IT service management supported by semantic technologies

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Abstract—Main objective of this paper is to present the idea of semantic structures to support IT Service Management processes. Utilizing the principles of Semantic Web and knowledge technologies with the standardized IT service management processes can provide a framework for designing and maintaining interoperable service-based applications. In presented paper we describe the conceptual framework for developing a semantic model of ITIL, one of the selected ITSM frameworks, and also discusses future work including the implementation and planned testing environment.

I. IT SERVICE MANAGEMENT

To precisely define what a service management is, it is needed to specify what the service is, more concrete, what is the IT service. According to [14] a service is a means of delivering value to customers by facilitating outcomes customers want to achieve without the ownership of specific risks and costs. This definition of service is rather general. Speaking of IT services we will consider the services that in some way facilitate ICT technologies to its use. Then, a simple example of IT service and customer outcome satisfied by this service can be:

Customer outcome: “Sales people spending more time interacting with customers” facilitated by service: “Remote access service that enables reliable access to corporate sales systems from sales people’s laptops”

To ensure, that the IT services satisfies the customer’s needs and to use corresponding ICT technologies effectively, these have to be put under specialized management processes. This discipline is called Service Management, and it is a set of specialized organizational capabilities for providing value to customers in the form of service.

IT Service Management evolved during the time into the highly standardized framework based on best practices. Best practices evolved into the industry standards management of ICT (ISO/IEC20000) and also into the public domain frameworks such as ITIL, or CoBiT. In the next section we briefly describe one of them – ITIL.

II. IT INFRASTRUCTURE LIBRARY

ITIL (IT Infrastructure Library) is a framework that describes best practices in the IT service management. Library is public and nowadays, in its third version, consists of 5 core publications. Office of Government Commerce (OGC) published initial version of ITIL in 1989 in Great Britain. It has been revised into the more connected and consistent ITIL V2 and in 2007 it was enhanced and released as ITIL V3. ITIL V3 consists of 5 core books that cover the whole lifecycle of the service. Different stages of service lifecycle are depicted on Figure 1. The figure shows each stage of the lifecycle from initiation from requirements from business. Its main stages are also connected to ITIL core publications. Main idea of the lifecycle is, that all activities and processes are business driven, its initial definition and analysis is covered by Service Strategy and Service Design stages.

Service Transition describes the migration into the live environment and Service Operation and Continual Service Improvement publications describe the real operation of the services in business.

Implementation of the service lifecycle enables seamless integration into the business processes as well as ability to control and manage the services from initial requirements until the service is operative.

Service Strategy focuses on helping the organizations improve over the long term. It covers some key topics including the service value definition, business case development, service assets, market analysis and also defines corresponding processes for management of assets, service portfolio, finances.

Service Design aims more specifically on designing of IT services and processes. Service Design means to
consider all elements that can be relevant to technology service delivery.

Service Transition covers the area between design of service and its transition into the operational use and describes the corresponding processes (Change Management, Release Management, Service validation, testing etc.).

Service Operation is the part of the lifecycle, where the services are actually deployed and are in operational use. It covers wide range of processes and functions including the monitoring of the services and problems and management between the service reliability and its costs.

Continual Service Operation then describes the processes and activities to monitor and maintain specified levels of service in order to provide values satisfying customer needs.

III. USE OF SEMANTICS IN IT SERVICE MANAGEMENT

The idea of semantically enhanced ITSM was invoked by general principles of Semantic Web [2], especially when they were applied on SOA-based solutions. Such applications are usually designed as compositions of services and sub-processes orchestrated into a workflow structure. The management of services in this type of applications is ensured by defined workflow sequences, which are formalized as abstract and executable business processes [12]. Managing IT services thus means designing properly the corresponding business process models for desired service workflow. Actually, the modeling of abstract business processes is tightly related to the Service Strategy and Service Design phases defined in ITIL, while the design of executable processes corresponds to the Service Transition phase of ITIL.

