Managing SOA Through Business Services – A Business-Oriented Approach to Service-Oriented Architectures

Dirk Werth, Katrina Leyking, Florian Dreifus, Jörg Ziemann,
and Andreas Martin

Institute for Information Systems (IWi)
at the German Institute for Artificial Intelligence (DFKI)
Stuhlsatzenhausweg 3, Geb. D3 2
66123 Saarbrücken
Germany
{werth,leyking,dreifus,ziemann,a.martin}@iwi.dfki.de

Abstract. The idea of more flexible, modular system structures thanks to web service interfaces feed expectations towards a novel degree of business agility. However, the challenge of the information system community consists in developing methods and techniques to vest service-orientation with business concepts that deploy a SOA according to organizational requirements. This paper tackles this challenge by introducing Business Service Management as an interdisciplinary discipline for business-driven deployment of SOA. It approaches this ambitious objective by utilizing business processes as semi-formalized representations of an enterprise's characteristics and requirements towards IT.

Keywords: Business Process, Business process management, Business Services, Service-oriented Architectures, Web Services.

1   Introduction

The current omnipresence of service-oriented architectures (SOA) could lead one to believe in the rise of a new software paradigm that will revolutionize IT landscapes especially in business environments. The idea of more flexible, modular system structures through web service interfaces feed expectations towards a novel degree of business agility. The dream of leveraging and integrating system resources on demand based on market requirements has been dreamed by business already multiple times. SOA shares the concept of flexible, business-driven system architectures with previous approaches such as business components or business objects. Thus, the legitimate question comes up what distinguishes SOA from them. Why should service-orientation become the envisioned panacea for bridging the gap between IT and business which all other concepts failed to be? Whether the SOA vision will turn out as short-dated fad or as durable step towards plug-and-play software architectures is not only a matter of technological progress but also of its seamless applicability to real business situations. In fact, SOA will primarily add complexity to managerial tasks instead of disburden them. Introducing SOA brings about novel unprecedented

challenges for the manageability of the IT landscape. The common business goal of efficient and transparent processes over the whole value chain becomes much fuzzier and very difficult to accomplish. In order to reconcile the conflictive objectives of flexibility promised by a SOA and manageability targeted by business (process) management, a rigorous approach to reduce complexity from service-orientation is needed. Thus, the challenge of the information system community consists in developing methods and techniques to vest service-orientation with business concepts that deploy a SOA according to organizational requirements [1]. This paper tackles this challenge by introducing Business Service Management as a mediating discipline for business-driven deployment of SOA. It approaches this ambitious objective by utilizing business processes as semi-formalized representations of an enterprise's characteristics and requirements towards IT and web services as representatives for the IT application landscape. Due to ever accelerating developments on the market, business processes are all but stable entities. They are subject to changes in the product portfolio, redefinition of core competencies, most innovative production techniques, etc. On the other hand, companies must not only deal with agility of their markets but also manage their constantly aging IT infrastructure characterized by heterogeneity, distribution, and out-dated technology. We define Business Services as the ultimately durable layer between rapidly changing business requirements represented by business processes and steadily evolving system landscape that ought to meet these requirements. The goal is to have a set of business-oriented building blocks that embody core functionalities, executed via composite web services, to be flexibly reused and combined to processes. The paper will finish by indicating the most urgent research questions to consolidate the new discipline of business service management in the context of business process management.

2   On the Relation Between Business Process and Service Orientation

2.1   Business Process Management

In order to design, analyze and control organizational structures as well as business activities companies nowadays are increasingly following the process orientation paradigm [2]. A business process is a "continuous series of enterprise tasks, undertaken for the purpose of creating output" [3]. In line with these efforts Business Process Management (BPM) is widely-used as a framework for having formal and repeatable proceedings in place. Various approaches to adopt BPM in companies have emerged in recent years. Besides approaches such as the Zachman Framework or PROMET the architecture of Integrated Information Systems (ARIS) is accepted as a standard framework for business process (re-)engineering throughout the community. Beyond notation and modeling dimensions the ARIS House of Business Engineering provides an overall BPM methodology which supports the entire BPM life cycle combining process design, process control, workflow control and process application implementation [4]. Generally speaking, concepts of business process management can be identified as requirements engineering approaches that take the needs of the business domain and relate them to implemented information technology (IT).

