

Reducing the Complexity of Services – A new Approach to Service e-Procurement

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1 Introduction and Problem Description

E-Procurement solutions like ERP solutions and catalogue data software solutions support materials and product but product service systems (PPS) are treated like exceptions and cannot be represented in a formal matter. For indirect procurement, different supplier management strategies should be applied, since the involved types of suppliers, interaction with suppliers and relationship with suppliers are completely different. In this paper we focus on formulization of industrial services characterized as product service systems. The paper looks at interoperability issues in the context of e-procurement for industrial maintenance services and asset management. The maintenance of industry facilities and assets is currently challenging the industry. Today's addressed industry domain is lacking shared e-business standards and information model which allow coherent and consistent data along the service value chain. There is a lack of sophisticated methods and integrated solutions as available for the direct procurement area. Classification systems as UNSPSC (UNSPSC 2009) and eCl@ss (ECL@SS 2009) today are solely unsophisticated with regard to services in general, and hybrid packages particularly. Services built of hybrid packages composed of immaterial elements as object-related services as inspection and maintenance or repair tasks which require technical material and tools etc. Service procurement is thus the hot topic in industry today (TDWI 2006) (BME 2009). The remainder is structured as follows: First, the state of the art of e-procurement of services in the industrial maintenance area is overlooked and actual challenges are highlighted. Then, we propose a classification model for industrial services. It is looked into in which form matter industrial services need to be specified and described. Based on that it is argued how service processes can be modeled and configured based on their characteristics and given context. Out of our reference model along the value chain for service procurement, we structure, analyze and derive the interfaces between the participants of service procurement as well as the different types of business documents for ser-

vices which are exchanged between them. As a part of an integrated IT solution we present the interactive shopping basket for catalogue based service procurement systems and give ideas for the quantitative measuring of efficient service processes. Our approach is focusing on the elements and concepts of the classification of industrial maintenance services and standardized descriptions and specifications, a Meta reference process for service procurement processes and in integrated IT solution for service procurement processes based on an interactive shopping basket and the quantitative measurement and comparison of service procurement processes based on process cycles.

2 Service Procurement – State of Play

The following section looks at one of the characters of typical service processes: the measuring of the services to quantify amounts and numbers isn't known before service processes are initiated. It is not like material procurement where the amount of materials and goods can exactly be specified and the processes go straight forward in terms of the control flow. The personal effort in service processes as well the amount of time needed along the transaction of the whole processes is mostly underestimated and disregarded in the electronic mapping of service e-procurement processes. Therefore the mapping and execution of service processes in ERP workflows is difficult because after the initiation of an order, the final information of quantities for the billing of the order is not specified yet and in most cases an order cannot be changed at that point of time. In daily practice users thus tend to overcome shortfalls of existing procurement solutions through using means available as e.g. practices and routes for exception handling which lead to increased inefficiencies requiring increased communication and interaction internally (accounting) and externally (service provider). As a consequence, it is shown, that the delays, unexpected efforts and inefficiencies due to numerous cycles and interactions between customer and service provider are required to compensate missing information. The results are delays in payments and increased transaction costs. Catalogue systems are provided for the procurement of goods and implemented in procurement systems. But a catalogue structure for services based on a classification of services - especially for combined services of immaterial and material elements as typically emerging in an industrial maintenance context. Formal description of hybrid services is not available yet. In our paper we present our approach for the classification and electronic standardization of electronic data in service procurement processes. We focus on the specification and description of services and present our proposal for service classification of industrial maintenance services (which can be interpreted as instances or objects of hybrid service classes specified by the classification system). Out of the specification and description of services we derive specific service processes and present a model process for above motivated integrated IT solution. We are looking at services

parties. The Meta process shows the typical evaluated activities and processes phases which should allow configuring process instances according to specific service types and business rules imposed through service frame contracts, etc.). The BPMN diagram [BPMN 2007] describes the choreography of document and information flow in the collaborative processes and specifies the interfaces within the both parties. Our goal are standardized description of the document flow of the collaborative process and describe it with a descriptive document standard based on XML [XML 2006] and the classification system eCl@ss. The standard will include already used standards on the market like GAEB XML (GAEB 2009), openTRANS (openTRANS 2009) or similar standards.

