Service oriented Enterprise-Architecture for Enterprise Engineering

Introduction

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I. POSITION STATEMENT

A. Enterprise Architecture

There is a more and more common understanding, that not the ownership of information technology resources but their management is the foundation for sustainable competitive advantage [1]. According to Ross et al. [2] , smart companies define how they (will) do business (using an operating model) and design the processes and infrastructure critical to their current and future operations (enterprise architecture), which guide the evolution of their *foundation for execution*. More and more companies would like their existing technology to enable their future capabilities. In [2] this capability to exploit the foundation, embedding new initiatives to make it stronger and using it as competitive weapon to develop new business opportunities is estimated as 5% of companies.

According to [2], building an effective foundation for execution has three prerequisites: (i) the operating model to involve a commitment to how the company will operate, which provides the necessary level of business process definition, integration and standardization for delivering goods and services to customers; (ii) the enterprise architecture to provide a long-term view of a company's processes, systems and technologies so that individual projects can built capabilities and not just satisfy immediate requirements; thus the enterprise architecture contains the organizing logic for business processes and IT infrastructure, reflecting the integration and standardization requirements of the operating model from a long-term perspective; (iii) the IT engagement model defines the system of governance mechanisms which should guarantee that business and IT projects achieve local and global objectives; in this sense the latter influences project decisions so that individual (local) solutions are guided by the enterprise architecture.

In the field of Information Systems and –in a broader sense- Enterprise Computing, the notion of "Enterprise modeling" refers to a collection of conceptual modeling techniques for describing different facets of the organization including operational (IS), organizational (business processes, actors, flow of information etc), and teleological (purposes) considerations [3]. Existing enterprise modeling frameworks stress the necessity of representing and structuring enterprise knowledge taking into account all these facets in order to develop IS and IT architectures that enterprises need. The contribution of the software systems to the realization of the business processes and consequently to the objectives of the company is of primary importance. A change in one of these facets of the organization implies multiple impacts on the two other facets. In other words, it seems unrealistic to consider an organizational change without any impact on the information system or an evolution of the IS which does not call into question the processes or even the objectives of the organization.

Thus a central means for the smart management of information technology resources is offered by enterprise architectures. Using enterprise architecture aims to ensure that enterprise strategy is aligned with processes and IT systems [4] [5]. An enterprise architecture [6], [2], [4] defines the interactions and articulations between business and information technology and their alignment or congruence. As shown in figure 1, enterprise architecture is used to map

the enterprise goal and strategy to the enterprise's resources (actors, assets, IT supports) and to take into account the evolution of this mapping. Enterprise architecture provides also documentation on the assignment of enterprise resources to the enterprise goals and strategy. To this end, advantageous patterns (best practices) can be reused and alternative design solutions can be compared. Furthermore, enterprise architecture may be checked for compliance with laws, regulatory rules etc. Enterprise architecture facilitates also to evaluate the performance and efficiency of the resources used.

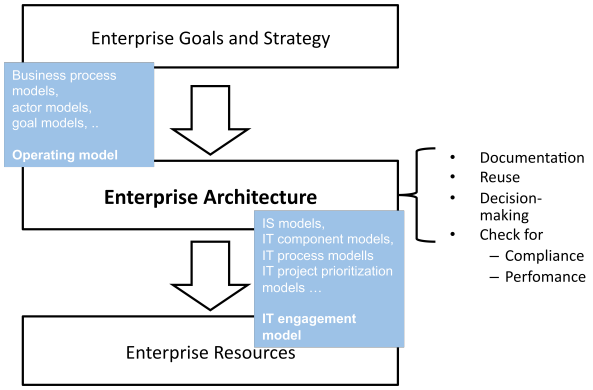

Figure 1. Enterprise architecture as an essential articulation between enterprise objectives and assets

B. *Services*

Services have become an impressive factor for growth and the creation of jobs. 93% of the new jobs created in the U.S. between 1970 and 2000 are jobs in services [7]. Leading enterprises in the U.S. derive more than 50% of their revenues from services [8]. This applies not only to pure services such as transportation but also for material products that are augmented by services such as maintenance, consulting and training. Through these services, enterprises stabilize their revenues. Therefore it is no surprise that the scientific interest in services has grown rapidly and has led to the creation of a services science [9]. At the same time, services have become popular as modules for enterprise architecture. Enterprise architecture defines the interaction between business and information technology. It describes the elements of this interaction and their possible aggregations. Thus, a service-oriented enterprise architecture uses service to describe the interaction of business and information technology.

