, and product development. Each of these systems includes valuable business information to support their service business. However, the limited interaction between these tools, in particular the service support systems that are used in the local service units, prevents the organizations from forming a comprehensive view on their installed base, the target of their service operations.

This paper presents results from an in-depth case study performed at a capital goods manufacturer with global service operations. The paper discusses operational benefits in service processes that result from creating installed base visibility by connecting the diverse support systems. The results draw attention to the value of service operations not only as a source of revenue, but also as a source of business intelligence.

Keywords: installed base management, industrial services, information management, business intelligence.

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Introduction

Many manufacturing companies have been interested in seeking additional revenues by offering after-sales services to their customers (Wise and Baumgartner, 1999). Three reasons can be identified for this shift of enterprise rationale (Oliva and Kallenberg, 2003): First, substantial and more stable revenue can be generated from an installed base of products with a long life cycle (Knecht et al., 1993; Hull and Cox, 1994; Goffin, 1999, Wise and Baumgartner, 1999). In mature capital goods industries, the combination of stagnant product demand and an expanding installed base has pushed economic value downstream. Second, the customers for capital goods are demanding more in services when concentrating on their core competences and seeking cost savings possibilities (Prahalad and Hamel, 1994; Parasuraman, 1999). Third, services can be a sustainable source of competitive advantage (Hull and Cox, 1994; Matthyssens and Vandenbemt, 1998; Goffin, 1999; Parasuraman, 1999, Youngdahl and Loomba, 2000, Oliva and Kallenberg, 2003).

When providing physical value-added services, such as equipment maintenance or upgrades, the capital goods manufacturers are confronted with a distributed production environment that differs from the centralized production environment with their goods manufacture, as these services most often require operations at the customer's site (Auramo and Ala-Risku, 2005). Another notable difference arises from the customer involvement in the production of services, in the form of necessary customer inputs prior to and during the service production activities (Sampson and Froehle, 2006). These two characteristics create two specific challenges in the service production process: 1) Instead of a central materials and personnel skills pool for the production in a production facility, there needs to be a more diverse procurement and distribution structure for materials and personnel that ensures the service production capacity at all local service units (Auramo and Ala-Risku, 2005). The particular skill and material requirements for each unit depend on the customer equipment, i.e. the installed base that is the responsibility of the unit. 2) Efficient production of a single service delivery requires that correctly skilled personnel as well as correct materials, tools and documentation are available at the location of the service production at a customer site. Ensuring that these preconditions will be met requires accurate information on the characteristics of the equipment, i.e. a single instance in the installed base that is the target of the service delivery being handled (Lehtonen and Ala-Risku, 2005).

Both efficient capacity planning for industrial services and efficient production of the services thus require information on the installed base. What this information is, and how it can be utilized has not been investigated comprehensively, although disparate applications have been developed. This paper attempts to develop an integrated view on installed base management for industrial services based on results from an in-depth case study performed at a capital goods manufacturer with global service operations. The following chapters give literature background for the concepts used in the analysis of the studied case, and present the research design used in the case study. Then, the operational benefits in service processes that result from creating installed base visibility are presented. Finally, the paper is concluded with discussion on the results in a broader context.

Background

Sampson and Froehle (2006) argue in their recent article that, independent of service type, all services share the common dependence of customer input. They classify the customer inputs into three main types: (i) Customer-self inputs, (ii) Tangible belongings or property of the customer, and (iii) Customer-provided information. Of these categories, the most relevant customer input type for industrial services are the tangible belongings of the customer and the customer-provided information: The tangible belongings (i.e. capital goods, equipment) are the necessary target for performing industrial services, while the equipment related and customer-provided information influences the execution of the service delivery.