Therefore, IT plays an important role in the context of BPM .It allows the automation of business processes, leading to higher productivity and quality gains. Nowadays, there are of-the-shelf products for almost common business process Applications such as Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM), emerged and offered by software vendors in the nineties, perform the task of supporting business processes. They combine and provide modeled and automated processes for companies of various industries following best practices. However, since applications such as the ERP or the CRM are focusing on selected divisions of a company and therefore using independent databases, the exchange of information within a company gets very difficult and between companies sometimes impossible. In this context the term silo emerged for enterprise applications, reflecting the fact that the application might be full up with valuable data, but that data is divided by technological walls. At the time when enterprise application emerged, most markets companies acted on were steady and competition was manageable; hence the problem of data exchange and communication between applications was neglected. Companies' primary intention was to utilize the productivity gains associated with the use of IT. If any action was taken to tackle the problem of transferring data between applications proprietary solutions, using Application Programming Interfaces for example, were applied, resulting in inflexible, costly and unstable stovepipe connections between applications. However, hardening markets and increasing competition coming along with new business models such as process networks or the real time enterprise as well as utilized productivity gains of IT in the context of BPM, confront IT with increasing demand on its interoperability and flexibility. In times of collaborative business [5] and real time enterprises processes have to be modeled and implemented across borders within the company (i.e. across divisions) as well as across the companies' external borders (i.e. to partners, suppliers and customers), in a flexible and manageable way [6]. Despite notable progress in Workflow Systems and Enterprise Application Integration (EAI) products as well as agreed and widely used industry standards for data exchange (e.g. RosettaNet), integrating applications along end-to-end business processes has remained the major challenge regarding an integrated BPM approach. In order to satisfy the demand of business of such an integrated BPM approach a successor of the widespread client server architecture is needed. In this context Service Oriented Architecture is discussed as the most recent and promising approach to satisfy the demand of an application architecture which allows the implementation of end-to-end processes in a flexible and agile way [7].

2.2   Service-Oriented Architectures

The Service-oriented Architecture aims at developing Applications Systems easily adoptable to business requirements. Therefore, in a SOA components are developed based rather on organizational criteria than on technical criteria, e.g. a SOA component should rather resemble business functions than for example a fine grained module that establishes a Database connection. SOA components are commonly implemented in form of Web Services that a service provider offers via a network. According to the SOA idea, the service provider is also supposed to publish the Service in a central service registry and to describe functional characteristics of the Web Service, not only its technical interface which is described by the Web Service

Description Language (WSDL). Since business functions can be expected to have fewer and less detailed parameters than technical modules, it implies a coarse granularity of SOA Web Service. This, and the fact that Web Services are late bound (e.g. it is only decided at runtime which Web Service is to be invoked), results in a loose coupling of the SOA components. Apart from having components that are being distributed, loosely coupled and easy to discover, an important further characteristic of a SOA is process orientation [13, 8]. This is realized on the one hand side by providing process components (e.g. Web Services) that might be (re-) composed in various sequences, on the other hand by providing process description standards that compose the Web Service into a process. Note, that thus the process flow is separated from programming code contained in single modules. The most prominent example for a Web Service Business Process standard is BPEL. Most of the SOA characteristics mentioned are not new but represent classical software engineering requirements, e.g. the concept of modularization and information hiding was proposed as early as 1972 [9]. But due to internet technology and vendor independent standards (e.g. XML, WSDL, SOAP, HTTP) today these concepts have a better chance to be realized. For example, a comparable technology to Web Service flows as realized by BPEL, formerly Workflow-Management-Systems were used to separate business process from business components. Nonetheless, workflow standards were vendor dependent, thus components could only be used in the scope of a proprietary workflow systems. Today, the vendor independent standard WSDL allows for an invocation of Web Service across boundaries of different workflow-engines (now also called orchestration engines) and possibly also of different organizations.

Nonetheless, SOA development is still a relatively young discipline with few practical experiences and various challenges remain. For example, methods are needed to ensure that SOA processes are compliant with conceptual processes as designed by business analysts. Though first approaches exist to transform EPC to BPEL [10], they have to be refined and put on a broader conceptual basis.

