SERVICE ENGINEERING FOR FUTURE BUSINESS VALUE NETWORKS

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Abstract: Traditionally, business value networks have orchestrated human and technical resources that worked together to form relationships and to add value to a product or service. The Internet and the Web have extended traditional business networks by allowing also a web of different digital resources to work together to create value. Additionally, the increasing adoption of service-oriented architectures has allowed the creation of service ecosystems in which Web services are exposed and connected. The TEXO project proposes to combine these two trends to create what is called Future Business Value Networks which enable IT-supported value networks via service ecosystems. This paper addresses the main challenging issues that need to be explored to provide an integrated technical infrastructure to support this emerging new type of business networks.

1 INTRODUCTION

Throughout the years, organizations have always tried to introduce new business models to gain a competitive advantage over competitors or to explore hidden markets. For example, IKEA introduced the concept that people could transport the merchandise and assemble the furniture by themselves. eBay gained an early competitive advantage by being the first-to-market with a new business model based on auctions. Dell was able to bypass distributors, resellers, and retailers and use the Internet to reduce costs. In all these examples, the new or adapted business models are often derived from the human perception that something could be done in a different way. The idea comes very often from intuition and it is driven by a business need.

Recently, the concept of a new business structure, termed Future Business Value Networks (FBVN), emerged. A FBVN is characterized as an architecture which describes organizational models with configurations of value adding collaborations within cooperative social networks among enterprises, organizations, and individuals in order to achieve a common set of goals enabled through specific infrastructures such as the Internet of Services (IoS) (Schroth and Till, 2007).

A FBVN combines and bridges two important perspectives: business networks and IT infrastructures. The business perspective describes how groups of organizations work together to deliver a service to customers. For example, the business perspective of a value network may include research, development, design, production, marketing, sales and distribution. These components work interchangeably to add to the overall worth of a product or service. Value is created from the relationship between the company, its customers, intermediaries, complementors and suppliers.

The IT perspective provides a global description of standards, tools, applications, and architectures available to support the business perspective. Currently, the service-oriented architecture paradigm has gained mainstream acceptance as a strategy for consolidating and repurposing applications to be combined with new applications in more dynamic environments, through configurable services. Services, once in place, can interoperate with other services, be composed into long-running business processes, span intra- and inter-organizational boundaries, and be procured through different business domains and market sectors. In this paper we describe the efforts being made in the context of THESEUS/TEXO project to support the concept of FBVN. We enumerate the challenging areas that need to be explored to provide fundamental insides on research to allow the implementation of FBVN.

The remaining of this paper is structured in three main sections. In Section 2, we briefly describe the THESEUS/TEXO project. In Section 3, we identify a set of requirements that need to be addressed to support the concept of FBVN to provide, create and drive a new "service industry" for producing, changing, adapting, (re)selling, and operating services in a Web-based business service economy. In Section 4, we discuss the importance of Service Engineering (SE) for FBVN. SE is a new discipline that will enable the development and implementation of technological solutions based on the Internet of Services to support FBVN.

2 THE TEXO PROJECT

The THESEUS program (Theseus, 2008) is a major research initiative funded by the Federal Ministry of Education and Research in Germany. THESEUS program targets the development of prototypes based on new emerging technologies and test them in six application scenarios. The purpose of the tests is to find short-term ways of converting new technologies into innovative tools and commercially-viable services for Internet-based networks.

As stated, the development of concepts and prototypical implementations are organized around six application scenarios: ALEXANDRIA (Consumer oriented knowledge database), CONTENTUS (Safeguarding cultural heritage), MEDICO (Towards scalable semantic image search in medicine), ORDO (Organizing digital information), PROCESSUS (Optimization of business processes), and TEXO (Business Webs in the Internet of Services).

TEXO (Texo, 2008) main goal is to develop new business models for the Web. The infrastructure to be developed will be independent of any individual company and will provide the new generation of marketplaces for (Web) services. The TEXO use case comprises the overall research vision which attempts to identify business models and technologies for the IoS research vision. It targets the development of an (open) platform for the development, distribution and provision of (business) services by supporting FBVN.