3 Classification and formal Description of Services

In order to compare services for a price comparison and analysis, the description and specification of services have to be based on a common formal language specification and classification. Due to the nature of services, a formal approach for the classification of services has to be found. The classification of products has been established and used in different approaches like UNSPSC or eCl@ss. In our work we extend the classification model for services based on the eCl@ss classification system and develop it further to meet those challenges we discussed before. Therefore we focus on industrial maintenance services and try to include their characteristics. Industrial maintenance services are most likely hybrid services or product service system. Integrated packages of products and services are also called product service system (Galbraith 2002; Kersten et al. 2006). Product service systems are in between pure payment in kind and pure service. But in our days pure services aren't really offered any more. Due to the tertiarization the choice of product service systems is increasing (Micic 2006). In the area of product service systems the profit margin is higher up to 10% and the margins range between 8% and 18% (Mercer 2006). Product service systems attribute an even higher reputation to the company's success. 94.9% of companies are growing by means of product service systems (Sturm et al 2007). But still despite the growing choice of product service systems, companies aren't able to describe and specify their service range (Backhaus et al 2007). In the area of modeling a lot of approaches have been proposed, but no unified formal description and specification of product service packages which can be used by companies was defined yet. For the maintenance or repair of industrial objects, products like consumables, supplies or working materials are used. A strong relation between industrial services and materials is necessary to classify industrial services. In our approach we build up a relation between services and materials using an object oriented approach (see Figure 2).

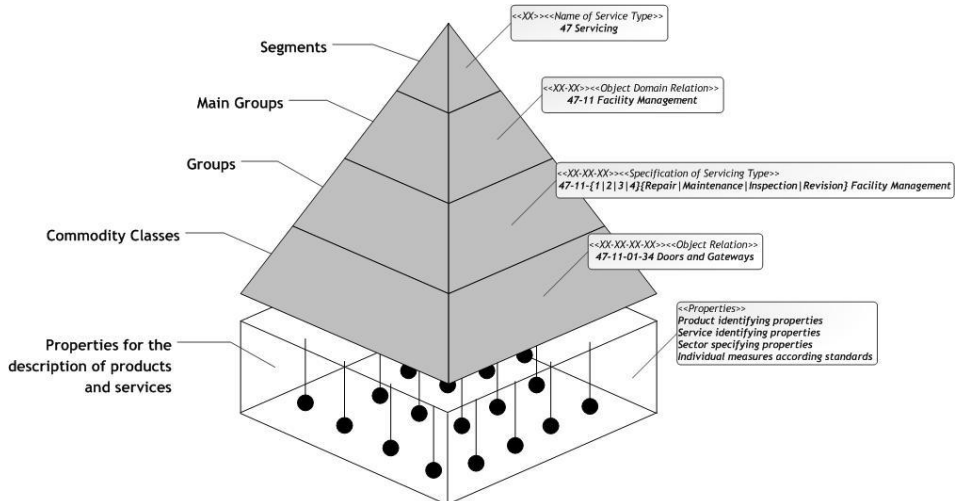


Figure 2: Classification of industrial Services

Based on the classification system of eCl@ss, we define an own segment for industrial maintenance services/servicing. The second layer “Main Groups” is specified by a first object domain relation. The elements and values of this layer are derived from object classification values of the existing classification systems for material. The third layer is described by the typical characteristic values and types of servicing and is built by the values repair, maintenance, inspection and revision and corresponds with the official definition of the DIN 31051¹ [DIN31051 2009]. The second object relation is represented on the fourth layer and specifies the object the services are carried into execution. The properties specify and characterize the object and the services in a more detailed way. Standardized individual measures according existing standards like the *VDMA-Einheitsblätter 24176 „Inspection of technical Equipment and Apparatus in Buildings“* (VDMA24176 2009) or 24186-0 „*Product Mix for the Maintenance of technical Equipment and Apparatus in Buildings“* (VDMA24186 2009) from the VDMA² can be mapped as well as product identifying properties, service identifying properties and sector specifying properties.

