

SERVICE MANAGEMENT BEYOND UDDI – A DESIGN SCIENCE APPROACH

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Abstract

The organisational change that comes along with the evolution of enterprise architectures (EA) towards service-oriented architectures (SOA) requires a consolidation of the enterprise's information system. Though, the SOA paradigm is not restricted to application system functionality, but takes also semiautomatic and manual services of an organization into consideration. In order to reach the inter-organizational transparency over the shared resources and processes and to facilitate the reuse of services, a consistent SOA management is recommended. A catalogue system was developed enabling access to both technical and organisational services. Benefits of this approach are illustrated in a pilot study implemented by the MIRO project at the University of Muenster.

Keywords: Service-oriented architecture, UDDI, service catalogue, service management.

1 INTRODUCTION

A big university like the University of Muenster offers their students and co-workers a vast number of information and services. The three central institutions (administration, library and information processing centre) manage and publish these services each using a different method: mostly on their own web sites with different information density and currentness. Similarly service-offerings of faculties (and their IT-departments¹) exist which are managed and offered decentred, too. The outcome of this are a low detectability combined with an insufficient reusability of services.

To take this challenge, in project MIRO (Muenster Information System for Research and Organisation) it was decided to create a comprehensive service catalogue which would support central managing and standardized offering of services in order to improve the quality of information supplied. Another important goal of the project is general improved flexibility of the University's IT-infrastructure. For that reason – first in central institutions – a process-oriented structuring of workflows is aspired, supported and furthered information technologically by adequate Service-oriented Architecture (SOA).

One major goal of SOA-approach is the establishment of interfaces to sub-processes (services) of utilized IT-systems. Specifications of the interfaces are in general registered in a dictionary service to simplify the search process. The main advantage of SOA concerns its reusability and maintainability of services with the consequential reduction in costs as well as its flexibility to react dynamically on changes in business processes by adjustment of particular parts in a workflow (Natis, 2003).

Under Web services we understand also normal services and therefore we follow the approach to create an integrated service catalogue where in addition to classic services semi- and fully automatic services can be registered and searched. Hence, we strive to develop a central multitenant catalogue with the ability to register ordinary services as well as Web services of an organisation using arbitrary meta-data sets. Over the Web service interfaces it is then possible to request more information or make an enquiry about the services. With recourse to the identity management also user role specific information can be included to authorise user access to managed services.

This article is structured as follows: the next chapter gives a brief survey about requirements of catalogue based SOA management. In Chapters 3 and 4 theoretical considerations and technical implementation of the catalogue is outlined and its practical realization by means of Web service is exemplified. The article ends with a discussion which sums up the essential ideas of the approach and illuminates the vague points concerning the realization of the productive use of the catalogue.

2 REQUIREMENTS FOR CATALOGUE-BASED MANAGEMENT

Complex information systems in an enterprise consist not only of business aims and business processes but also software and data. For a successful development of an enterprise it is necessary to combine these different views. Enterprise architectures (EA) have been established to fulfil this task. A service-oriented architecture can be comprehended as a part of a company's enterprise architecture (Barry, 2003). It is a system model, which intends the provision of business functionalities in terms of services (Erl, 2004).

The continuing evolution of traditional enterprise architectures towards SOA demands organisational change in conjunction with the task to management a whole portfolio of enterprise services. It encompasses a consistent and capacious documentation of these services and their adjustment to the actual business processes requirements. A catalogue system is the fundament for a methodical portfolio development and its alignment with the business strategy. The management task has to be done in cooperation with IT and operations departments of the enterprise. Especially the specification

¹ So-called information processing and providing units

of a new enterprise service is a conjoint task. Emerging standards, service networks, Quality of Service (QoS) – these definitions have to be taken in consideration. The operations departments have the expertise regarding the business processes examined and the business objects involved.