3   Business Service Management Bridging the Concepts

3.1   Business Services

In order to leverage service-oriented architectures for flexible enterprise systems driven by business requirements, it does not suffice to compose IT-driven web services into processes and run them on an Enterprise Service Bus. This would only entail a not so new form of system integration, instead of bridging the gap between business and IT as it was propagated for SOA. To reach the very SOA vision, one must rather think how business requirements can be possibly seamlessly transferred. As outline above, BPM can be identified as a requirements engineering approach in the business domain but highly related to information technology. Thus, it provides a solid starting point for IT development in general and SOA development in particular. Business processes as defined above serve as the very business context needed for web services and service processes to form a truly business-driven service-oriented architecture. Service orientation of an organization means that functions and subprocesses needed by numerous organizational units are provided by a single unit

towards multiple units in order to reduce costs and complexity. We define such functions as business services. Due to their close relationships to functions of business processes they can be derived from business process models and rely on web service interfaces. Thus, business services act as an abstraction layer between business and IT. However, due to their content and design directives, they belong to the business layer, that is defined and reworked by business users (in contrast IT people is in charge of the technical layer). Figure 1 illustrates this relationship.
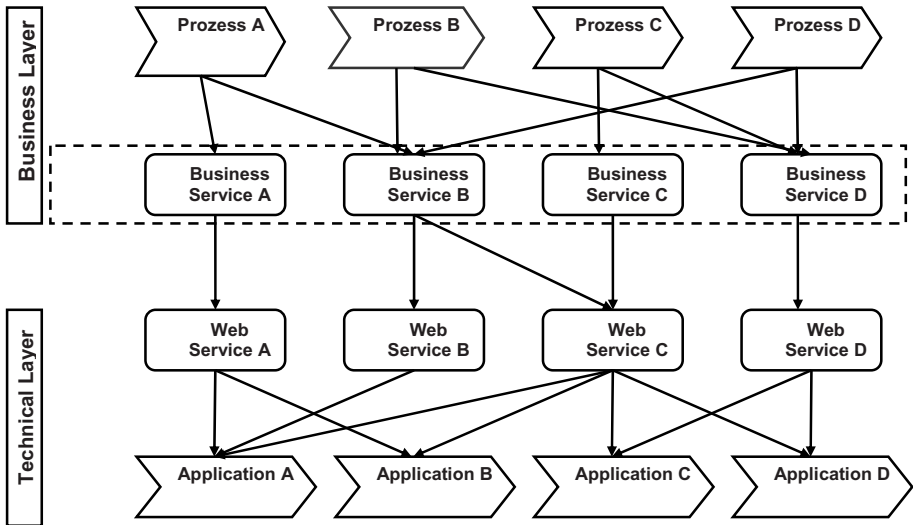

Fig. 1. Business services acting as mediation layer

Business Services are specified through their business relevant inputs and outputs but their internal operating is not visible to the outside i.e. the consuming world. Inputs and outputs can also be considered to be products that are either composed to more complex products or a single product of the types service, goods or information. Organizational units consume and provide products. In this context, they are responsible for creating certain business services and/or using them. Functions are business activities that are hierarchically structured, supported by information systems and – as a logically and timely ordered set – form a business process. As outlined above business services execute processes and functions. For quality reasons, the usage of a business service is subject to so-called service-level-agreements (SLA) that determine exact quality targets for its execution. From a technical point of view, each business service is assigned to a WSDL-operation, i.e. an operation of a Web Service described in a WSDL file. Though, due to its additional business semantics it goes beyond a web service. An excerpt from the information model of business services is presented in figure 2.