4 Process Model for interactive Service e-Procurement

e-Purchasing of services is fundamentally different from purchasing of products. Since services contain dynamic parts which depend from the execution of the ser-

¹ DIN 31051:2003-06 defines the term maintenance and characterizes and classifies it into the four domains repair, maintenance, inspection and revision.

² VDMA association (Verband Deutscher Maschinen- und Anlagenbau e.V. – German Engineering Federation) is one of the key association service providers in Europe and represents more than 3,000 mainly small/medium size member companies in the engineering industry.

vice, they need to be configured regarding the use case. In this paragraph a process model will be introduced which provides the required functionalities.

4.1 Problem Description

Services are fundamentally different from physical goods in terms of properties (Töpfer 2007). Whilst physical goods such as tools or office supplies are physical on one hand and can be produced prior to the ordering process, services are significantly different. Services and also bundles of services and goods (Engelhardt et al. 1993) contain immaterial parts to some extent. Immaterial parts make them variable regarding the explicit execution of the service and volatile because the act of service execution not necessarily leads to physical results. E.g. assurance services or educational services are mostly immaterial and don't result in touchable outcomes. Immateriality is one of the major aspects which make it hard to formalize and concretize services prior to their execution (Corsten 1985).

4.2 Catalogue-based Service Shopping

Today's e-procurement systems offer great functionality and cost savings by optimizing the procurement process of material goods. These gains are based on electronic multi supplier catalogs for each commodity to be sourced, offering most excellent prices and transparency for shopping activities. For services tend to be offered in a generalized service description (not specified to any specific target case), they need to be configured further. Therefore structured procedures are necessary in order to provide executable service descriptions. In order to procure goods and services a specific process is necessary which enables buyers and service providers to configure and thus specify the required services properly. But even standardized service descriptions might not fit the desired services and thus modifications and customizations are necessary. Today's systems aren't built to provide this interactivity yet for individual customizations and negotiations for customers and vendors in defining and ordering services. So in order to introduce configuration functionalities to these systems there need to be concepts for the underlying processes. Premises for such a model process to work are *service templates* and *connectivity*. For a service provider to execute a service autonomously, the service description itself needs to be concretized regarding the individual requirements of the task (Pahl et al. 2006). In the accomplishment of a proper concretized service, a configuration process is involved. Since the outcome of this procedure depends on the nature of the service, the results naturally differ from each other (Meffert and Bruhn 2006).

4.3 A Process Model for Service Configuration

To build a system for the configuration of heterogeneous services, it is essential to define a process which is abstract on the one hand to be able to capture the variety of services and on the other hand still manages to configure services individually. In this paper we attempt to solve this issue by introducing a new component interactive shopping basket to the system which offers and monitors the interaction between buyer and service provider prior to the start of the service execution. The interactive shopping basket features the same characteristics of shopping carts used in regular online stores with an additional roundtrip component providing interactive negotiation features within the system between buyer and service provider. This article propagates an interactive configuration process using an interactive shopping basket. Following the initial selection of a service which is accessible via an electronic catalog, the buyer configures the service parameters regarding the specific service scenario. E.g. the installation of a fire door in an office building requires multiple parameters like the location, the thickness of the walls and the type of door to be installed. After providing these details or at least the essential ones, the configuration is checked by the system before being transferred to the service provider for further configuration and customization. Errors like missing parameters or false content are checked by the system. For background checks the interactive shopping cart can be connected directly to the ERP system to autonomously check for available budget. If an error occurs the configuration is necessarily sent back to the buyer. Once transferred to the service provider the buyer needs to check the configuration and, if necessary, correct or complete it. Since one can't assume the buyer to be an expert for the service which is required, configuration errors or incomplete configurations are very likely. Again the configuration is checked by the interactive shopping cart if it exceeds budget limits or contains other errors like mentioned above. As before, depending on the type of error it either returns to the service provider if the error is with regards to content related matters. If the checked configuration is ok it could be sent to the buyer to prevent the service provider from testing the maximum possible budget by continuous trials. At this stage the buyer can decide whether he accepts the changes and assigns the tasks to the service provider to be executed or he can continue to reconfigure the service configuration. Before a contract is closed, the buyer needs to review all the changes and acknowledge the configuration. Otherwise changes retrigger another cycle in the configuration process.