Another important point that Sampson and Froehle make in their article relates closely to the service delivery process. Since the customer has to provide inputs to the service process, the customer may be viewed as a supplier to the service provider. However, compared to other suppliers' inputs, managing the quality of customer supplied inputs is a difficult task as the bargaining power of the provider is much lower with their customer-suppliers than with their other suppliers (Sampson and Froehle, 2006). The implications of this view are twofold for the service delivery process: Either, service operations need to be robust enough to handle the stochastic nature of customer-supplied inputs, or, customer-supplied inputs need to be controlled to minimize their variation.

Robust service operations can be created with effective resource planning and support processes for the service organization to have the capability to take care of a variety of different service tasks with minimum preparation time (Auramo and Ala-Risku, 2005). Controlling the customer-supplied inputs can be achieved by managing information on the installed base of the capital goods that are serviced, so as to reduce the reliance on uncertain customer-supplied information. (Lehtonen and Ala-Risku, 2005)

For the purposes of analyzing the operations in industrial services, a typical service delivery process can be described by the following sequence of tasks: handling the service request, preparing for the service operations, accessing the equipment, diagnosing the status of the equipment, performing the service operations, testing the system, and reporting (Lehtonen and Ala-Risku, 2005; Knotts, 1999).

Diverse support systems have been developed to assist the individual tasks of the service process: the incoming customer service requests are channeled through service call centers (e.g. Albright, 2000; Pintelon et al., 1999), or even better automated with remote condition monitoring systems (e.g. Liedman, 1998; Knezevic, 1999; Kantor, 2004; Kozak and Shinpaugh, 2005). Further, to increase the service process responsiveness, there has been development of automated routing solutions (e.g. Blakeley et al., 2003; Hamblen, 2005; Townsend and Widener, 2004), as well as tools that based on a knowledge base suggest probable failure reasons (e.g. Ives and Vitale, 1988; Albright, 2000; Marsh and Finch, 1998; Zachariasson and Wilson, 2004). Finally, Albright (2000) and Hamblen

(2005) stress that by using wireless computers to create the service reports on-site it is possible to increase the reporting accuracy and make the payment cycle start immediately.

However, a holistic view on the information needed for a single service delivery and the processes required to operate all the support systems is missing. In particular, each phase in the service delivery process requires some information from the customer or related to the customer's equipment. To identify the requirements for making this information support the service operations we pose the following research problem: What installed base information is needed to support industrial service deliveries?

Research design

In order to address the research problem, we designed a case study with a capital goods manufacturer operating a global service network. The service operations of the company are based on a number of local service units that are supported by a global organization in the form of spare-parts distribution and technical support. The industrial service processes we focused on during the study were maintenance, repair, and upgrade services, as well as service patch deliveries. At the time of the case study, the company was improving their installed base management system to reach global consistency of diverse local systems.

The main research method used in the case study was thematic interviews with a total of twelve representatives from the global support organization and one local service unit. The interviews were semi-structured with the goal to identify the specific information needs and the operative or planning uses for those pieces of information in each functional unit. The functional units in addition to the local service unit were spare-parts distribution, personnel planning, route planning, quality control, service patch development and upgrade development.

Additionally, service report data from local service units was reviewed to identify the level of detail feasible for gathering installed base data through the service operations themselves.

Research results

The research results for the installed base information needs to support the service delivery process are summarized in Figure 1. The service process phases are illustrated with the row of pentagon shapes. Above the process row are descriptions of installed base information on the specific target equipment related to each of the service process phases. Below the process row are listed the most important support functions used in the process phases that utilize information on the installed base. Finally, below each support function, the installed base data and service record data that the function relies on are described.