The following requirements analysis of the catalogue system reflects on the one hand the needs of the supplier and demander, how they exist on a trade market place of services, and on the other hand it is basing on requirements identified by interviews with personnel of the faculties and central institutions at the University of Munster. In an abstract way three central requirements can be identified:

- 1) Demand on transparency: all services in an institution will be catalogued methodically. Each supplier gets an overview over his own service portfolio and therewith a better decisions basis for strategic alignment of the services in his institution.
- 2) Demand on information: The service demander gets information about the service portfolio of the University and can contact them, if necessary.
- 3) Demand on reuse. Services – specially Web services – should be easily reused within a virtual community.

In the next part the identified demands of the stakeholders will be gathered as a basis for the development of functional and non-functional requirements for the system in progress. Functional requirements describe the functions that the application system in progress has to comply (Balzert, 2001). Here the tasks are described only on from outside. The question of implementing the tasks – means how the system manages the tasks – will be handled in the concept of the application system (see Chapter 4).

R1: Ability to manage. The services offered in the catalogue are rendered separately as a virtual community through the three central institutions and fifteen faculties (clients). The ability of the system to be administrable from many different clients without giving them a chance to see each other's data, user management etc. is required. The service catalogue has to comply with these features and guarantee mainly a disjoint data hold, presentation and configuration as well as distinguish between data and objects dependant on clients and overlapping the clients.

R2: Management of Services. This point is about the whole management of services including opening, editing, searching and deleting a service. The upload of documents in a service and their versioning is supported by the document management system (DMS). Therefore, special Web services of DMS have to be bounded into the administration surface.

R3: Classification. The catalogue has to enable a systematic gathering of services and its delimitation from each other. The specifications that exist already in the particular institutions have to be illustratable and administrable by the service catalogue. A functionality of importing and exporting of classification trees is required. Generating a classification in the service catalogue has to be possible in a generic way, so that clients can create specific classification trees. Clients can register their services in their own classification tree and in the classification trees of other clients, as long as these are available for a public use. Furthermore a creation of an inter-university classification tree is aspired, established and attended by an editorial staff.

R4: Quality of Service (QoS). Service Level Agreements (SLA) have to configure the negotiation between demander and supplier about the service features transparent. The catalogue system has to offer a chance to exactly describe the ensured capacity features such as reacting time, complexity and speed of editing. On the authors' point of view, there are no standards for describing services for example at a university. Therefore, the catalogue has to provide a proprietary cataloguing of university services. Also like the classification the metadata necessary should be dynamically generated and clients dependant administrable.

R5: User and rights management. A private user management is not intended. Instead of this, the approach aims at the integration with the Identity Management (IdM) of the University, meaning managing only user accounts and roles. Non-functional requirements (NFA) sum up a heterogenic

amount of information according to the catalogue system to develop, as well as of the development process itself (Partsch, 1998).

R6: Quality attributes of the catalogue functionality. The system has to be suitable to be integrated in the SOA of the university. Functionality used external should be as granular and technically aimed at the supported operational function, encapsulated as well as over the Web Service Description Language (WSDL) or over the Simple Object Access Protocol (SOAP) callable as possible (Weerawarana, 2005).

R7: Requirements to the whole system. The explicit development of a web application takes place only in administrator surface. The virtual community aims at flexible combining of individual Web surfaces with few, semantically rich Web services to access service catalogues. Therefore, the business logic has to be developed decoupled from the presentation view.

3 MANAGEMENT OF WEB SERVICES

On the SOA point of view an important criterion for a successful reuse of services is a pertinent documentation of them. Within the framework of the development of catalogue systems different approaches for a unitary specification of services have been established. In this context we reference the ideas of Overhage (2004). The challenge of a service catalogue development is to describe all different kinds of services (manual, semi-automatic, fully automatic) and at the same time distinguish between them (Juhrisch and Weller, 2007).