5 Process Cycles

Within the process model indirect³ communication towards the configuration of the service to be delivered takes place controlled by the interactive shopping cart. Because of the need to specify all the details (e.g. amounts of material, delivery date or service object) to enable the service provider to estimate the costs of the desired service, an exchange of this information is necessary. Related to calculating the costs of flexible goods, there are various concurrent approaches to formalize and measure the performance and total costs of providing services or other volatile goods (Kooimey 2007; Ramaswamy and Banavar 2007; Machuca et al. 2009). The interactivity during the configuration of a selected service generates various configuration cycles. According to the three roles (buyer, interactive shopping cart and service provider) contained in the process model, three cycles can be identified within the order process:

- Buyer-Cycle “BC” (Buyer and Interactive Shopping Cart)
- Service Provider-Cycle “SPC” (Service Provider and Interactive Shopping Cart)
- Complete cycle “CC” (Buyer and Service Provider)

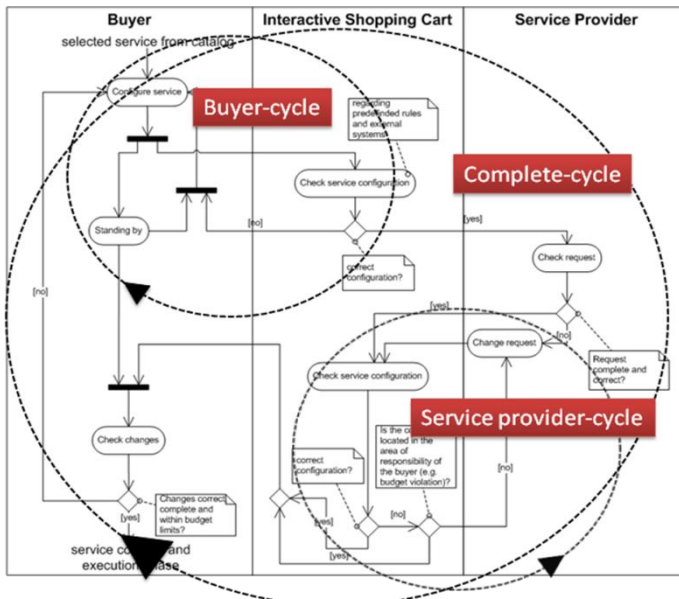


Figure 3: Cycles within the Process Model

³ The communication is carried out asynchronously, since buyer and service provider don't talk to each other directly but alternately controlled by the interactive shopping cart.