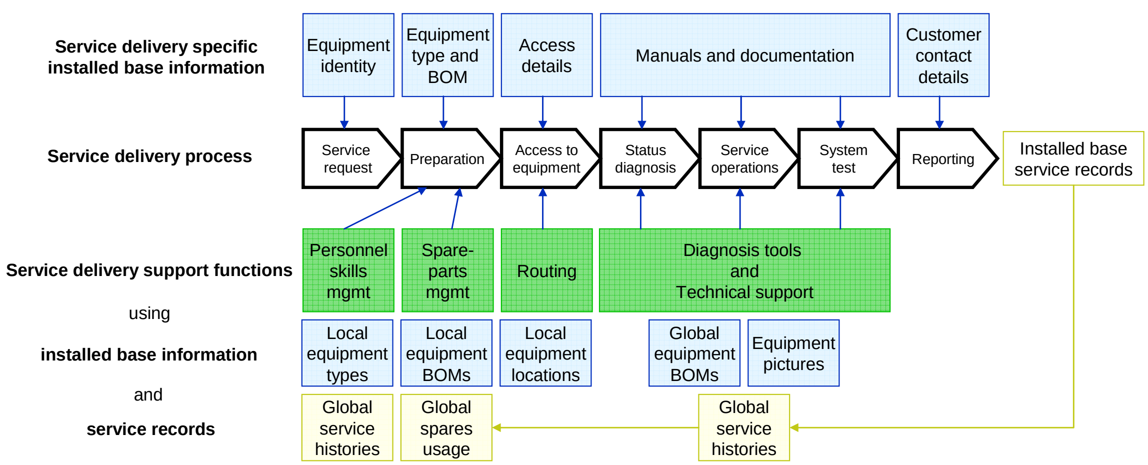

Figure 1 Installed base information and the service delivery process

The following sections will discuss the mechanisms for the use of installed base information in each of the process phases.

Service request

A service request for a local unit in the case company organization typically originates from one of three main sources: 1) a customer call (request for repair), 2) the maintenance program for the equipment (request for a scheduled maintenance visit, request for repair based on remote condition monitoring), or 3) a service patch rollout from the global organization (request for repairing a known defect in the equipment)

Independent of service request source the involved equipment needs to be identified in order to correctly negotiate the request contents and priority (i.e. reflect to service level agreements) and to correctly communicate the request to the queue for preparation of the execution unit. The efficiencies of subsequent phases strongly depend on the correct identification of the targeted equipment.

Although the bulk of service requests arise from maintenance programs where the identification is straightforward as the programs are equipment specific, an installed base system identifying pieces of equipment in a uniform manner would help in the accuracy and efficiency of handling the other types of service request. With customer calls there is a challenge to match the description of the customer with the correct equipment identity as the input provided by the customer may not be unambiguous. Having equipment owner and location data enables short listing the equipment for speeding up the identification. With service patch rollouts the challenge is with the distributed service delivery environment: how to identify globally all equipment containing the patched defect and communicate the lists of involved equipment to each local unit. Thus, each piece of equipment should be uniquely identifiable in the global installed base.

Preparation

In the preparation phase personnel and material resources are allocated for the service request. To ensure the allocation of correctly skilled personnel for the request, some relevant characteristics of the service target have to be known. In the studied case, the equipment manufacturer, equipment age, equipment type code, and the technologies used in three main components were considered to be sufficient to allocate the service request to a capable service technician. Although the equipment is property of the customer and resides at the customer's facility, this is information that the customer is not capable of providing reliably. Therefore, the service units have to gather this information to reduce reliance on the customer input.

Identification of all potential spare-parts needed during the service visit would require a full and up-to-date bill-of-materials listing for the equipment concerned. Due to the vast number of equipment in the installed base and the variety of types and ages make maintaining comprehensive BOMs for all equipment unfeasible. This is a result from the distributed service production environment: it is very costly to analyze all equipment details at customer sites. A compromise between cost and utility for describing the equipment was deemed to be the type codes of a dozen main components, in addition to the details listed for skill management above. This information enables the service technician to verify with sufficient certainty that spare-parts for the target equipment are available in the spare-part inventory in his service vehicle.

