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Ontological map of service oriented architecture for shared services management

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ABSTRACT

Service oriented architecture (SOA) and shared services (SS) have been widely studied in the information technology literature. However, there is a lack of tools for shared services management (SSM) to apply SOA. This paper proposes an ontological map for SSM to apply SOA. This mapping approach, based on the well-known Zachman framework of information architecture, specifies the ontological perspective of SOA for SSM. The ontological map semantically links all aspects of SOA for SSM. Through a case study, a design artifact of computerized ontological map of SOA demonstrates the usability of the artifact for SSM.

1. Introduction

Service oriented architecture (SOA) (Jeong, Cho, & Lee, 2009; Papazoglou & Georgakopoulos, 2003) and shared services (SS) (Rolia, Cherkasova, Arlitt, & Machiraju, 2006; Sabucedo, Rifon, Corradini, Polzonetti, & Re, 2010; Yuan & Fei, 2010) are two correlated streams of research into the alliance of business and information technology. SOA deals with information architectures that support service oriented computing for on-demand business applications (Huhns & Singh, 2005; Keen et al., 2004; Stal, 2002). SS, on the other hand, is the consolidation of common functions across multiple organizations to reduce information process duplication and increase information and knowledge sharing. SS provide new impetus of business sourcing strategies in using information technology (Janssen & Joha, 2006; Sako, 2010; Wang & Wang, 2007). Generally, accounting and financial management, human resources management, acquisition transactions, and customer relation management are the designated lines of business processes for SS.

Clearly, the major motivation for organizations to adopt SOA is to implement SS (Yuan & Lu, 2009), and the major technology foundation for the implementation of SS is SOA (Allen, 2006; Jung, 2011). In spite of the close connection between SOA and SS, the two areas are distinct from each other in many aspects. Generally, research reports on SOA have been focusing more on computational technologies (e.g., cloud computing, virtual Web service networks, and software standards), while studies on SS have placed more emphasis on organizational business process management through applications of information technology. From the standpoint of information technology management, integration of the two subjects is imperatively needed to establish SS management (SSM) that supports the transformation of business process requirements into service-centric computing. In our definition, SSM refers to organizational activities that coordinate the efforts of shared services partners to accomplish desired goals and objectives using shared services efficiently and effectively.

The information technology community has called for establishing multidisciplinary service science (Spohrer & Riecken, 2006). This study is to meet this challenge by integrating SOA into an SSM framework. This paper discusses the aspects of information architecture in the SSM context, and proposes the ontological map of SOA for SSM. The rest of the paper is organized as follows. Section 2 is a comprehensive literature survey on SOA which indicates a lack of tools for SSM to apply SOA. Section 3 discusses the Zachman information architecture framework, formalizes the aspects of SOA for SSM, and suggests the ontological map of SOA in the SSM context. Section 4 implements the proposed ontological map in the design research perspective, presents a prototype of computerized ontological map of SOA for SSM, and demonstrates the advantages of the proposed ontological map over the traditional free-format modeling approaches. Finally, Section 5 summarizes this study.

2. Literature survey on SOA: needs for SOA model for SSM

To investigate the current research trends of SOA, a comprehensive literature survey was conducted. Nine hundred forty (940) research papers on SOA published between 1990 and July 2012 were

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found in the ABI/Inform database, IEEE database, and ACM database. The majority of these papers were published in technical journals and conference proceedings. Two hundred twelve (212) published in the journals, which the authors considered noteworthy, were selected for thorough reading. The attention of reading was given to issues of SOA related to organizational information technology management. Our reading suggests that these papers can be fit into three categories: vision of SOA, benefits of SOA and measures, development of SOA for enterprise. A summary of the survey is exhibited in Appendix.

The literature survey reveals that the primary driver of SOA comes from the software industry to move from the development of large-scale applications to the building of reusable modules that can be shared across existing or new business applications (Varadan, Channabasavaiah, Simpson, Holley, & Allam, 2008). However, the survey did not show a practical tool of application of the SOA paradigm in SSM. This seems to be an explanation why the SOA paradigm has still received rather low adoption rates in the industry (Beimborn & Joachim, 2011). The concept of SOA is not entirely new, but the SOA movement has created many new research opportunities given the complex nature of SOA. In the technological areas such as computer science and electronic engineering, research on SOA focuses on the software standardization and software development at the technical implementation level. In the information systems area, research on SOA emphasizes on visions of SOA in business and the benefits of SOA at a higher level of business motivations. Few research papers on SOA that guide SS within the multiple organizations with common functionalities can be found in the literature, and little research has systematically analyzed how organizations apply SOA to improve their inter-organizational shared services networks (Lohe & Legner, 2010). As a result, SOA remains by and large a myth in response to business needs (Smith, 2009).