Figure 2. SCM ontology

Moreover, to assure the service interoperability and data mediation, the services in the workflow can be semantically described by means of a shared knowledge model (ontology), which provides a common vocabulary for information exchanged between possibly heterogeneous services. This feature is especially important for ITIL phases of Service Operation and Continual Service Improvement, since it enables seamless communication between services according to the meaning of input and output values, dynamic discovery and selection of services in a running workflow, as well as a relatively easy replacement of a service with an alternative service. The advanced technology of these so-called Semantic Web services [15] is quite frequently used nowadays and is supported by semantic frameworks such as OWL or WSMO. In a combination with business process modeling, the Semantic Web services should be capable to serve as a methodological and technological platform for developing modular service-based solutions in line with all the phases and processes of ITSM.

The vision of semantic business process modeling was formulated in [8] and was further elaborated in numerous research initiatives such as, for example, the Object Management Group (http://www.omg.org), European FP6 R&D projects STASIS (http://www.stasis-project.net), OPUCE (http://www.opuce.tid.es), or SUPER (http://www.ip-super.org). The project SUPER is probably the most comprehensive attempt towards the implementation of semantic business process modeling environment [1]. The aim of this project was to achieve a higher degree of automation in discovery and mediation of co-operating services. The use of semantic technologies as Semantic Web services in the process modeling, service configuration, execution, monitoring, and analysis is envisioned as a method that can overcome the heterogeneity and incompatibility problems towards the semantically interoperable services. It may also help to reduce the human intervention throughout the lifecycle of business process modeling [10]. However, in the project SUPER as well as in other mentioned research activities there is no direct and explicit support for ITIL phases. It means that, to be applied in practice in the environment of IT enterprises, the proposed solutions of semantic process models need to be mapped into ITIL best practices or standardized ISO/IEC 20000 requirements.

From perspective of ontology modeling for particular ITSM phases, several existing approaches exist. For example, SCM Ontology [16], depicted on Figure 2., describes the ontology for Configuration Management phase. It serves as unified taxonomy in order to maintain change management processes by providing the common vocabulary for configuration database and configuration items. In [17] an rather generic approach for IT service modelling is introduced. Main aim is to focus on several aspects of IT services, such as infrastructure management, software outsourcing.

On the other hand side, there exists a wide variety of commercial as well as open source tools supporting all the ITIL phases and the respective processes. These tools are regularly evaluated and compared on well-known web portal of Pink Elephant (http://www.pinkelephant.com). However, focus of these tools is solely on ITIL and a support of semantically enhanced services or processes is lacking.
It seems that there is a gap between the enterprise practice, which is focused mostly on ITIL and related standards, and the research community trying to investigate in the area of Semantic Web. There are some attempts to overcome this gap, for example [13]; in general, however, it can be stated that the research and development in modeling ITIL practices by semantics is still in its beginning.

IV. SEMANTICS AND IT SERVICE MANAGEMENT IN SPIKE PROJECT

EU FP7 project SPIKE (http://www.spike-project.eu) focuses on semantic-based integration of IT services, organized into a structure of predefined business processes. Main objective of the project is to develop the platform for secure, open and flexible collaboration of enterprises in short-term project-oriented business alliances. The SPIKE platform was designed as a “market place” that enables contracting, invocation, execution and monitoring of services provided and consumed by the business alliance members. The services are organized into the predefined value chain, which is specified by a workflow of sub-processes and tasks grounded in the services of several types – web services, electronic on-line services, or tasks performed by human actors. Interoperability of these heterogeneous services is achieved by semantic extensions over the formalized WSDL service description.

The overall SPIKE platform integrates external services into the process workflow thus alignment with IT service management principles and standards is natural. Indeed, all the phases of ITIL can be identified during the setup and maintenance of business collaboration. The Service Strategy processes can be applied during the specification of value chain, where is important to ensure its compatibility with business goals. Creation of business process models for the given value chain, definition of tasks organized into workflow structures, as well as grounding of tasks on concrete services is related to the Service Design lifecycle phase. The specified set of external services, including alternative or candidate services for some of tasks, can be considered as the service portfolio, which is the most important system in the Service Design phase [14].