In addition to the service request specific details on the installed base equipment, the functions supporting the preparation phase benefit notably from having the ability to analyze local installed base details. This is especially useful in situations where the installed base serviced by the local unit changes due to changes in service agreements with customers. As the installed base changes, the service capacity of the local unit needs to be adjusted accordingly: having correctly trained personnel in proportion to the serviced equipment types, and ensuring correct spare-part inventories accounting for new equipment types. With a global installed base management system, basic information on equipment entering a service units responsibility area might be available by analyzing records made by other service units (such as spare-part and skill needs based on equipment type). This installed base data could be used to support the data gathered with the audits of the new equipment.

In planning for the local unit service resources, a global installed base management system with details on historical service records would enable the consolidation and transfer of experiences across different service units: for example, the behavior of failure rates and spare-part use as a function of time for each equipment type or component type could be analyzed. These analyses could then be used to forecast the personnel resource needs and spare-part consumptions for each local service unit based on the equipment type and age distributions in their respective local installed bases. From the spare-parts distribution viewpoint the sought-for bills-of-material for all different equipment types could be statistically approached with service record analyses, and fine-tuned by increasing detail in the description of the serviced component.

One specific use for such analyses in the global spare-part distribution network would be the identification of obsolete spare-part items. Making scrapping decisions based only on consumption figures is risky, as the demand for slowest moving spare-parts is sporadic at best, and there may be periods of several years when there are no requests for an item. Maintaining inventories to be able to deliver all possible items is costly, especially as the total number spare-part items is in the order of hundreds of thousands for the company. However, if suddenly needed old spare-parts have been scrapped, the procurement of the parts can be even more costly, not to mention the influence on the customer service level due to the delay caused by the procurement process. Having a global installed base system in place would enable the assessment of the likelihood for future demand for a spare-part item prior to scrapping, and thus enable the reduction of spare-part safety stock without sacrificing customer service levels.

Access to equipment

Once the resource needs for the service request have been resolved, the request is scheduled to the work queue of the selected service technician. With non-time-critical requests, information on the physical location of the target equipment is used to add it to the task list in a logistically efficient slot accounting for the other service requests for the technician. There may also be equipment specific definitions on whom to contact at the customer site, and how, where and when to enter the customer site for the service operations.

With very time-critical emergency requests the equipment location information can be used as a criterion already when selecting the service technician: a closely positioned technician with suitable service skills may be the optimal choice to guarantee the customer service level.

For the routing used to schedule the service requests to operate effectively, there has to be a comprehensive list of equipment locations for the local serviced installed base.

Status diagnosis, service operations, and system test

The actual service production at the customer site consists of general phases of status diagnosis, service operations, and system test, the significance of each varying with the service delivery contents.

Assuming the preparation phase succeeded in securing the necessary materials to take care of the service operations, the service operations efficiency depends on the personal skills of the assigned technician. During the service visit the service technician may rely on four sources of information in addition to his own experience and knowledge: documentation and manuals residing at the customer site, documentation and manuals that he has either in physical form with him or to which he has electronic access with his laptop computer, diagnosis tools that connect with the equipment, and the technical support team of the case company.

An installed base management system can be used to improve these means to support the service technician. The system can provide equipment specific documentation in electronic form, thus reducing the reliance on customer provided information (documentation at site). A global installed base system with service records can be used to refine the diagnostic tools for identifying a wider number of possible root-causes for problem situations. And when contacting the technical support organization, the selection of a knowledgeable support technician can be eased with having correct information on equipment manufacturer and type. Further, the communication with the support technician can be alleviated with having pictures available from the site, either stored during site audits in the installed base system or provided with mobile solutions in real-time from the service technician at the site.

Reporting

The reporting phase has two immediate purposes: informing the customer that the equipment is once again operational, and starting the invoicing process. The former can be supported with the installed base management system by giving details on who to notify at the customer after the service operations are completed. The latter can be made more efficient with mobile solutions that use installed base data to compile a suitable report form with pre-completed fields.