There have been countless models of SOA in the literature; however, few of them deal with information architecture aspects in the context of SSM regardless of the synergic relationship between SOA and SSM (Janssen, 2008). The research community and the software industry have few guidelines of SOA models for SS consumers. From the ontological perspectives, OWL-S (OWL-S, 2004) and well-recognized WSMO (WSMO, 2005) works have developed ontology languages for Web services, and intend to generalize taxonomies and vocabularies for Web services. However, these ontology languages are rather deficient in terms of visualization of ontology and human–computer interaction for service management. Research (Dustdar & Truong, 2012) has indicated that Web service management can be better accomplished through human–computer interaction. Without the support of visual ontologies, tagging all types of meta-data and relevant keywords to every Web services could be prohibitively expensive and will eventually make any search engine practically powerless. More importantly, Web service models should have two different views: users' view and designers' view to distinguish operational behavior and control behavior of Web services (Sheng, Maamar, Yahyaoui, Bentahar, & Boukadi, 2010). While an ontology for the designers of Web services describes the internal semantic organizations of Web services at the technical level, a visual Web service ontology is needed to provide the view for the business users in various perspectives to enhance the usability of Web services for diverse applications. A visual ontology that enables human–computer interaction can serve as a map to allow the user to search needed candidate Web services effectively. Our literature survey clearly suggests that there is a lack of modeling methodology of SOA that can provide an operational view of SOA for the business users and support human–computer interaction for SSM. The motivation of the present study is to address this critical issue. Specifically, we develop a modeling tool of SOA that possesses two key properties for SSM: (a) integration of the ontological aspects of SOA that are concerned by the SSM users; (b) provision of human–computer interaction through visualization of the ontology to explore the end-to-end relationships between the SS needs and the Web service components in a large-scale ontology.

3. Ontological map of SOA for SSM

3.1. General framework of modeling SOA for SSM

The difference between ordinary software systems modeling and modeling information architecture for SSM is significant. Ordinary software systems modeling addresses major object structures and encapsulated functionalities of the software system. Its key concerns are functions and program interfaces. On the other hand, modeling information architecture for SSM addresses the structure of services provided by a SS network at the global level for the planning and management of service assets and resources to meet the multiple organizations' SS needs. Conventional software systems modeling tools, such as UML (Rumbaugh, Jacobson, & Booch, 1999), emphasize descriptions of objects, functions, and data requirements within the context of software manufacturing. Because of this, it has been a common practice in the literature to use UML diagrams to model SOA in the perspective of software systems. On the other hand, modeling SOA in the SSM context must present many global SSM aspects of SS needs including service types, locations of services, service standards, rules, etc. As suggested by our literature survey, there is a need for a modeling approach that can model SOA in the SSM context so that the SOA model can be capable to describe the aspects of SS and guide the construction of SOA at the implementation level. The general framework used in this study for modeling SOA for SSM is information architecture.

Information architecture has been one of the most important issues in the information systems field (Allen & Boynton, 1991). The term information architecture has been used broadly in the information systems community. In the inter-organizational service context, an information architecture is a high-level description of the information requirements of an inter-organizational network (Wang, 1997). One of the earliest information architecture models is the Zachman framework (Zachman, 1987) which provides a taxonomy for relating the concepts of information systems. Later, Sowa and Zachman (1992) attempted to formalize the framework. They used symbolic logic to describe the concepts of information architecture. Such logic expressions, however, are too implicit for business planners to understand and too abstractive for information technology professionals to apply. Nevertheless, they extended the Zachman framework by expanding the taxonomy. According to the extended framework, an information architecture must describe six concepts: *what*, *how*, *where*, *who*, *when*, and *why*. Since then, there have been numerous other conceptual frameworks of information architecture, but few of them contain new concepts beyond the Zachman framework.

The Zachman framework is a well-regarded generic model of architectures in the field of enterprise architecture. It is a tool for describing the elements of enterprise information architecture, but is not supposed to cover all prescribing solutions for enterprise problems (Gokhale, 2010; Neaga & Harding, 2005). Practically, the depository that stores the framework with consistent rules in building up an architecture is always needed when solving a specific enterprise problem (Fatolahi & Shams, 2006). This study attempts to develop an ontological depository model based on the Zachman framework that can establish and organize the six core concepts of SOA and possesses human–computer interaction properties for the SSM users.