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Standardization of Service Delivery in Industrial Product-Service Systems

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Abstract
Industrial Product-Service Systems (IPS²) provide the best value in use for the customer. The high demand for this product model in the future, will lead to a high number of service deliveries. These service deliveries need to be executed in a service network in industry, but are planned and organized by a central intelligence hosted by the OEM of the IPS².

This article will describe the possibility to minimize the derivation of execution time by the standardization of the boundary conditions in service delivery. An example scenario for resource planning with minimized derivation of execution time will be shown.

Keywords:
Industrial Product-Service-Systems; IPS²; Resource Planning; Standardization of Workplaces and Tools

1 MOTIVATION

The intangible service shares of IPS² provide a value to the customer via the complete life cycle [1][2].There are some severe differences between the planning of industrial production and the planning of service delivery of IPS². These differences result from the characteristics of services like the immateriality and thus the following non-storability of service, the concurrent producing and consumption (uno-actu-principle) and integration of the customer in the delivery process [3].

One of the major differences is to be found in the variance of execution time. In industrial production, a much more precise forecast of execution time is possible, contrary to the service delivery of IPS² (Figure 1). The qualitative difference between the derivations of execution time is shown in the figure, the ordinate representing the number of performances.

The higher uncertainty of the execution time leads to an imprecise planning of the delivery processes and the connected resources, due to the uncertain occupation time of the technical equipment, e.g. of a specialized measuring device. Furthermore the IPS² is occupied for an uncertain service time and is therefore not available for use for the customer. Within the planning of the delivery processes, an additional time, depending on the know-how of the service technician is taken into account. It is a disadvantage concerning the warranty or availability of manufactured products, especially in availability- or result-orientated use models [4].

If it is possible to forecast the execution time more precisely, resource planning will be more accurate, the reduced resource demand will lead to a cost reduction and to an increase of customer satisfaction.

2 APPROACH

Focusing this problem the first question is: Why does the variation of execution time differ that strong between the industrial production and the delivery of services?

In industrial production every workplace is designed for its specific production step, that is possible due to the split up of the whole production task into small parts [5]. Even today, through job enlargement and enrichment, the workscope is increased. By specifying the optimal position of the worker, parts and tools for every production step it allows to produce in clock cycle. Overall, there is the same boundary condition for every task at each production step.

In service delivery of IPS² the task will be described in different degrees of detail, also depending on the kind of service in advance. Due to the integration of the external factor every delivery process has to be carried out with different boundary conditions.

According to this, service delivery is a kind of extemporaneous process whose management depends on the operating experience of the service technician.

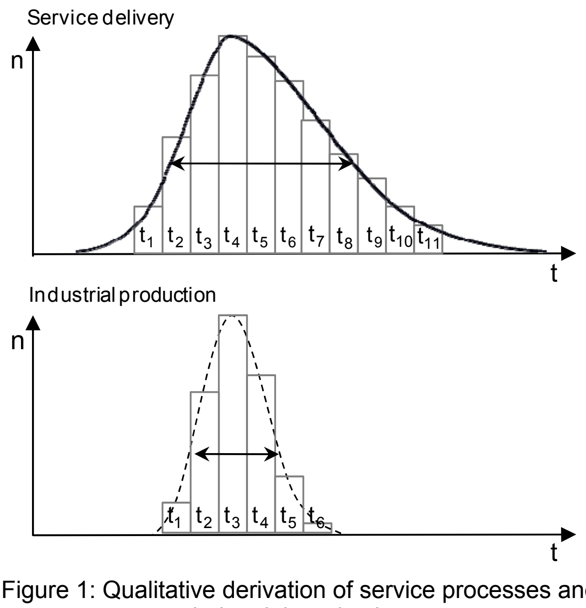

Figure 1: Qualitative derivation of service processes and industrial production

Following this conception the main objective is to generate standardized boundary conditions as far as possible in service delivery.

