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Procedia Technology 11 (2013) 794 – 800

Procedia Technology

The 4th International Conference on Electrical Engineering and Informatics (ICEEI 2013)

A Review of SOA Modeling Approaches for Enterprise Information Systems

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Abstract

Since the last years there has growing interest in implementing more flexible information systems to solve business problem effectively, the aim of this paper is to review and examine existing modeling approach based on Service-oriented Architecture (SOA) that shows the concern researchers towards information system modeling based on SOA. This approach narrows the gap between business analysis and IT in the domain of enterprise information systems and enables information system engineers and business analyses to rapidly design and establish models in business environments. The focus of this paper is comparison of service modeling methods based on SOA including SOA-RM, SOA-RFA, SOMF, PIM4SOA, SoaML, SOA ontology and SOMA. The findings implies that the combination of SOMA and SoaML led to more perspective and detailed in a systematic way that would inspire rapid design and more flexibility in service modeling for SOA solution.

Selection and peer-review under responsibility of the Faculty of Information Science & Technology, Universiti Kebangsaan Malaysia.

Keywords: Service-oreinted Architecture; Service modeling;Informtion system;

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doi:10.1016/j.protcy.2013.12.260

1. Introduction

In a general sense e-business, extended enterprises, and virtual organization are examples of networked enterprises, which performed, based on their partner's information system [1]. On the other hand, due to dynamic and rapid changes of such environment, information system (IS) are encountered with vast amount of information for exchanging which requires interoperability at the communication level, data, process, and services [2][3].

Traditionally, an enterprise provided new application for specific requirement and developing IS, but this approach was costly and difficult to changes as the enterprise's need evolves [4]. This has given rise to integrate IS; so that such integration creates a flexible and agile environment for real-time data exchange, real-time responsiveness, real-time collaboration, and real-time visibility through the information systems [5]. Such interoperability and integration in processes, services, and data in enterprise information systems and inter-organization network can be addressed by SOA as fast growing paradigm in IT to increase flexibility and agility [3][6].

In fact, SOA is an approach for designing and developing IS [7]. By this approach, design, development, and implementation of IS are possible due to the web technology [7]. However, interoperability of services in SOA is not limited to web services [3][8], the web services are the most suitable technology for successful SOA [9]. In IS based on SOA, information source and business functions can be converted into modular services units for control and management [10]. Moreover, these units are shared over a network and collaborated in enterprise information system [10].

In order to support and develop an IS based o SOA, it should be described at a high level of abstraction [11]. For this purpose, modeling plays important roles in SOA based application [12] and service modeling as a first step is essential for developing of successful SOA system regardless of implementation details [11]. Furthermore, SOA modeling helps to better understand and communicate between business users and IT experts [13]. The focus of this paper is to review and examine existing SOA modeling approaches. The rest of paper is organized as follows: section 2 provides an overview of SOA and service-oriented modeling approaches and some related works are discussed in this section. Section 3 presents the finding and discussion. Section 3 concludes the paper with a brief summary.

2. Background and related works

This section presents summarized results of existing literatures on SOA and service-oriented modelling methods to provides some theoretical back ground in the domain.

2.1 SOA

From the viewpoint of business and technology, Markes and Bell in [14] defined SOA as follows:
SOA is conceptual business architecture where business functionality or application logic is made available to SOA users, or consumers, as shared, reusable services on an IT network

Generally speaking, in SOA, a service is described in a standardized style, published to service registry, discovered and invoked by a service consumer [15]. The service provider, service consumer, and service broker are three primary elements in SOA. The service provider publishes a service description and provides the implementation for the service, a service requester (consumer) finds a service description in service registry, then binds and invokes the service, and the service broker provides the service registry. However, the service broker is optional and the service consumer can obtain service disruption directly from service provider [16]. Figure 1shows the conceptual model of a SOA architectural style.

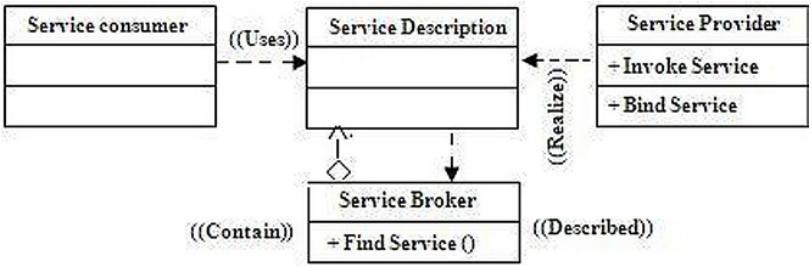

Fig. 1. The conceptual model of a SOA architectural style [16].

