Building a SOA ontology for universities websites

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***Abstract*— Service-Oriented Architectural style is attracting industry attention and it is gaining momentum in vertical industry like healthcare and government by becoming the key enabler of emerging technologies. This paper enables SOA solutions for campus information system to offer Web services in collaborative learning sessions to utilize resources enhance educational efficiency and scalability. Websites of universities fit the initial requirements needed to have a successful service oriented enterprise. The majorities of the services that universities offered are generic and are offered to their internal and external audience in the same manner. The paper discusses the preliminary stages of learning environment process modeling, and designing the application services needed to support these processes. One of the major tasks of the learning process is students' assignments' assessment. in this paper an otology based framework has been proposed to implement a set of e-learning services given in learning environment such as universities The proposed framework , the proposed framework is consisted of a set of services including an assessment service upon which students shall depends to enhance their programming skills.**

***Keywords*— SOA, e-learning, and ontology**

I. INTRODUCTION

Service-Oriented Architectural (SOA) style is attracting industry attention. SOA is gaining momentum in vertical industries like healthcare and government by becoming the key enabler of emerging technologies. Regardless of the economic decline, Gartner analysts do not predict a dramatic decline in SOA adoption because it enables initiatives aimed at cost reduction. SOA style is about an effective, efficient, and agile integration of enterprise level architecture and services. It provides a high-level an architectural description of a business process and development models (logical physical). Furthermore it provides an insight to the roadmaps for becoming a SOA-enabled enterprise and to build applications as a suite of reusable business objects. SOA is a promising architectural paradigm based on loosely coupled, self contained software components or services. Each service can be executed as an independent entity. SOA is defined by OASIS as a "paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains" [6]. This definition implies that SOA is another IT standard. In general, the standardizations efforts have not deliver on their promises and it created a high-level of cynicism about SOA because middleware technologies such as CORBA, DCE, and so on did become silver bullets as and Enterprise Software Bus (ESB) solution. Fredrick Brooks' statement about the complexity of building software: "is inherently no silver bullet" [5] is holding true for many people involved. However, Krafzig et al, 2005 took the position that SOA "is neither a technology nor technology standard" and declared it as "technology-independent, high-level concept that provides architectural blueprints" [7]

SOA promises to encapsulate and wrap existed technologies and make information system components more loosely coupled. Archimate models are useful architectures to be applied in a layered environment such as universities [1]. In this case study, the users of SOA services are university students. They are assessed based on a set of organizational services to evaluate their programming practices. The assessment process represents our business process in the learning environment. The BiZZ design Architect tool is adopted create a set of application services or functional services viewed in our archimate architecture.

Web Services

A Web service is a software system described by an interface that can be conveyed using a transport protocols such as HTTP. It is designed to support interoperable client and server (Request/Response) interaction using the most popular application of web technologies (SOAP/WSDL) [8]. Web Service Description Language (WSDL) is a description framework for Web services based on XML format to define network services and binding mechanism [9]. Web services are one of the enabling technologies in many of today's SOA environments. They are increasingly delivered by vendor products and used in many organizations. However, it is crucial to understand that Web services are an enabling technology and not the same as SOA.

Figure 1 presents an ontology viewpoint of SOA principles and Web services technology. The following are the core technologies used for Web services.

1. Extensible Markup Language (XML). It is the markup language that underlies most of the specifications used for Web services. XML is a generic language that can be used to describe content in a structured way.

2. Simple Object Access Protocol (SOAP). It is a specification for the exchange of structured XML-based messages between the service provider, service consumer, and service registry.

3. Web Services Description Language (WSDL). It is an XML-based interface and implementation description language.

II. Related Work

Adaptive Educational Hypermedia Systems (AEHSs) architecture was implemented by [3], where a set of independent learning services were built by involving SOA and a learning management systems. Several measures were used in the experiment phase, usability, interoperability and openness tests. The test on a software engineering course revealed that the system was robust in providing a collaborative learning environment. However, the system usage was not as expected. Enabling learning web service over mobile systems is one of the major challenges in SOA because it requires some integration with the learning management system. In [4] a service oriented architecture was used to integrate mobile assessment with learning management systems The proposed architecture was built on several layers , the interface layer and the service layer, a mobile portal was used to interact with service available in the learning management systems by some sort of SMS communication channel the SMS manager , the learner manager the session manager are examples of service s provided by the proposed architecture .