In order to reach this objective there are four fields of action to be considered:

- *Workplace*

  Like in industrial production, the workplaces of the technician have to be declared in advance. The designer has to consider ergonomic issues, i.e. the reach ability of parts and tools, and economic issues, e.g. time for the processing of parts. That means in practice, that the position of the technician and the position of his toolset are determined by the designer in advance. Simulation of the workplace with software tools like eM-Human [6] will support these decisions and will probably lead to changes in machine design.

- *Tools*

  Especially the extemporaneous tools are a common problem in service delivery today [8]. Only cost intensive tools are considered in the planning process; the other tools and their configuration are left to the service technician. The latter implicates a know-how depending on the execution time and in addition, the danger of losing this know-how in case of abrogation of the service technician. This means in practice that for a service process, which is described in detail, a set with required tools will be provided in which every tool has its certain place., thus supporting the technician by saving time for searching tools et cetera.

- *Qualification and Support*

  It is necessary that the service technician who is involved in the process has got the right qualification to manage the process. In case of a sufficiently qualified technician the IPS² provider has to take care that the process is carried out with support so that the planned process parts can be managed in time. This field of action implicates a good communication between the IPS² provider and the service technician located at the customer.

- *Information and Communication*

  It is the backbone of the service delivery in IPS². The use of information and communication technologies is a very important field of action, starting for example with the automated communication between the IPS² provider and the IPS² as well as his suppliers up to the outsourcing of service parts, e.g. failure diagnosis.

3 THE SEVEN SERVICES CLASSES AND THEIR ABILITY TO USE THIS APPROACH

3.1 The seven types of service

Services which are relevant in the capital goods sector can be summarized in the following seven types of services:

- Planning services, e.g. material flow planning, factory planning
- Counseling services, e.g. calculation support, personnel counseling
- Training services, e.g. operator training, determination of the need for training
- Logistic services, e.g. replacement part service, machine implementation
- Function creating services, e.g. start-up. Ramp-up management
- Function maintaining services, e.g. maintenance, repair
- Optimizing services, e.g. process optimization

There are differences in the services of a cluster in reference to operation, resource requirements and planning complexity. The individual service types can be given by criteria, which describe the **process type, intensity of the interaction with the share of tangible goods, the dimension of the customer integration and automation degree [7].**

Process types

Four process types can be differentiated in reference to the description level of a service:

- Creative processes,
- Expert processes,
- Technical time-value processes and
- Logistic processes.

In this context, the description of the process is detailed differently, but it is not considered for the standardization of the boundary condition.

Logistic processes show the highest level of a standardization potential, followed by technical time-value processes, expert processes and creative processes. The standardization potential of a service process defines the degree of detail of a process representation in the context of the design of an Industrial Product-Service System. It is in particular the sub-processes of the provisional phase, which need to be described, depending on the process types, as, e.g. the results of a creative process are negatively influenced concerning its operation by the concrete specifications from the planning phase. A technical time-value process can be specified to a high degree by the process description in order to secure the result.

Intensity of tangible and intangible product shares interaction

The intensity of the interaction describes the mutual influence of tangible and intangible goods of an Industrial Product-Service System in the development phase. If there is a high intensity of interaction, there needs to be a special emphasis in the design of the process steps, on the adaptation with the development of the tangible goods.

Dimension of customer interaction

It is typical for the customer integration to have a large impact on all kinds of service processes, the influence of the customer on logistic processes, however, can be regarded as neutral. In case of industrial services the service is determined by the interaction with the customer’s object much more than the customer himself. The customer and respectively his processes determine the date of service as well, as he has to prepare the service process in his organization. Usually he has just a small influence on the service process itself, except for supporting activities such as switching on/off the air supply etc.

Degree of automation

The degree of automation of a service shows how far the processes can be executed without a member of staff. One example could be a teleservice solution to monitor the condition of an IPS².

3.2 Usability of the suggested approach

The standardization of boundary conditions is just valid if the frequency of performances exceeds a certain level or if the service process and/or its consequences (e.g. downtime of the IPS²) respectively are connected to high costs. Altogether, the basic decision to standardization depends on costs for each service process over the life cycle of all IPS² in the market.