Additionally, we focus on black box reuse, meaning the catalogue user relies on the information of an outside perspective of the encapsulated implementation. The configuration of the SOA is performed without knowledge about concrete implementation details (Szyperski, 1998). Thus, an extensive and functional description of the outer component perspective is important as we attach great importance to a university wide understanding of catalogued components.

The Universal Description, Discovery and Integration (UDDI) Standard represents probably the most known description framework for companies and the specification of their Web services (Cerami, 2002). For describing a Web service there are three categories of directories (white, yellow and green pages). The white pages include general information about the service, for example an explicit name and an informal, textual description. The yellow pages represent classification information which gives information about technical domains of the services (cp. UNSPSC). And finally, the green pages are meant for registration of the interface and its address.

The UDDI Standard aims at reusing the Web services at runtime and therefore it offers language constructs for a detailed technical description. But as the assessment of the service semantics is limited to a textual description in white pages, it is not possible to follow this goal and it additionally hinders the integration of semi-automatic and manual services by its strong technical relation. Hagemann et al. (2007) note to this that UDDI – like also other service registries – evinces weaknesses particularly when searching for Web services (Hagemann, Letz and Vossen, 2007).

Hence, additionally to a standardized technical specification with UDDI we require conceptual information in a notation that allows a comparison of different specified components. An entire specification has to contain all necessary data to rate a component e.g. the semantic or the performance (Gruntz and Pfister, 1998; Szyperski, 1998).

Most problematic is to adjust the semantic and pragmatic heterogeneity between components. Semantic heterogeneity means that components implement domain specific concepts in different ways. To set an example, the concept of a “student account” is comprehended differently between two components. Therefore, Overhage suggests an explicit register of concepts together with their definitions as well as a reuse of components that implements the same conceptual standard (Overhage, 2004). Pragmatic heterogeneity references the varying understanding of components about the

component internal and external business process flow (Overhage, 2004). A solution could be an adoption of a uniform business component framework which implements common business flows.

The present article focuses on an approach for a generic documentation about manual, semi- and fully automatic services. Hence, on the one hand, information about the status of reuse in terms of supplier and contact information as well as information for the quality management have to be able being recorded in catalogue, on the other hand, also adequate information to make a choice of a Web service and to assess its suitability for a certain operational context. Contrary to the prevalent efforts to achieve a standardisation of service description (Turowski, 2001) we recommend a tool enabling users to decide in which form the service has to be described.

This will be reached by a dynamic extensible meta-model for describing services (Juhrisch, 2008). A catalogue user can define an own linguistic elements and use these to describe the service. The language elements are designed in a form of meta-records. Figure 1 illustrates the method with a Web service. To describe Web services various metadata sets were created enabling a specification of different levels and still meeting the expectations of UDDI.

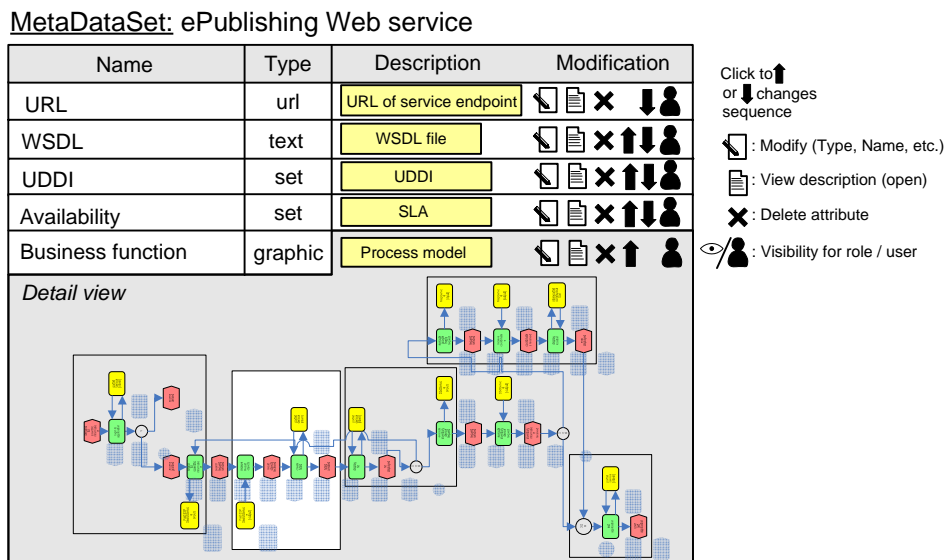


Figure 1. Meta-records documenting the ePublishing Web services.