3 FBVN REQUIRMENTS

The support of FBVN requires identifying and understanding the challenges to address to provide solutions to realize this vision. As we have seen, a FBVN bridges business networks and IT infrastructures perspectives. As a result, FBVN requirements need to have a strong emphasis on the business and IT sides. Therefore, the following topics need to be analysed, studied and framed within FBVN:

- *Legal, Community Aspects and Business Models*. The implications of FBVN need to be studied from a legal perspective. The combination and integration of world-wide regulations is fundamental. A special emphasis has to be given to the generation of new business models for all stakeholders (i.e., service providers, brokers, and consumers) and corresponding incentive mechanisms. Community aspects encourage cooperation, innovation and boost innovations through the extensive exchange of knowledge.
- *Service Innovation*. Efficient approaches for fostering innovation are required. Innovation suggestions can be derived from successful and unsuccessful discovery efforts made by service users, from service communities or from information sources in the Internet.
- *Service Governance*. Governance addresses the strategic alignment between business services and business requirements thereby reducing risks and assurance compliance with rules and regulations.
- *Service Delivery Platform*. An infrastructure for service delivery has to be provided for technically enabling businesses to participate in FBVN. This infrastructure has to be scalable with respect to complexity, i.e., its users must be able to counter the intricacies of distributed systems.
- *Service Engineering*. Involves and integrates the software and service providers by providing methods and tools for constructing and deploying services.
- *Platform Services*. Platform services are provided directly by the platform supporting a FBVN and include brokering, mediation, billing, security and trust services.
- *Management of Services*. The ability to freely compose and orchestrate business functions which are available as services on a diversity

of market places bears overwhelming opportunities.

- *Security and Trust*. Trust and trustworthiness of service offerings must be facilitated by the platform, balancing individual requirements, policies, and must be capable of adapting to the given business context.

While all these topics are important to support the vision of FBVN, we will concentrate our study on the emerging research discipline termed *Service Engineering*.

4 SERVICE ENGINEERING

One recent development that it is believed to allow organizations to support the notion of FBVN is the adoption of Service-Oriented Architectures (SOA). The OASIS SOA Reference Model defines SOA as "*a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains*" (OASIS, 2006). With SOA, designers of services are facing the challenge of gaining a deep understanding of the business for which they are developing solutions with the right scope and granularity. Designing services is not only a technical undertaking; it is the job of analyzing the business environment and business processes, and identifying business functions that could be implemented as a service. It should be noticed that it is frequently impossible to implement an innovative business model without, eventually, rely on the underlying IT infrastructure. This constitutes a major problem since there is a considerable gap between these two complementary worlds. Therefore, one challenge lies on bridging the gap between business and IT. This challenge requires a set of design principles, patterns, and techniques that has not been precisely identified yet.

4.1 Definition

The set of activities involved in the development of SOA-based solutions in a systematic and disciplined way that span, and take into account, business and technical perspectives can be referred to as service engineering.

*"**Service Engineering** is an approach to service-oriented development that provides a platform for using models and techniques to guide the understanding, structure, design, implementation, deployment, documentation, operation, maintenance and modification of services."*

Service engineering is a structured approach for describing a part of an organization from a service perspective that expresses the way the organization works. The approach should systematically translates an initial description from a natural language that expresses the way stakeholders think and communicate about the organization through a sequence of representations using various models to a representation that is accepted and understood by a FBVN.

Developing and implementing SOA has become one of the major chores for organizations. Dealing with hundreds of services may be seen, from a management point-of-view, as difficult as managing hundreds of human resources inside an organization, requiring a dedicated department, specialized staff, and adequate methodologies.