The different service types do not allow deciding about the ability to use the suggested approach. This decision is to be made on a more detailed level of process description. The first hints are the special criteria of every service process. So the process type directly indicates the potential of detailed description of a process, depending on the creative demand of the process. The less creativeness is necessary, the more detailed process description is possible. This increases the degree of reproducibility and ensures a constant process quality.

The dimension of customer interaction is important, regarding the boundary conditions of the service delivery. Therefore, the active interaction of the costumer should be as small as possible.

Given the standardization of processes, automation is a maximum standardized process, whose properties are perfect for planning, due to its independency of the boundary conditions, except the scheduling of the customer.

For a more detailed look on the usability the processes has to be split up into parts which have to be characterized by the explained criteria.

Summarizing the properties of delivery processes discussed before, a portfolio of usability can be shown (Figure 2). As mentioned, this portfolio is just valid if the earned cost savings exceed the cost for standardization of the boundary conditions. This depends on the savings per process delivery and the number of performances or the cost intensiveness of the service delivery respectively.

The two axis of the portfolio are the "Process type" especially the "creativeness and the know-how" and the "dimension of customer interaction". Both axes are ranging from low to high. Therefore, there are four quadrants to divide the service process in their capabilities to use the suggested approach.

Quadrant I:

Due to the high creativeness or know-how and the parallel low dimension of customer interaction the standardization of boundary conditions is quite good. One example could be the standardization of the boundary conditions by setting up an expert workplace with defined software tools as well as the transfer of defined IPS² data. There will be just a raw description of the workflow to avoid blocking the creative processes.

Quadrant II:

The high creativeness and also the high degree of customer interaction lead to problems. On the one hand the customer defines the boundary condition of the service delivery himself and on the other hand the creativeness and know-how does not allow a detailed description of the process. Therefore quadrant II is the hardest field in standardization of boundary conditions.

Quadrant III

Due to the high degree of customer integration, the standardization is as hard as described before but qualified by the low creativeness and know-how, the detailed description of the process is possible and thereby the standardization of the boundary condition has a higher possibility than within the first two quadrants.

Quadrant IV

The low creativeness and the low degree of customer interaction lead to the best condition for standardization of the boundary conditions. One example could be the change of a wear and tear element. Therefore, the definition of a workplace at an IPS² including a tool set with a fastener integrated in the IPS² was executed so that the service technician has to do well defined movements with calculable duration.

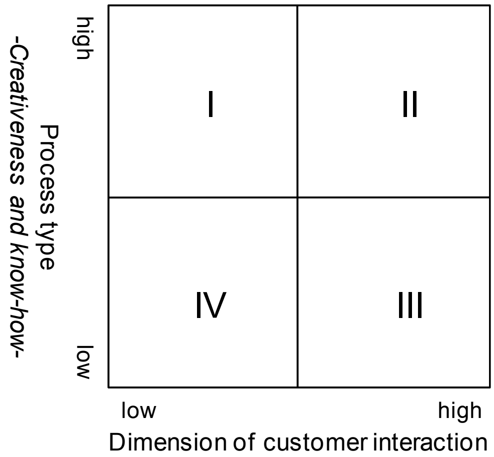

Figure 2: Use ability of the suggested approach

3.3 Example scenario

For example, an upcoming machine breakdown was detected [9]. In order to manage the risk of a break down, normally a service technician is sent to fix the problem. Due to the description of the customer, the planner takes care that the service technician and all relevant resources are occupied for a time interval depending on the operating experience of the planner.