The term service-oriented and SOA came into existence before the arrival of Web service [14]. Web services are the most suitable technology for successful SOA, although it is not limited to web services [17]. For instance, Common Object Request Broker Architecture (CORBA) and Message-oriented Middleware systems such as the IBM Message Queue Series and Java Messaging Service (JMS) can be applied, but web services in comparison with others have more loosely coupled interfaces [15].

Web services provide the underpinning technology for SOA including the standard invocation mechanism defined by Web Service Definition Language (WSDL), the standard communication protocols provided by Simple Object Access Protocol (SOAP) as a mechanism for exchanging XML-based message in web applications, and Universal Description, Discovery and Integration (UDDI) for supporting web services location management [15] [18]. Figure 2 shows service collaboration based on SOA.

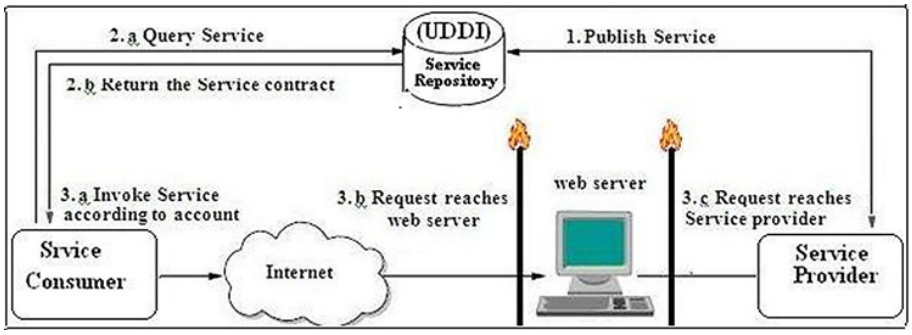

Fig. 2. Shows the service collaboration based on SOA [19]

A lot of businesses and organizations run their processes in silos, which limits their efficiency and ability to provide cost effective services to customers [20]. In service oriented thinking, services share their capability by breaking the silo business process into recyclable services and implementing them with SOA [21] [22]. Figure 3 depicts the arrangement of business processes with shared capabilities through services.

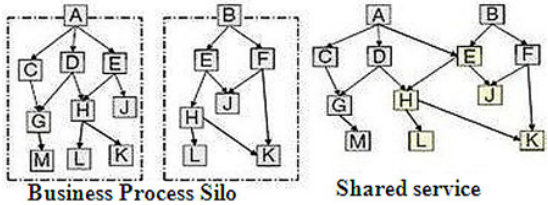

Fig. 3. The shared capability by shared services [21].

Systems today run on various technologies and today's software applications are most times not modular systems. With regard to this, service-oriented systems can be divided into modules for controlling, management and development [10]. As a result, system modularity could be applied to web services and web services can be upgraded or replaced without distributing the functional or integral independent services [10].

2.2 SOA Modeling Approaches

Various methods for service-oriented modeling have been proposed to apply SOA in industrial and business environments by many researchers. The focus of this section is based on seven modeling approaches including: The Reference Model for SOA (SOA-RM), The Reference Architecture Foundation for SOA (SOA-RFA), Open Group SOA Ontology, Service-oriented Modeling Framework (SOMF), Platform-independent Model for SOA (PIM4SOA), SOA Modeling Language (SoaMl), and Service-oriented Modeling and Architecture (SOMA) which have been widely used in industrial and academic.

2.1.1. OASIS Reference Model for SOA (SOA-RM)

The SOA-RM is an OASIS standard that intended to provide a common vocabulary for capturing the essence of SOA [23]. It's designed explicitly not to be implementable directly, but rather provide a common conceptual and terminological framework for everyone working in service-oriented modeling [23][24]. Moreover, this reference model defined meta-model aspects of services related to service description and policies [23].

2.1.2. -OASIS Architecture Foundation for SOA (SOA-RFA)

SOA-RFA is currently an OASIS committee specification that is an abstract, foundation reference architecture addressing the business via service view [24-26]. SOA-RFA started life and in early draft as the SOA Reference Architecture, but it was left to several Reference Architecture could coexist, reflecting domain of implementation paradigm. Consequently, it was renamed by adding the word Foundation that provides a common vocabulary to understand the important of the ecosystem view within the SOA paradigm and shows how SOA-based system can be realized in an abstract way [25].

2.1.3. Open Group SOA Ontology (SOA Ontology)

The SOA Ontology is an Open Group standard that defines the concept, terminology, and semantic of SOA in both business and technical terms [27]. It contains properties corresponding to the core concept of SOA such as object, class and relationship between them, which is supported by Web Ontology Language (WOL) [27][28].

2.1.4. Service-oriented Modeling Framework (SOMF)

The SOMF is a model-driven methodology with specialized modeling notation to help model, analysis and identification services that is proposed by Bell [29]. It provides a formal method of service identification at different levels of abstraction including meta-model concept and specific notation [30][31].