For a long time, there had been no accepted general definition of service. However, nowadays there is growing support for the idea, that a service is "the application of specialized competences (knowledge and skills) for the benefit of another entity, rather than the production of units of output" [10]. Services are therefore considered as part of a so-called service system. A service system is defined [11] "as a value co-production configuration of people, technology, other internal and external service systems, and shared information (such as language, processes, metrics, prices, policies, and laws)".

The term service has also become very popular in enterprise computing. Three basic types of services can be differentiated: technology services, software-services, and business services.

1. **Technology services** are more hardware-flavored services, which are provided using computers. They may have a human addressee but contain many infrastructure services such as providing computing power, storage etc. They are an important topic in management and practice collections such as ITILV3 [12] or standards such as ISO/IEC 20000 have gained a high popularity.

2. **Software services** are managed in so-called Service-Oriented-Architectures [13] that are a popular paradigm for creating enterprise software. A service in the context of SOA is a special kind of interface for an encapsulated unit of software.

3. **Business services** are services, which directly support business processes. They may be further differentiated into those visible to the customer and those that are not. Business processes can also be developed dynamically (on -the- fly) using business services which are available in a repository for a given business domain.

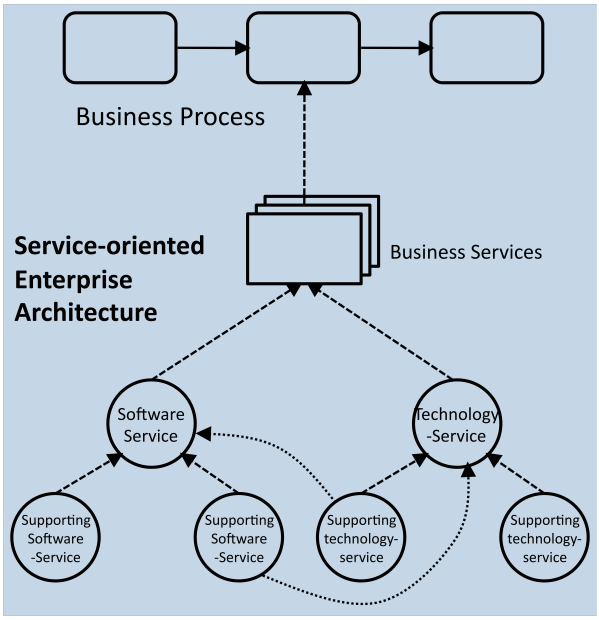

Figure 2. Types of services in a service-oriented enterprise architecture

II. GOAL AND OBJECTIVES

The goal of the workshop is to clarify the relationship between business process management and service provisioning. The objective is twofold:

(i) To characterize the strong relationship existing between Business Process Management and Service oriented Enterprise Architecture (SoEA)

(ii) To develop concepts and methods to assist the engineering and the management of Service-Oriented Enterprise Architectures (SoEA) and their support systems;

III. TOPICS FOR DISCUSSION

During the workshop the following topics have been considered for discussion:

A. *Service engineering*

- Do we need new paradigms to cope with service engineering?
- How are business services discovered, defined, composed, adapted?
- How are business services assigned to business processes?
- How are technology-services discovered, defined, composed, adapted?
- How are technology-services assigned to business services?
- Are there design patterns for developing service-oriented systems?
- How can the MDA/MDD techniques and methods be applied for engineering SoEA?
- Which test methods exist for technology-services?
- How are business services and technology-services rolled out?
- Which change management procedures have to be applied during the deployment of SoEA?

B. *Service management*

- Which benchmarks and key performance indicators should be applied to services?
- Which information system architectures are adequate for services?
- Which approaches exist for mastering the migration of legacy systems to SoEA?
- Which triggers exist and what mechanisms should be applied for escalation?
- Which approaches exist for the continual improvement of services?
- Which evaluation and validation techniques can be applied for SoEA?