The aspect of software architecture is illustrated with the first three metadata sets. The WSDL record includes all interface information exported by the service and necessary for the service in order to fulfil its technical task. The meta-record for UDDI references another metadata set required to specify the semantic of the service functions. This metadata sets enables a UDDI conform publication of the service using a SOAP interface (Weerawarana, 2005). To estimate the suitability of a service in a certain business context the business function metadata record is imaging the sequences between service functions of different services as well as within one service using process models. Thus, we focus on the part of the business process documentation implemented by the Web service.

4 IMPLEMENTATION

4.1 Pilot study

The following chapter introduces the scope for the implemented pilot study of the service catalogue. The project MIRO focuses on the development of an integrated information management at the WWU Munster – one of the greatest universities in Germany (Dietz et al., 2007). A cooperation agreement – made by the senate of the university – between the central institutions of the university established the

structural basis. Subject of the cooperation is the use of synergy effects at the process orientated reorganization of the administration using information and communication technology.

The authors of this paper deal with the tasks within the organization and service development at the university. The growing number of Web services and other software components at the participating organisational units require an appropriate service registry. The pilot study for developing a shared service catalogue of IKM-participants and IV-supply units is based on the results of a comprehensive analysis of business processes at the University of Munster.

The idea of the process analysis in MIRO is to make procedures intra- and between the central institutions visible as well as to implement new services at the university based on target-state organizational models and to document. Through the interviews with the staff in the central institutions, examining offices and faculties separate processes were documented and associated in a process map. The goal of the modelling is the finding of transparency over the inter-institutional business processes and deduction of service candidates for a picturing of SOA. The characteristics of process map at the University of Munster with core processes in research and study as well as supportive processes of the central institutions makes a holistic documentation that could bring transparency over the shared resources complicate. To make the process models usable as problem description for the administration reengineering an analysis from the perspective of a service receiver (for example a student, scientific staff etc.) was performed. Since August 2007, an establishment of a "Student-Lifecycle" began by interviewing regularly staff of the departments of organization and revision, department 1.3 (student secretariat), digital services of the university library, operating system of computer centre as well as the chair of information management in the faculty of information systems.

With the decomposition of the lifecycle of a student or staff in an amount of received services including a regulation of technical and organisational interfaces begins the extraction of organisational modules with a high coherence and a possibility of a loose coupling. This means, joining elements with a strong dependence onto one module and describing the rest of the relationships to other modules by as small, controlled amount of interfaces as possible. The gained target-models build the base for the deduction of service candidates. The analysis fulfills the task to determine directives for the service design and to combine the faculties in the process of SOA development. Thereby we restrict the idea of SOA not only to Web services but we aim at a new fundamental alignment of the processes in the central institutions. The basis for this builds a common administration of all services over the whole university.

In this pilot study the first services in the area of digital publishing / digital repository, development of digital semester devices and development of a comprehensive long-term-archiving concept of digital resources, testing of new retrieval methods and methods of knowledge representations, optimization of library portal and profile services were catalogued. Also services from eLearning-systems or HIS-databases of the university's administration were participated.

4.2 Implementing the approach

Before starting the implementation of a service catalogue that fulfils the needs of a UDDI as well as a multitenant catalogue, a dynamic expandable data model with special concerns to the metadata has to be designed. Hence, meetings with employees of the three central institutions were arranged to determine the requirements and wishes for a university-wide service catalogue. After analysing the results and gained knowledge, a following data model with the four main categories could be generated: master data, mandator data, classification data and metadata.