A service oriented architecture framework and prototype were used in [5] the main goal of the proposed framework was to implement a set of post graduate students web services, and to logically building a services hierarchy. There were several services enabled by the proposed framework such as registering for semester courses, paying registration fees as well as checking exam table. The proposed framework was useful in terms of services reusability and modularity. In [6] software architecture was used in order to develop a distributed e-education system. Applying the SOA principles in Figure 1, a set of education services were available on an education server , a user device agents collaborated with service agent by means of XML ,SOAP and WSDL messages in order to get an education service, and the education service integration center was responsible for integration of several services, the education service integration center was consisted of the following service Education registration service , User registration service, User profile updating service and Content discovery service, the proposed architecture represents in their opinion a new option for distributing web services

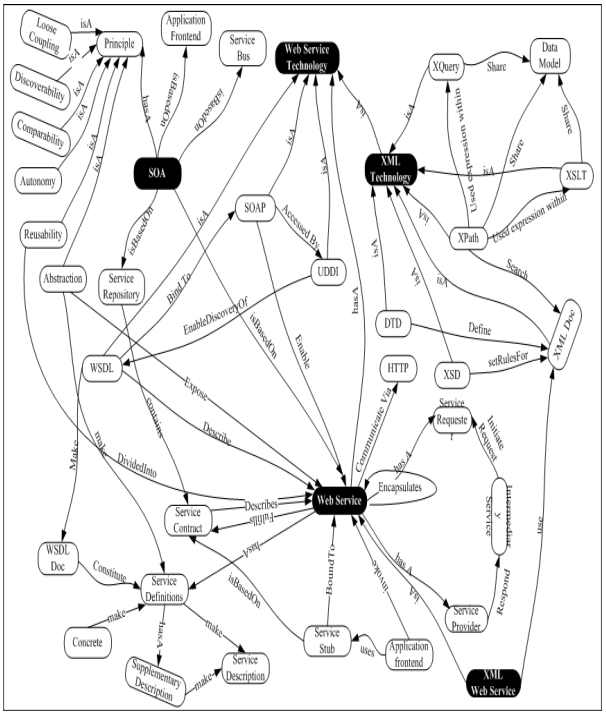

Fig. 1: An Ontology Viewpoint of Web Service Technology

III. Goals and Approached

Ontology engineering has enhanced information structuring and knowledge representation, little research is found in the area of interactive learning environment and e-learning. The basic goal of this case study is to propose a SOA framework in order to implement a set of interactive e-learning assessment services on. The services are arranged in categories. The users are also located into groups, hence each group have their own services that can be accessed by them but not by others

Requirements

There are certain requirements that should be considered to make new SOA model to work on existed systems. For example, the desired SOA model should fulfill certain requirements that are regulated by the current system. Any university educational system services can be divided into

several components according to its users. Those users are grouped into the following: Faculty members, students, leadership, administration, and externals. Figure 2 summarizes those groups of users and types of services they may require from the enterprise system. The users of universities websites are grouped into 6 major groups. Those groups can be divided further into more specific groups based on common services.

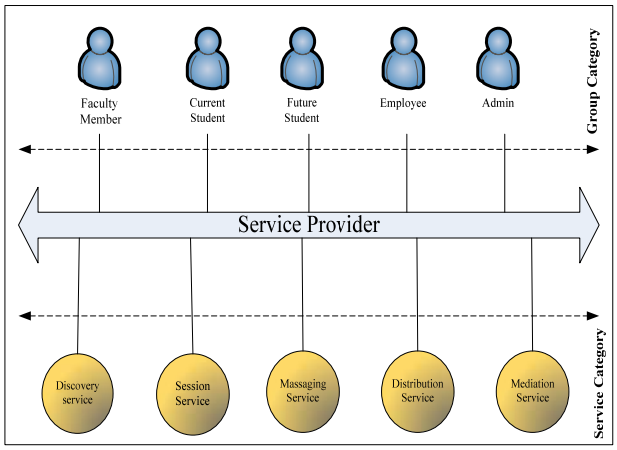

Fig.2. SOA High level ontology for a university website

If we review all websites of universities around the world, we will find them all share those common services that they provide to their viewers. This typical and generic

Services and service classifications

To fulfill the requirements presented in Section 3.1, several functionalities were introduced. Those services are required and offered to all the users group based on their status. As presented in Figure 2, They are grouped to form the following services:

- Discovery: This service allows students, faculty members, leaders, employees, etc to browse for information, discussion, make queries, and access functionalities.
- Session: It provides different authentication and authorization levels, auditing capabilities, single sign-on and transaction support. This all depends on the data and services users want to access and on their privileges offered to the specific user.
- Messaging: A publish/subscribe module enables the implementation of asynchronous communication patterns by allowing clients to register and receive messages produced by resources.
- Repository: It provides caching and persistence capabilities.
- Distribution: It provides routing, aggregation, load balancing and registry capabilities. For example, add/remove operations are part of the distribution module that allows to aggregate data sources for the sake of enhancing performance.
- Mediation; It provides proxy and service adaptation capabilities and mapping rules that are applicable to integrate heterogeneous resources. Figure 2 shows how typically such services can be distributed on one of the 6 categories described above.

Services Classifications

The purpose of the ontology-based e-learning framework is to provide an integration solution of e-learning resources by semantically expressing the true meaning of business concepts and interacting services and linked together with IT technologies. Figure3 illustrates the commonly described services classification in literature. Different classifications are adopted based on business concerns to solve a particular problem. The framework demonstrated in Figure1 adopted the most comprehensive classification of services presented by [13] as it focuses on the interrelationship and communication among services to provide guidance for architects and decision makers.