2.1.5. Platform-independent Model for SOA (PIM4SOA)

PIM4SOA is developed based in a meta-model for SOA consisting of a set of important aspects including services (description of services including access, operation and types), process (logic order in terms of action, control flows and service interaction), information (message or structured of service exchanging), and quality of services (QoS) (extra-functional qualities regarding to service, information and processes) [34]. The main goal of PIM4SOA meta-model is to define a language for describing SOA as a platform independent level [34][35].

2.1.6. SOA Modeling Language (SoaMl)

The Object Management Group (OMG) proposed SoaML in 2009 for representing SOA artefacts using Unified Modeling Language (UML) as a core-modeling standard [36]. Moreover, a meta-model and a UML profile are provided in SoaML for the specification and design of service to SOA (meta-model for modeling the requirement for a service and UML for specifying services) [37].

2.1.7. Service-oriented Modeling and Architecture (SOMA)

SOMA is a modelling technique for developing and building SOA-based systems proposed by IBM in 2004 [38]. SOMA activities focuses include: service identification (discovering candidate service and interaction between them), service specification (making decision for exposing services), and service realization (capturing service realization) [39]. The most focus of SOMA method is on the service, service components and flows with emphasizing on reusing services [40].

3. Findings and Discussion

Since the SOA-RM is an early body of work on the SOA reference architecture, its focus is the lower level, but most abstract modeling analysis to SOA. As such, implementation issue as identification, authentication and service composition cannot be covered [23-25]. SOA-RFA address service-oriented modelling and it doesn't cover service identification, but it is sufficient in a particular resource for SOA-based system [25]. The SOA Ontology defines a formal ontology for SOA that potentially contributes to model-driven SOA implementation and defines the concepts and semantics of SOA-based system [27]. However, it doesn't explain exactly how they should be applied to services and products [27-28].

SOMF defines services as entities to encapsulate business requirements and different perspectives of a software life cycle can be shown by SOMF diagrams [31]. In spite of those three types of models including analysis, design, and architecture can be constructed by SOMF [32], it doesn't support transformation of already existing assets to SOA [33].

PIM4SOA meta-model cover essential views such as services, process, information and Q-o-S to reduce the gap between enterprises model and service-oriented implementation [35]. SoaMl contains a meta-model and UML profile that provides artifacts for SOA modeling, but is not a methodology to develop SOA-based system [26][37]. In SOMA methods, the most focuses are service model and reusing of services. This method is widely used in multiple industries [39][40]. Furthermore, SOMA is more perspective and detailed in allowing the practitioners in a systematic way toward a set of SOA solution. The most important features of the aforementioned SOA modelling methods are summarized in Table 1.

Table 1, features of SOA modeling methods

Method/ reference and year	Summary of features
SOA-RM [23](2006)	No modeling language for service-oriented modeling Used to understand the essence of SOA and core concept Most abstract model relating to SOA in the lowest level Service identification and service composition are not supported
SOA-RFA [25](2012)	Used to understand the important features of SOA No service identification, but a particular resource in SOA Using UML2 to visualize structured and behavioral architecture conception of SOA
SOA ontology [28](2009)	Corresponding core concept of SOA Using OWL as a modeling language and UML to illustrate classes and properties in SOA modeling No service identification Potentially contribute to model-driven SOA implementation
SOMF [29](2008)	Using specialized modeling notations and support SoaML Service identification in granularity level and relationship between services

	Covering analysis, design and architecture but doesn't support transformation of existing assets to SOA
PIM4SOA [34](2007)	Developing a meta-model for SOA
	Covering essential aspects for SOA (service, process, information and QoS)
	Supported by WSDL and XSD (web modeling languages) and UML
SoaML [36-37](2009)	Using UML
	Focusing in the basic service modeling concept
	QoS specification cannot be supported
	Defining business process choreography and bridging business process to SOA in details
SOMA [38](2004)	Using SoaML
	QoS can be supported
	Service identification, service specification and realization
	Widely used in industry and business area

4. Conclusion

In this study, literatures of SOA approach were reviewed with emphasis on service-oriented modelling. In developing IS base on SOA solution modelling is the first step. This paper reviewed and compared the most important of features of widely used SOA modelling methodologies. Each of these methods has its pros and cons, which are summarized in Table1. The result shows that most of modelling methods focus on the main concept of SOA. In this regard, SoaML doesn't act as methodology, but as a foundation on service modelling with further extension and SOMA as a SOA methodology focuses on service identification, service specification and service realization, and reusing services in SOA-based model. Therefore, the combination of SOMA and SoaML allows the practitioners to model services in detailed and systematic way.

Overall, this research provides a preliminary analysis; therefore, further empirical with details will be presented in future reports. However, despite of the preliminary of analysis provided in this paper, the findings are applicable for both business analyses and information system engineers in the domain of enterprise information system based on SOA solution.

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