Given this close connection between business processes on the one hand side and web services on the other, business services are the very building blocks propagated by the SOA paradigm that flexibly implement a company's business strategy. However, as
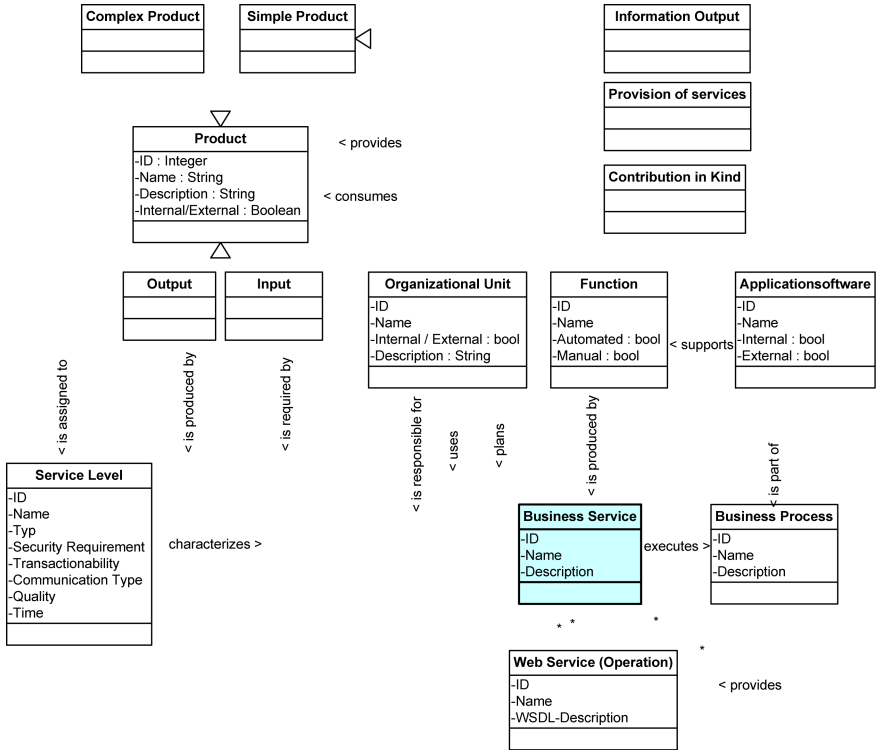
Fig. 2. Information model for business services

an additional layer of such functional modules (business services) between business processes and IT complexity rises and risks to give way to chaos and complexity instead of transparency. To counter this risk, a coherent concept to manage the business service layer based on business processes and IT resources is needed.

3.2 Process-Driven Business Service Management

Embedded in the business process logic on the one hand and in the SOA interfaces on the other hand, the business service layer must be understood as linkage between both. The challenge resides in the way business services are identified, described, composed, maintained, and controlled. The former being the currently most intricate issue since business services must be tailored in such a way that they comply with business process requirements as well as SOA postulations such as reusability, effectiveness, sustainability, transactionality, etc. and meet corresponding business needs. In order to ensure business effectiveness of these business services, the data structure proposed embeds their semantics in a business process context while linking it to technical entities of Web Service languages like WSDL and BPEL. Beyond the design of business services, there is the need for methodologies to manage business services during their run time, i.e. to deploy them to tackle new business challenges along new

business processes, to compose them to form new services, to communicate their semantics towards all stakeholders, to align them vertically with given system functionalities and horizontally across departments and business units. This is vital for ripping off the potential of service outsourcing pictured by service-orientation: Only clearly, i.e. from a business perspective described services (business services) can be offered to external customers or bought in from external providers. Business service management aims to administer the alignment between business and IT. Hereby the concept of business services incorporates the interdependences between business strategies expressed in business processes and IT infrastructures. It connects business-driven web services dynamically with underlying software systems and business-level processes. Business service management is made up of a set of activities that can be ordered as figure 3 outlines. One can roughly distinguish four phases: Analysis, Design, Execution, and Controlling. In the analysis phase three steps are necessary. The business foundation of all subsequent tasks is formed by a business process analysis that defines semi-formalized representations of an enterprise from a business domain view. Secondly, the IT view on an enterprise with the running application systems, their components and responsible organizational units are examined to explore the system landscape in place. Having analyzed both business and IT constraints, this information is evaluated and scoped with regard to their quality and ability to be transformed into business services. In the subsequent phase, the design phase, these parts of the new business layer, the business services and their interactions, are identified and described. Therefore various (semi-)automatic algorithms are applied to the input data to find good candidates of EPC parts, organizational units and IT components that possibly form together a new business service.