C. *Alignment with business strategy*

- Which interdependencies exist between services and business strategy?
- Which concepts and methods are necessary to align services with the business strategy?
- Which new potentials to reengineer business processes are created by services?
- How are services aligned with compliance requirements?
- How are compliance and governance requirements enforced?

IV. MAIN ORGANIZATIONAL ASPECTS

SoEA@EE workshop is a full day workshop in conjunction with EDOC'09.

We received 14 submissions from Belgium, France, Germany, Iran, New Zealand, Norway, Philippines, Sweden and USA. All of them have been peer-reviewed by three members of the international program committee. Two of them have been transmitted to other EDOC workshops and accepted.

Five full papers have been presented during the SoEA@EE workshop.

A. *Papers presented at SoEA@EE'09*

The first paper, *Business service identification and modeling with context support*, presents an approach, called PROSERVE, based on a service context scheme and service trees, to overcome the shortcomings of existing service modeling frameworks.

Espen Moeller (Oslo University Hospital) and Arne J. Berre (SINTEF ICT, Norway), argue that encapsulation and black-boxing of business processes reduces complexity and makes it easier to consider outsourcing to both external partners and IT. Thus, it is up to the service providers to cope with the complexity in how to produce their services and how to deliver them accordingly to a service contract. Authors provide a matrix to describe how different types of participants can interact within and across domains, and derive rules for extracting context-views and context-interaction for services. They also highlight that the semantics of the term service is dependent on the context it is being used in. In fact, in business, the core concept of service is exchange of value [14].

Moeller and Berre were asked to model a service for sending appointment reminders to patients from Oslo University Hospital. Since missed appointments at the hospital have major economic consequences, an appointment reminder service was considered in order to reduce the problem. The paper reports us that for the hospital, it was important to reduce the complexity of descriptions on how entities in the enterprise interoperate and to focus on value transfers in the organization. This allowed them to analyze and identify how realization of services can cause increased

expenses on other organizational entities through required services, and keeping track of the expenses in the enterprise as a whole.

In summary, PROSERVE uses the services metaphor as an artifact for business modeling within business architecture. It is used primarily in the meaning 'conceptual service' or 'business-as-a-service' (BaaS) [15].

The second paper, *an enterprise architecture framework for application consolidation in the Swedish Armed Forces*, is about an increasing service orientation in the Swedish Armed Forces.

The statement underlying the presented work is the following: With increasing competition, smaller budgets and growing cost-awareness, consolidation projects have recently become popular among enterprise IT decision makers. Accordingly, 'to help manage IT portfolio' has been identified as one of the top reasons for using Enterprise Architecture in large corporations [16].

Ulrik Franke and Pontus Johnson (Royal Institute of Technology, Sweden) report in this paper that the service orientation of MODAF since version 1.2 was largely due to the bilateral collaboration between the UK and Sweden and attest that restructuring a large and diverse application landscape into the service-oriented paradigm is not easy. The application consolidation project presented is qualified as having a crucial role in enabling a greater service-orientation, by documenting and eventually transforming the application landscape in order to make it more efficient and more transparent.

Franke and Johnson develop first a general model of application consolidation decision-making. Some consolidation benefits commonly cited are (i) lower total cost of ownership, (ii) improved service levels and availability, and (iii) reduced business risks which can have -negative- impacts on each other. Authors suggest to model the problem using the framework of decision theory [17], and thus to express it in terms of a cost-benefit analysis. Each application in the enterprise must then be identified with a cost and a utility and to make as rational decisions as possible, these costs and utilities should all be weighed together. Then they define how to get good estimates of the data needed for this decision-making. Finally, they discuss about the problems arising when dealing with intertwined application landscapes and suggest the use of two techniques: a mathematical formalism for probabilistic descriptions of entities connected to each other, and MODAF, an Enterprise Architecture Framework developed by the British Ministry of Defence in cooperation with other partners such as Sweden.