4.2 The ISE Methodology

Compared to other approaches, the methodology which we are developing (the ISE methodology), not only focuses on a technical perspective, but also focuses on a deep and prominent business perspective when developing business services for the IoS. Since the notions of abstraction (perspective) and artifacts (important concepts) were important for our approach, we have followed an approach based on the Zachman framework (Zachman, 1987) to support service engineering.

	Service	Workflow	Data	People	Rules
Scope Model {contextual}	TXT, VISIO, PPT description of services	TXT, VISIO, PPT description of the workflow	TXT, VISIO, PPT description of data assets	TXT, VISIO, PPT description of organizational units	TXT, VISIO, PPT Goals and strategy
Business Model {conceptual}	Formal definition of functional/ non-functional requirements	Formal definition of functional/ non-functional, BPMN	Interrelations between semantic data assets	Organizational chart	Business plan (rules and constraints)
Logical Model {system}	(semantic) Interface, message, format, data, etc	BPMN+	Semantic data model	Interaction between people and service/processes	Business rule model
Technical Model {physical}	SAWSDL, WSDL, SOAP, WS-Policy, XML Schema, XML, WSMO, etc	WS-Policy, WS-CDL, WS-CI, BPEL	OWL, RDFS, XML Schema, XML	GUI between people and services/processes. Security model WS-policy	RuleML, SWRL
Runtime {operational}	WP7/WP10	WP7/WP10	WP7/WP10	WP7/WP10	WP7/WP10

Figure 1: Perspectives and artefacts of the ISE methodology.

Each of the perspectives (layers) of the ISE methodology (Figure 1) can be regarded as a phase in the development process of business services. Thus, the models and methods which are assigned to each of the layers support the development process from different view points (e.g., strategic, business, logical, technical, implementation, and runtime).

For all the layers we have developed major artifacts which should be considered in the business service development process. These artifacts include important elements such a data, people, rules, etc. Models and methods (e.g. balanced scorecards, UML, mind maps, BPMN, BPEL, OWL, OCL, etc.) are assigned to the intersection of an abstraction layer and to one of the artifacts. Figure 2 shows the various layers of abstraction for business services.

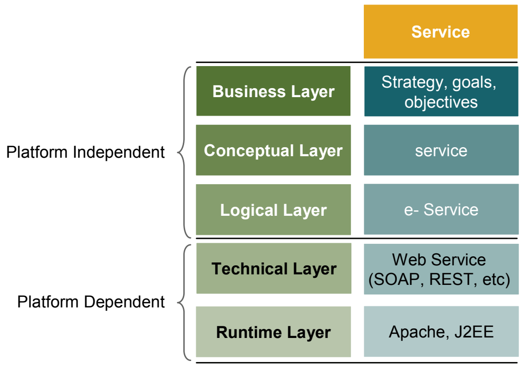

Figure 2: Services abstractions within ISE.

At the business layer, the development of a service is triggered, typically but not always, by the planning process, where strategies, objectives and performance measures (KPI) that can help an organization to achieve its goals. Fundamental services can often be derived from the strategic planning activity of an organization. Other elements that are typically part of the strategy, or direction, of an organization include resources, capital and people. Models and techniques that can be used to identify fundamental services at the business layer include the SWOT and PEST analysis. Once a list of services is identified – that is deemed necessary for the organization to stay competitive – the service engineering process will proceed with the analysis of the conceptual layer, the logical layer and the technical layer. Once a full technical specification of the service is created, the service is sent to the runtime platform for execution. For services, the business layer, the conceptual layer, the logical layer, and the technical layer give a different perspective for stakeholders (i.e. CEO, CTO, CIO, architects, programmers, etc.) to services.

4.3 The Service Stack

The terms Service, e-Service and Web service have been widely used to refer, sometimes, to the same concept and other times to different concepts. These terms are generally used to identify an autonomous software component that is uniquely identified by a URI and that can be accessed using standard Internet protocols such as XML, SOAP, or HTTP. Baida, Gordijn and Omelayenko (2004) have identified that the terms "Service", "e-Service" and "Web service" actually address related concepts from different domains such as computer science, information science and business science. We believe that a deeper understanding of those concepts needs to be made in order to conceptually separate and address the various stakeholders involved when architecting an enterprise wide solution based on services. Therefore, we introduce a set of definitions for ISE.