The master data represents the mandatory data of a service description in the catalogue, including at least a short and a long name, a shortcut and a description of the service. The underlying concept of the service catalogue is based on a centralized information system, although the editors and the service provider respectively are spread over the whole university. To distinguish the data on a logical level, different mandators are used and every single row is marked with a mandator flag while using the

same physical database. Finding a service is easy because every service has to be assigned to at least one classification. There exists one global classification where each mandator can assign services to. Furthermore they can create and manage their own classifications suitable for their specific needs. The metadata construction within the catalogue is essential. Here the mandator is able to design any metadata set extending the master data of a service description (see Figure 2). There are three data tables to store and manage the metadata: the metadata-set table, the metadata-attributes table and the metadata-range table. Another two tables are needed for the connection of service to metadata set and service to metadata attribute with the last one connecting the concrete values of a metadata attribute within a set to a service.

The following metadata attribute types are implemented in order to be able to construct a metadata set: text, integer, URL, picture and file. Furthermore, various value ranges can be defined to build data types with fixed values to choose from, e.g. for grades from 1 to 5. With these flexible abilities complex metadata constructions can be defined and managed.

This flexibility in metadata construction allows saving a repository conform to the UDDI-standard; meaning the use of green, white and yellow pages. The implemented UDDI interface is another logical step to use the service catalogue as a full replacement for UDDI.

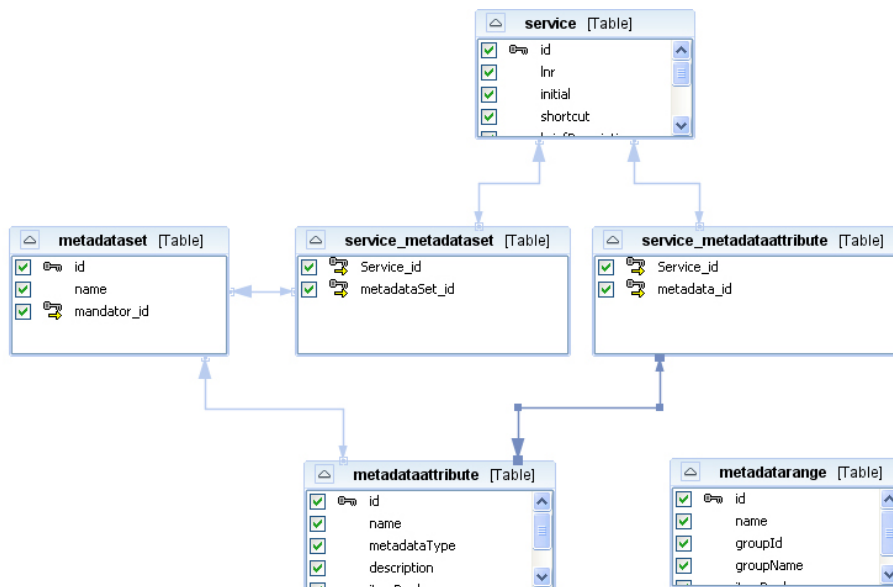


Figure 2. Flexible metadata model.

The infrastructure of the MIRO project is built upon a Java environment using JBoss application servers and Enterprise Java Beans 3.0 as back-end and mainly Java Server Faces as front-end component. Therefore, each kind of database can be used for the service catalogue (here a MySQL database is chosen).

Another important fact is that the Web service interface supports a full data integration of service descriptions in every context. Simple Web services return only an A to Z list of all services or a list of mandator categories; the more complex ones provide specific data descriptions and metadata of a service depending on the role of the user. In figure 4 a possible use of the service catalogue in different scenarios can be seen, e.g. a subset of services is shown on the website of the library.