In summary, this paper provides an analysis and description of application consolidation from the perspective of decision theory. The problem is formally characterized as a large optimization problem in random variables, and the practical problems of treating it are discussed. The insights from the decision theoretical framework are applied to create a more practical framework for application consolidation. Finally, the use of this framework is discussed, and the use of scenarios to aid decision-making is proposed, along with a tentative criterion on how to evaluate the scenarios.

The third paper, *gap analysis of application landscapes*, introduces one typical constituent of evolution towards service orientation making extensive use of enterprise-specific information.

Matthias Postina, Igor Sechyn and Ulrike Steffens (OFFIS Institute for Information Technology & University Oldenburg, Germany) argue that SOA is no longer considered a technical solution combining web services over standardized interfaces and protocols. Instead, SOA is conceived as a conceptual approach in order to align enterprise IT systems with the business strategies and processes they are supposed to support. The notion of "service" as the lowest common denominator of business and IT seems to offer an adequate starting point for consolidating IT application landscapes according to business needs. Combining services in new service choreographies promises a flexible, easily adaptable and thus sustainable IT support.

The approach presented in this paper and prototypical implementation for the gap analysis of current and ideal application landscapes are considered by Postina, Sechyn and Steffens as a building block for more general architecture development methodologies like for example proposed by the TOGAF Architecture Development Method. The gap analysis measures the distance between two states of the application landscape by applying and aggregating a set of metrics specifically aimed at the context of architecture development. It results in a list of concrete actions, which can be considered for landscape migration planning and hence can be a helpful instrument for enterprise architects.

In summary, this paper introduces gap analysis of application landscapes as building block for overall architecture development. It defines the term distance for application landscapes and introduces a prototype able to measure distance over a period of time. Measures to overcome structural deviations of the current application landscape from the ideal application landscape are provided as starting point for architects to define a road map including a number of interim target application landscapes for architecture evolution.

The fourth paper, *towards a holistic framework for describing and evaluating business benefits of a service-oriented architecture*, proposes a holistic framework for evaluating the business benefits of SOA.

Ulrike Abelein, Francois Habryn (Karlsruhe Service Research Institute) and Alexander Becker (Techniche Universität Darmstadt, Germany) argue that while research on the technical perspective is in an advanced state, the economic questions of SOA have not been answered, neither in theory nor in practice [18], [19]: many companies struggle to measure the benefits of SOA projects and in several cases there have been disappointments as value expectations were set too high. They also consider that a challenge to determine the benefits of SOA is that its impact cannot be measured easily and needs to be described along various criteria such as efficiency, increased insight into the organization, or agility. The analysis of existing work provided in this paper shows that only a few approaches support practitioners in this evaluation.

Abelein, Habryn and Becker collected 29 business benefits of SOA from various scientific and practical papers and books, including an expert study on SOA value potentials [20]. They justify this broad selection based on the alignment of theory and practice and the need for a holistic approach. Furthermore, they analyzed and categorized the business benefits in a 2-dimensional matrix. The first dimension consists of the enterprise area in which SOA has impact. Their analysis led the authors to categorize the business benefits in three so-called enterprise layers: technical, organizational and strategic. The second dimension denotes the economic type of the business benefit. Based on existing methods for determining the business impact of IT systems (e.g. the Business Case approach [21]) and other SOA-specific approaches [22], [23]) presented in the paper, Abelein *et al* have defined four different economic types: revenue increase, cost reduction, quality improvement, and risk minimization. Finally, additional attributes defined for each business benefit aim to ensure that there is no ambiguity regarding the meaning of the business benefits.

In summary, this paper provides an overview of a framework for describing and evaluating the business benefits of SOA. Based on 29 business benefits collected from several literature sources, authors developed a 2-dimensional matrix for structuring these business benefits and mapped these benefits inside the matrix. Afterwards, they selected three benefits, to show one example from each enterprise layer: “Reduced Complexity of the IT Infrastructure”, “Improved Support of Business Processes” and “Increased Agility”.

The fifth paper, *DYNSEA- a dynamic service-oriented enterprise architecture based on S-D-Logic*, presents Enterprise Architecture as an essential basis for aligning enterprise strategy with IT resources.