Service. In business and economics, a service is the non-material equivalent of a good. In these domains, a service is considered to be an activity which is mostly intangible by nature. Services are offered by a provider to its customers. A service should be interpreted as an act of economic nature, rather than an operational action. Since our methodology also includes a business perspective to services, we adopt the definition of 'service' as it is understood in the business research community. Examples of traditional services include *processing an insurance claim*, *typing a letter*, and *filling a form*. To be most effective, the service engineering lifecycle needs to begin at the "beginning", with a strong emphasize on business.

E-service. With the advances made by the Internet, companies started to use electronic information technologies for supplying services that were to some extend processed with the mean of automated applications. At this stage, the concept of e-service (Rust and Kannan, 2003), electronic- or e-commerce was introduced to describe transactions conducted over the Internet. Examples of such transactions included purchasing books, and other products, requesting for services and transmitting insurance claims electronically. The main technology that made e-commerce a reality was computer networks. Initial developments included on-line transactions of buying and selling where business was done via Electronic Data Interchange (EDI). While many definitions for e-services can be found in the literature, we will use the definition given by (Hull et al., 2003) since it adequately matches the service model: "a e-service is a collection of network-resident software services accessible via standardized protocols, whose functionality can be automatically discovered and integrated into applications or composed to form more complex services." Therefore, we consider that "e-services" are a subset of "services" (Figure 3).

Figure 3: Relationships between Service, e-Service and Web service.

E-services are services, for which the Internet (or any other equivalent network) is used as a channel to interact with customers. It is the provisioning of services over electronic networks. It should be pointed out that this definition implies that the ability to withdraw money from an ATM machine is supplied trough an e-service. E-services are independent of the specification language used to define its functionality, non-functional properties or interface. There is some common agreement that e-services imply the existence of business functionalities behind the software.

Web services. Web services are e-services based on software or applications to be used on the Internet that are made available for end users using Web-based protocols or Web-based programs. Separating the logical and technical layers specifications of a service leaves open the possibility for alternative concrete technologies for the service. A Web service is a Web resource that is constructed to be consumed by an autonomous and automated application as opposed to a Web page which is typically handled by humans. Nowadays, we can identify three types of Web services: RPC Web Services, SOA Web Services, and RESTful Web services.

RPC Web Services bring distributed programming functions and methods from the RPC world. Some researchers view RPC Web services as a reincarnation of CORBA into Web services.

SOA Web Services implement an architecture according to SOA, where the basic unit of communication is a message, rather than an operation. This is often referred to as "message-oriented" services. Unlike RPC Web services, loose coupling is achieved more easily since the focus is on the "contract" that WSDL provides, rather than the underlying implementation details.

RESTful Web Services are based on HTTP and use a set of well-known operations, such as GET, PUT, and DELETE. The main focus is on interacting with stateful resources, rather than messages or operations (as it is with WSDL and SOAP). Roy Fielding (2000) describes REST objectives in the following way: "The name 'Representational State Transfer' (REST) is intended to evoke an image of how a well-designed Web application behaves: a network of web pages (a virtual state-machine), where the user progresses through an application by selecting links (state transitions), resulting in the next page (representing the next state of the application) being transferred to the user and rendered for their use."

5 CONCLUSIONS

TEXO proposes to support the vision of the Future Business Value Networks (FBVN) enabling IT-supported value networks via service ecosystems. Such future business value networks will provide the opportunity to create and drive a new "service industry" for producing, changing, adapting, (re)selling, and operating services. By providing a holistic approach, TEXO will be able to contribute to the larger topic of a Web-based business service economy.

FBVN can only be successfully deployed if important topics, such as legal issues, community aspects, new business models, service innovation, service governance and service engineering are exploited.

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BRIEF BIOGRAPHY

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