To confirm these business service candidates, they must be aligned vertically, i.e. between business activities and IT functionalities, as well as horizontally, i.e. across
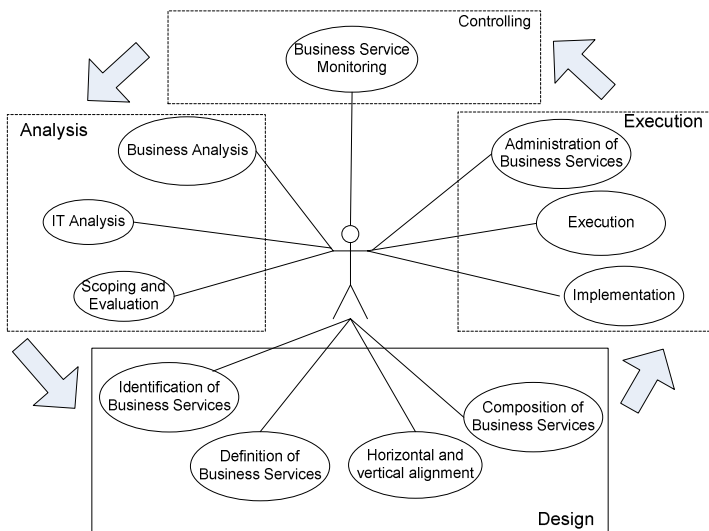

Fig. 3. The lifecycle of business services

organizational units that are to use them. Finally the newly defined services are composed to a BPEL process on the basis of business processes to support the course of business in the enterprise. The conceptual analysis and design phases (build-time) are followed by the execution and controlling phases (run-time). The execution phase establishes the connection between the business services and underlying technical web services (described in WSDL) that again access system functionalities via communication protocols such as SOAP. Hence, the SOA implementation is initiated but not finalized before having implemented a whole SOA infrastructure including Enterprise Service Bus which is responsible for instantiating and executing the services. Last but not least, the final phase, the controlling phase, of the business service management lifecycle controls the success of the business services definitions measured against business objectives. Different run-time attributes are extracted from the operating SOA, aggregated to key performance indicators and used to reconvene with the initial analysis to redesign the business service definitions and improve their fit to upcoming business requirements and new information systems.

4   Tool-Support

In real business environments, a concept as presented in this paper cannot be used without a comprehensive tool support. The very fact that there are hundreds or thousands of processes and services to be managed underlines the need for an IT solution.
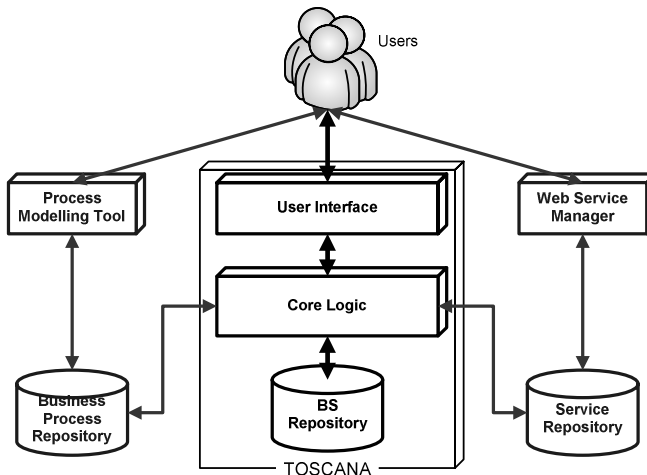

Fig. 4. Technical architecture of Toscana

To deploy our concept in practical scenarios we are going to develop a toolkit that can support all lifecycle tasks of business service management. This toolkit for business service management is called TOSCANA. The technical architecture of Toscana is shown in figure 4. It follows a classical 3 tier architecture pattern.

However, as we initially explained within the concept of business service management, BSM acts as the intermediator between BPM and SOA. Consequently, Toscana is not an insolated application, but it is intended to intensively interact with business process management systems on the one hand and with service management application on the other. Therefore, we try to prototypically connect Toscana to the ARIS Toolset (world marked leader in business process modeling) and to the Oracle Web Service Manager (commercial SOA management suite).