Rainer Schmidt (HTW-Aalen) and Axel Kieninger (Karlsruhe Service Research Institute, Germany) differentiate heterogeneous and homogeneous enterprise architecture approaches. They define heterogeneous enterprise architectures as the ones, which integrate different paradigms e.g., services and processes equally. On the contrary, homogeneous approaches have one dominant paradigm, e.g. service that determines the overall structure of the enterprise architecture. Authors also define and differentiate dynamic and static enterprise architectures. Dynamic enterprise architectures define mechanisms for adapting them to changed external conditions or to react on events. Static enterprise architectures need to be adapted using mechanisms external to the architecture.

The contribution of this paper is to create DYNSEA, a homogenous and dynamic service-oriented enterprise architecture, using a new perspective on economic exchange – the so-called Service Dominant logic. DYNSEA consists of interacting service systems, co- creating value with an actively involved customer, called prosumer. Based on abstract principles from the so-called Service Dominant logic (S-D logic) [24], the macro architecture is first developed. It describes the interaction of service systems as basic elements of the Enterprise Architecture. Authors argue that the main purpose of service systems is to ‘design, propose, agree and realize’ value propositions with other service systems [25]. In opposition to classical industrial production, S-D-Logics considers interaction with the Customer not as an add-on, but as a prerequisite to render service. The interaction process is a common process between service provider and customer, who is called prosumer, due to his active involvement [26].

Then, the internal structure of this service system, the micro architecture is developed. In addition to functional properties, also non-functional ones and so-called meta-services contribute to the value created by the service. These three dimensions define a service. The value judgment a service system applies within a particular service relationship depends on the types of services involved. There are in fact different forms of value judgments such as monetary value or reputation value. For example, the value of train connections offered is not only determined by the transport from A to B but also influenced by the reliability of the connection. Also meta services influence the value created. Meta services are services, which operate on the functional and non-functional properties of a service. For instance, a meta service may provide the possibility to measure the availability of a service and to redefine targets for availability. Also the possibility to complain about a service violation is a meta service.

In summary, DYNSEA inverses the structure of existing Enterprise Architectures. Services are considered as the first class objects, supported by processes in the service units. According to the authors, within most standard BPM [27] models of enterprises, services are subordinate to processes.

B. Discussion session

The aim of the discussion section is to deepen the common understanding of service-oriented enterprise architecture and its associated methods. To achieve this, a questionnaire distributed to the participants is used. It contains questions about the fundamental understanding of service-oriented enterprise architecture, and presents status and possible further developments.

C. SoEA@EE Workshop Program committee

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D. Organizers

Selmin Nurcan is Associate Professor at the Business School of the University Paris 1 Panthéon Sorbonne and a researcher at the 'Centre de Recherche en Informatique' (CRI). She has a Ph.D and an engineering degree in Computer Science. Her research activities include enterprise computing, business process management, change modeling, and business/IS alignment, process (re)engineering and IS engineering and CSCW. She has actively participated in research projects in collaboration with the industry. Selmin Nurcan is co-organizer of the BPMDS workshop series at CAISE, the BPMS02 workshop at BPM, co-chair of the "Business Process Management" Track during the four last editions of the IRMA International Conference and member of IFIP WG 8.1. She is acting as a program committee member of a number of international conferences and workshops and she is serving on the editorial boards of International Journal of Innovation and Learning, International Journal of Information System Modeling and Design, International Journal of Information Systems in the Service Sector, the editorial advisory board of the Advances in End-User Computing Book Series, and she is the associate editor of the e-journal on Advances in Enterprise Systems.

Rainer Schmidt is Professor for business information systems at Aalen University. He has a Ph.D. and an engineering degree in Computer Science. His current research areas are service science, business process management, social software and the integration of these themes. Rainer Schmidt is co-organizer of the BPMDS workshop series at CAISE, the BPMS02 workshop at BPM2008 and member of the program committee of several workshops and conferences. Rainer Schmidt is serving on the editorial boards of International Journal of Information Systems in the Service Sector and International Journal on Advances in Internet Technology. Rainer Schmidt applies his research in a number of projects and cooperations with industry. He has industrial experience as management consultant and researcher.

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