A less emphasized purpose for the reporting phase is the gathering of service data on the installed base, both for further analyses and for updating the installed base information in cases of component changes. As discussed in accordance with the support functions for the service deliveries, analyzing masses of service records can be used for a variety of purposes to enhance the capabilities of the service organization. In addition to the already presented ones that relate to the service delivery process, a number of other business intelligence uses for service record analyses emerged during the case study interviews.

1) Equipment maintenance cost behavior to help with maintenance agreement pricing or identifying upgrading opportunities

2) Generating insights for new product development and new upgrade products

3) Extensive follow-up of new products at customer sites to reduce early problems in new designs

4) Extensive product reliability knowledge for product development and marketing purposes

The potential uses for analyzing service records on a global scale highlights the two distinct information types related to the installed base: information on the equipment characteristics and customer site that are needed prior to the service delivery, and the service records that are generated after the delivery. The former are important for efficient operations in the service delivery process. The latter are important for improving the support to the service delivery process and to generate other valuable business intelligence, when analyzed with regard to the equipment characteristics.

Discussion

The installed base information requirements identified during the case study are in line with capabilities of concurrent maintenance management systems with their asset management functionalities as discussed in the background section above. However, an additional viewpoint to such asset management data arises from the practical fact that globally operating companies may have several diverse applications in operation at their local subsidiaries, whereas the globally operated support processes would require uniform analyzability of the data across all local units. Thus, the gathering of information on a global scale for the support functions requires a definition of a minimum set of data that is necessary for starting integration efforts across the systems. This study identified the support functions and operative needs that need to be accounted for when integrating asset management and service recording practices in the context of one company. The service delivery process and the phase specific needs for installed base information were presented in this paper in an attempt to develop a generalized framework for analyzing installed base information in the service delivery context. A key enabler for the analyses is the ability to relate installed base data and service records to each individual piece of equipment in the global installed base.

From the viewpoint of the service delivery process, the uncertainty of customer input (Sampson and Froehle, 2006) can be reduced with reliable installed base data. With service requests originating with the customer, the request handling can be made more efficient and accurate with equipment location and owner information to help the organization identify the customer's equipment. Similarly, with the preparation, access and production phases the service organization can manage the necessary equipment related data to reduce reliance on customer's capability to provide critical information for the service delivery process.

The robustness of the service delivery process (i.e. the capability to respond to a large variety of service requests) can be increased with reliable service records and installed base data. Analyzing past service operations classified by the equipment type provides statistical insight into the variety of different service requests and their requirements for material and technician skills. These probability calculations can then be used to support the local service units with proper spare-part supply and service technician training according to their local installed base.

On the other hand, due to the distributed production environment of industrial services (Auramo and Ala-Risku, 2005), gathering high quality installed base data on the equipment and site requires dependable recording practices with new equipment deliveries, or else they need to be gathered with costly customer site audits. Nevertheless, well-structured site audits are needed with third party equipment in the installed base. And gathering high quality service records requires carefully defined service reporting practices and faithful adherence to those practices. Here, mobile solutions that both necessitate and ease the input of key items by the service technician will help improve the service reporting coverage and the service record quality. In the distributed production environment, mobile technology provides important connectivity between the production control back-end and the actual production operations.

The results of this study show that reporting the actual operations is in a much more relevant role with service operations than with manufacturing operations. Whereas in a product factory the details of the manufacturing operations (e.g. material requirements, production tasks involved) are laid down in the current product portfolio of the manufacturing unit and are known at the time of resource commitment, with service operations these are known only after-the-fact. This is a clear challenge for the planning functions, as they need to ensure having the capacity to perform tasks with customer input (service request contents and target equipment) that are not known in advance. The capacity planning processes therefore have to rely on available information on past operations and the installed base that give indication on the variance in resource needs, and the potential amount of each specific resource needed.

However, viewed the other way, in manufacturing operations past product deliveries are not necessarily indicative of future deliveries, due to market related changes such as introductions of substitute products by competitors. In contrast, past service deliveries can be used to statistically forecast future service deliveries, if the installed base can be accounted for.

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