5   Related Work

The approach presented in this paper originates in two major fields of the information systems discipline: Business Process Management and IT Management. As this paper will reveal, the abstract service construct is very much related to existing concepts of business process management. As software functionality, a service features a very functional nature with input being transformed into output. Thus it corresponds to the artefacts of activities, functions, or actions as they have been used in enterprise modelling for decades (e.g. [4], [11]). Analogously to these artefacts, services may be composed to processes. Such service processes again can be offered as – more coarse-grained – services. Thus, it is vital to understand the central role of business process management for service-oriented architectures.

This goes hand in hand with the notion of SOA not so much being based on new technological design principles but rather on the vision to accomplish a business-driven design of IT resources. Thus, Pullier and Taylor [12] consider the effectiveness of service design depending more on business processes than on technology. Accordingly, they define service quality based on reusability of resources "that serve the needs of processes". Frankel [13] considers Web Services in the context of enterprise architecture and defines the notion of business services as "composed from lower level, finer-grained business functions and information entities." Krafzig et al. [14] shifts the focus of enterprise SOA on taking advantage of business logic and data maintained in many applications, databases and legacy systems in order to flexibly adapt IT systems to changes in business requirements. Krafzig et al. also emphasize the importance of mapping services directly to business entities, promoting SOA as a mean for enterprise integration on a business not so much on a technical level. Hagel III [15] also calls for web services that deliver "mission critical functionality" and are based on shared meaning not only on shared formats. Understanding that business-relevant service design is not the only requirement for a business-centric SOA, he develops a Service Grid consisting on Service Management, Resource Knowledge Management and Transport Management. Unfortunately, Hagel III's thoughts never get any specific but remain sketchy. Nevertheless, his and other authors' recognition of managerial perspectives on a SOA is the basis for our Business Service Management approach.

On the industrial side, there are multiple approaches on service management. However, most of them are technically motivated and aiming to manage an IT-infrastructure based on WebServices (e.g. [14], [16], [17]). They provide functionalities to assess, store and query service resp. interface specifications (mostly on data level) in

order to ensure a certain quality of service and to simplify the maintenance of the it-environment. The approach of SAP is going beyond [18]. It tries to leverage the technical service descriptions on a business level. However, in contrast to this business-driven approach, it is also technology driven. SAP relies on their BAPI specifications, describing interfaces to the R/3 ERP system and it is extending these interfaces to describe business activities. Due to this procedure, the services are fully aligned with the IT-systems, but may strongly differ from the business operations and strategic objectives.

6   Conclusion

We have presented business service management as an approach to leverage the beneficial characteristics of web services and service-oriented architectures in order to flexibly align business strategy and supporting information technology. Business processes have been chosen as the very context representing business requirements for SOA, i.e. an enterprise's static and dynamic structuring and its activities. The lifecycle of business service management includes the interdependent tasks that are to be performed in order to align business process and SOA via business services. Being a cycle, it emphasizes the fact that automating business processes through services leads to a continuous improvement of both business processes and information technology: The former is subject to optimization due to previous performance and subject to change due to external economical influences. The later also needs to evolve continuously given ongoing innovations in software, hardware, and services and ever increasing quality requirements. Given these freely flowing economical and technological variables, the layer of business services is to provide the very stability and transparency needed. As business success depends on the quality of business services, their design and maintenance must be thoroughly managed. We consider research questions how to identify and tailor business services most optimally most decisive for success or failure of the enterprise SOA. Upcoming research therefore must focus on the design phase of business service management. At the moment a prototype is being developed to demonstrate feasibility and advantages of the business service management idea, especially focusing on the analysis and design phase. It is designed as a wizard to support the equally business analysts and IT specialists. By integrating the approach into business process management concepts, we propagate a comprehensive solution that bridges the gap between existing business management and the upcoming challenge of SOA administration.

This concept was developed at the Competence Centre Business Integration (CCBI), Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI), Saarbruecken. It addresses current research problems in the area of process integration and networked businesses by bringing together the business-oriented and the IT-views. The work is performed by clustering national and international funded research projects (esp. ArKoS, ATHENA, INTEROP, P2E2, VIDE), intending the development of solutions for a better interoperability in business networks.

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