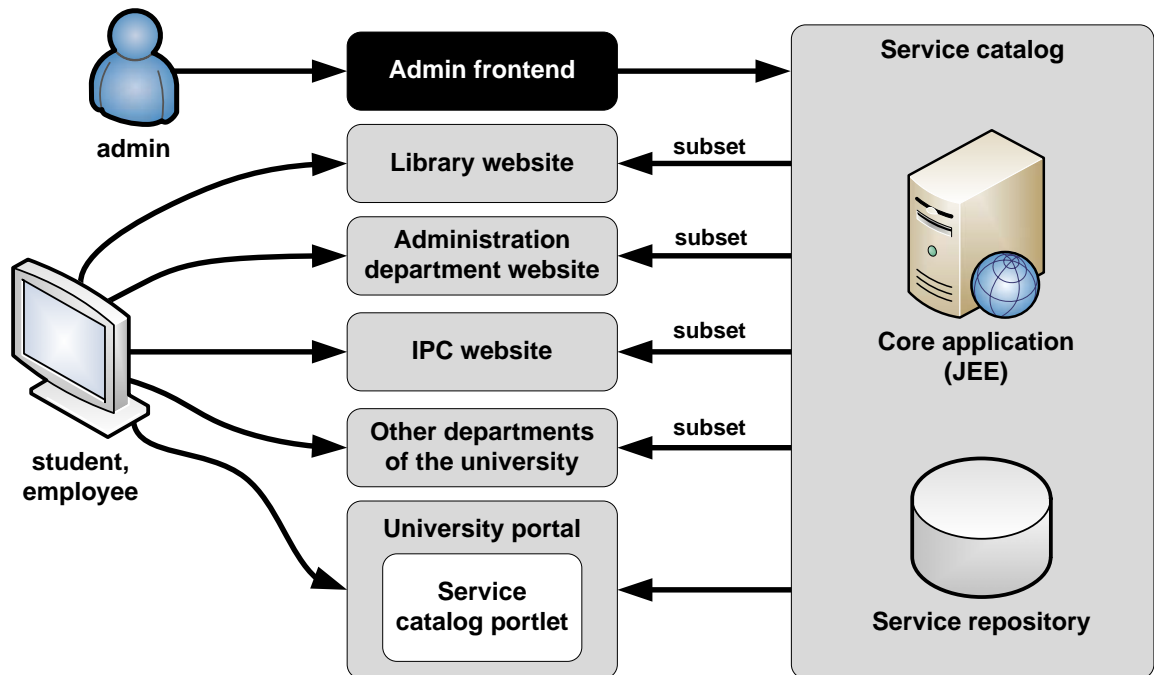


Figure 3. Conceptual overview of the service catalogue.

5 SUMMARY AND FUTURE WORK

Following the concept behind service-orientation as a general goal – meaning orientation on consumer needs – leads to a holistic management of services within an organisation. The presented approach picks up the idea of a standardized Web service description, including the ability of more generic descriptions to affect some shortfalls of the UDDI standard and allows the users to manage even non-IT services within the service catalogue alongside Web services.

The next steps set out a completion of the technological aspects (e.g. security aspects of the Web service interface: therefore including the identity management, which is another part of the MIRO project) and a beta test with the first central users within the university. While the UDDI interface is fully standard conform, the conceptual description of services needs an integration approach with the help of a modelling tool. In addition to the technological aspects, there should be clarified which part of the data resides in the modelling tool and which part has to be saved in the service catalogue.

Since there are no implemented catalogue systems allowing a management of services in different grades of automation (Juhrişch and Weller, 2007), the usefulness of the presented service catalogue lacks empirical evidence. After going live in the near future and the inclusion of decentralized organisation units of the University for a beta test, a quick and overall acceptance of the service catalogue can be predicted. The consistent use of the service catalogue within the MIRO project and close-by software projects – not only as replacement for a UDDI – will help to see it as fully functional universal service catalogue.

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