The three cycles comprise the necessary interaction in order to deliver a fully specified executable service (see Figure 3).. The buyer initially selects a service from a catalog structure and specifies the parameters necessary (*Buyer-Cycle "BC"*). Successively the interactive shopping basket verifies the data provided and checks according to mandatory rules embedded within the system for exceptions (e.g. budget) and errors. In case an error (e.g. blank field) is found, the configuration is returned to the buyer for correction, otherwise it will be transferred to the service provider. The input for the Service Provider Cycle is a service configuration template already initially configured by the buyer (*Service Provider-Cycle "SPC"*). The service provider manually checks the configuration for errors not detected by system and parameter fields left blank. In case an error is found, the service provider reconfigures the parameters and thus the service description. After submitting the configuration back to the buyer, the interactive shopping cart checks again for various errors like budget exceptions. In case of a budget exception the configuration is returned to the buyer to prevent the service provider from testing for budget limits. For different types of errors the cycle starts over. A complete cycle is traversed if the buyer needs to reconfigure the service configuration (*Complete-Cycle "CC"*). This could be necessary if he finds the changes by the service provider to be incorrect or if he wants to adjust parameters. Each traversing of a cycle requires manual effort and delays the service ordering process. By defining and analyzing these process cycles within the interactive procurement process phase, we are able to measure the effectiveness and assessment of the procurement processes and the solution. Benchmarking of service processes allows the comparison of e-procurement processes and an improvement analysis. The formula is a first attempt to identify all possible types of efforts and costs which influence the total cost of a service ordering process.

$$\text{Total time } T_{\text{complete}} = \sum_{i=0}^m (T_i^C + T_i^V + T_i^S) , m = \# \text{ of Complete Cycles (SPC)}$$

$$\text{Time for Configuration } T^C = T^{\text{CBuyer}} + T^{\text{CServiceProvider}}$$

$$\text{Time for Verification } T^V = T^{\text{VBuyer}} + T^{\text{VServiceProvider}}$$

$$\text{Standby time } T^S = T^I + T^L$$

$$\text{Idle time } T^I = T^{\text{IBuyer}} + T^{\text{IServiceProvider}}$$

$$\text{Total effort } E_{\text{complete}} = \sum_{i=0}^m (T_i^C + T_i^V) , m = \# \text{ of Complete Cycles (SPC)}$$

$$\text{Configuration effort } E^C = E^{\text{CBuyer}} + E^{\text{CServiceProvider}}$$

$$\text{Verificaton effort } E^V = E^{\text{VBuyer}} + E^{\text{VServiceProvider}}$$

The formulas capture the time and effort which has to be invested to configure a service description in detail prior to execution of the service. Total time (T_{complete}) involves time for configuration, time for verification of the parameters and standby time of the ordering process, mainly idle time when the system is not actively used and transmitting time of the configuration templates. The total effort (E_{complete}) covers the man hours which buyer and service provider have to invest towards a complete service configuration. While T_{complete} incorporates all time related aspects of the configuration process, E_{complete} comprises the manpower, which needs to be put into the configuration process.

6 Conclusion and Outlook

The paper presented a newly approach to e-procurement for industrial maintenance services. It has been highlighted that procurement processes in industrial maintenance are complex because they require more interactions and communications between involved actors to configuration and billing of services and related technical material. Despite the fact that IT solutions and systems for material procurement are mature and have achieved a high level of efficiency, service procurement is still characterized through inefficient and expensive transactions between customers and service providers. Most approaches and solutions on the market are often tailored to the needs of the customer view and needs (linking service contracts and orders to object commodity groups). We have presented the major elements and components of a solution to improve service e-procurement through the usage of standards along the supply chain. A standardized process combined with transactions standards (document types) to organize the information exchange between the actors at the interfaces. A collaborative process supports the communication and coordination externally but as well internally as many inefficiencies are caused through interactions within the buyer organization. Next steps in our research foresee to further develop the conceptualized approach through field experiments and setting up pilots to evaluate the results. In focus are services which are characterized through high standardization potential and typically ordered in context of an immediate corrective maintenance service to be rendered through a service provider. Our aim is to provide the same functionality as we find it today in material e-procurement, ordering services online through e-catalogues, fast, easy and efficient. We aim at showing that service classification standard, an agreed collaborative process and transaction standard (tailored to the needs of service procurement) will lead to significant cost savings. Cost saving can only be achieved through a joint effort of all actors, mainly service provider (supplier) and customer to exploit mutual benefit. After successful evaluation standardization will require further efforts and continuous marketing and communication of our results based on concrete figures of savings and improvements.

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