The Service Transition phase corresponds in SPIKE to the process of establishing a business alliance for defined process model. The services are contracted on agreed level of quality, processes of change management, configuration management and release management are specified. This phase also includes a proper distribution of identities, access rights and credentials for all dedicated alliance members, consumers of contracted services, which allows accessing internal applications and resources on the side of alliance members in the role of service providers. The way of providing such identities, as it is applied in SPIKE pilot application of Identity Federations for setting up the collaboration within an established business alliance, is schematically depicted in fig. 2. On the side of SPIKE system, the process is supported by the authorized service requester.

BPMO model of the sub-process of ordering and contracting services is presented in Figure 3. This use case, which is a core of the Legacy Applications AC, is modeled as an interaction between three actors – Service requestor, Service provider, and the SPIKE platform. The Service requestor searches for a proper service (by the Service Search sub-process, which is modeled in a separate use case) and prepares an order for the retrieved service that matches with his/her business needs. Afterwards, the order is processed by the SPIKE platform. The Service provider is notified; the contract of usage is generated and forwarded to the requestor. After accepting the contract the service is ready for usage. Optionally, the requestor may negotiate the contract details with the Service provider. Abstract business process models for all use cases of SPIKE pilot applications were created in a similar way and are accessible under a single root location of http://www.spike-project.eu/BPmodels/. Tasks in these process models can then be grounded to concrete services expressed in WSDL format. To ensure the interoperability of services in the process workflow, the service parameters (i.e. inputs, outputs, capabilities, etc.) need to be described by additional semantic structures – ontology concepts. For example, the process in fig. 3 requires, according to the ITIL specification, a formal contract on desired quality of provided service, together with precise conditions of the service usage. Such a contract, known as Service Level Agreement (SLA), is a document that contains specific and obligatory fields such as service scope, availability, reliability, customer support, performance, charging, responsibility, etc. These parameters of SLA can be specified as concepts in a shared SPIKE ontology and then may be used as semantic extensions of services dealing with formalized service contracts. In SPIKE, the SA-WSDL format of service annotation [5], WSML ontology format, and WSMO Studio toolkit [4] are employed for these purposes.

![Collaboration setup in SPIKE](image)
V. CONCLUSIONS AND FUTURE WORK

The described approach of integrating services into workflow structures by means of semantic structures indicates tight relationship with the IT service management principles and standards. It is, however, necessary to state that the presented SPIKE solution, at least in its first prototype finished in winter 2009, was not built primarily upon ITIL specification. Contrary, the testing of the first SPIKE prototype showed a necessity to adapt the ITSM processes modeled in SPIKE according to the ITIL best practices or ISO/IEC 20000 standards. It is especially important for ensuring wider acceptance and reliability of SOA solutions of SPIKE-like type.

Similarly, semantic structures supporting the shift of SOA solutions towards Semantic Web should be constructed with full respect to ITIL. The SPIKE ontologies developed for the first prototype of the platform do not precisely reflect ITIL concepts, name- ly in the management of incidents, problems, capacities and configurations. However, due to the complexity of ITIL, its semantic modeling is rather difficult and long-lasting task. A suitable approach could be to divide the ITIL into relatively independent parts such as particular phases and processes, which can be expressed by respective structures of ontologies and process models. At the Technical University of Košice, in the scope of Business Informatics field of study and in a co-operation with itSMF Slovakia (http://www.itsmf.sk), we have defined a series of themes for diploma thesis for designing and developing the semantic structures of ITIL parts. It includes, for example, ontology and process models for service design, service operation, configuration management, capacity management and incident / problem management. In parallel, the semantic structures will be employed and tested on finalized SPIKE platform, which will be used as a reference application for created models and ontologies.

ACKNOWLEDGMENT

The presented work is the result of the project implementation: Development of the Center of Information and Communication Technologies for Knowledge Systems (ITMS project code: 26220120030) supported by the Research & Development Operational Program funded by the ERDF.

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