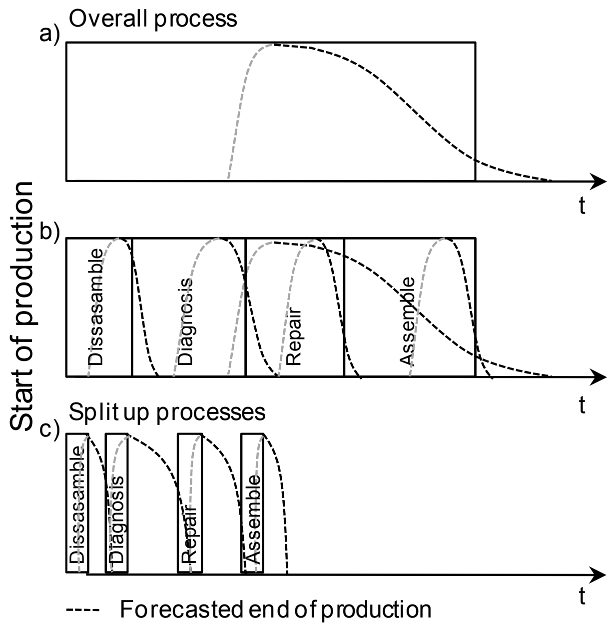

Figure 3: Optimizing of execution time

His operating experience follows the feedback of service technicians, who managed service processes similar to the current process (Figure 3, a). However, this feedback specifies the whole process and is to fuzzy for an efficient planning. He occupies the resources for a certain percentage of the maximum execution time. This is the reason why the process square in Figure 3 (a, b) ends before the maximum forecasted end of production.

The service consists of the sub processes disassembling, diagnosis, repairing and assembling. Each of these sub processes has its own variance in execution time (Figure 3, b). These specific variances depend on the time to find the right tool in an unsorted toolbox, the unspecified position of the service technician and the uncertain condition at the IPS².

The aggregation of these specific variances leads to the overall variance in execution time noticed by the planner. So the aim is to disintegrate the overall process and to analyze which part could be optimized by the suggested approach.

The disassembling, the repairing and the assembling of the machine are technical time-value processes with a very detailed description (Figure 2, quadrant IV). The diagnosis is an expert process with a high demand on creativeness and operation experience (Figure 2, quadrant I). So the process has to be split up in sub processes (Figure 4) that the design of the three technical sub processes can be done in detail considering the boundary condition of delivery in advance. Therefore, it may be possible to design a fastener for the tool set in an optimal position depending on the defined position of the service technician.

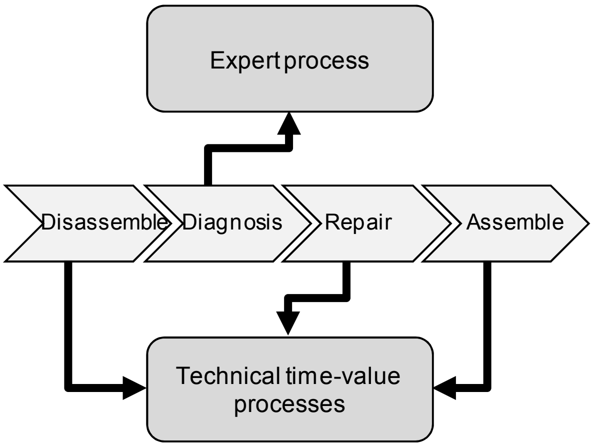

Figure 4 Split up of a process

The diagnosis of the failure is as announced an expert process. In order to manage this in an efficient way, information and communication technology can be used, e.g. by an automated transfer of machine data to an external expert in advance and sending him pictures after dissembling the machine by the service technician. The involvement of the expert by information and communication technologies guarantees the failure diagnosis in a certain time and allows concentrating the expert man power in one place by using the expert knowledge in several processes.

This procedure allows sharpening the schedule. The specific variances in execution time become more accurate and the overall variance of execution time decreases strongly (Figure 3, c).

4 CONCLUSION

The paper has shown that there is a difference between the planning of industrial production and the planning of service delivery. The latter is connected to the different boundary conditions for every service delivery in opposition to the industrial production where the boundary conditions are always the same. So the suggested approach is to create a homogeneous boundary condition in service delivery. The basis for this process are standardized workplaces with standardized tool sets.

The four groups of services, divided by creativeness/know-how and the degree of customer integration, feature different usability of the suggested approach to design the workplace at the IPS² for service delivery and to allocate a specialized tool set for the specific service delivery. It should be supported by the use of information and communication technologies and the qualification and the supporting of the service technician respectively.

Finally an example scenario was given to demonstrate the advantages of suggested approach.

5 ACKNOWLEDGMENTS

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