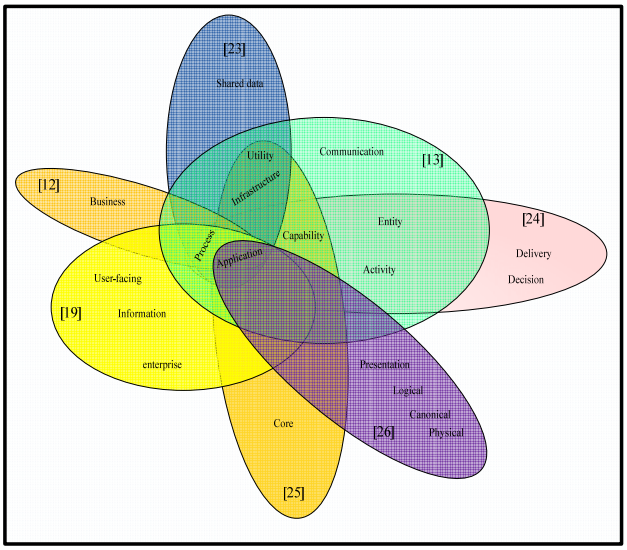

Fig.3: The Commonly Described Literature of Classification Services

The proposed an abstract e-learning framework is a comprehensive solution to enable knowledge-based integration strategies. The semantic layer will reduce the

complexity of services construction, data integration, and bring shared semantics to services. The framework presented in Figure 2 provides a robust mechanism to integrate and manage distributed e-learning infrastructure. Furthermore, it enables service discovery, invocation, and composition.

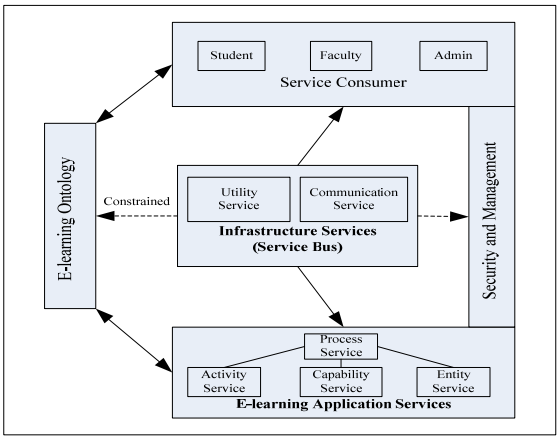

Fig.4: Ontology-based E-learning Framework

E-learning Infrastructure (Bus services)

Bus services are an infrastructural requirement to enable communication among business processes in SOA. It provides a set of features to implement SOA. A service bus can support different communication model such as synchronous (CORBA and EJB), asynchronous (MQSerice) communication. With e-Learning solution it is critical to provide an environment that supports various communication model such the Enterprise Service Bus (ESB) environment. ESB simplifies the integration and reuse of service components [9]. Bus service software increases connectivity, agility, and enables B2B relationships. Bus service software is normally purchased and centrally managed. ESB enables SOA to allow student and developers to work on a variety of applications at the various campuses and access information by placing the data in message objects. [8]

E-learning Communication Services

E-learning communication services enable the exchange of messages between applications without the knowledge of technical details. This service does not process the content of the message but it can enable applications' configurations to messages. For example, an application confiners the communication service by applying list of subscribers to the content of the message. Here we introduce the ontology-based to component to E-learning communication service to support following tasks:

- Monitoring Messages: Support communication services information analysis of traffic.

- Located Documents: Locate the WSDL document of the Web service to be routed.

- Search Operations: The knowledge-based routing processes search for meta-level entities involved in routing activities. As described Parlanti et al., 2008, the search operations performed by resolution processes (logic-entity, grounding, concrete, physical) [10].

E-learning Utility Service

E-learning utility services support non application-specific infrastructural functionality. It establishes functional context that is non-business-centric. Ontology based E-learning utility services enables the following:

- Component Discover and mapping: knowledge-based component discovery and message transformation services based on discover and mapping of message schema.

- Service Activity Monitoring: Knowledge-based monitoring mechanisms based OWL-S is valuable extension of Web services. As described by [11], an event-based monitoring of Web service is application independent.

- Support Service Management: It include statistical information about students, faculty, and administrative usage patterns and error rate of failure transmutation messages. The ESB routes selected messages to an event application. The event based application uses the ontology rules to analyze the events and draw conclusions [12].

Security Service

Security Service is the access to all other services. In order to implement security services that adopt SOA, they should deliver single sign on capabilities and identity propagation that enable services to operate on the behalf of the user. Figure 5 shows a conceptual model for building the security service, the figure given below is adopted in some way to the learning services used in our proposed framework. This conceptual level of security ontologies was originally proposed by (Tsoumas, Dimitris) 2005.

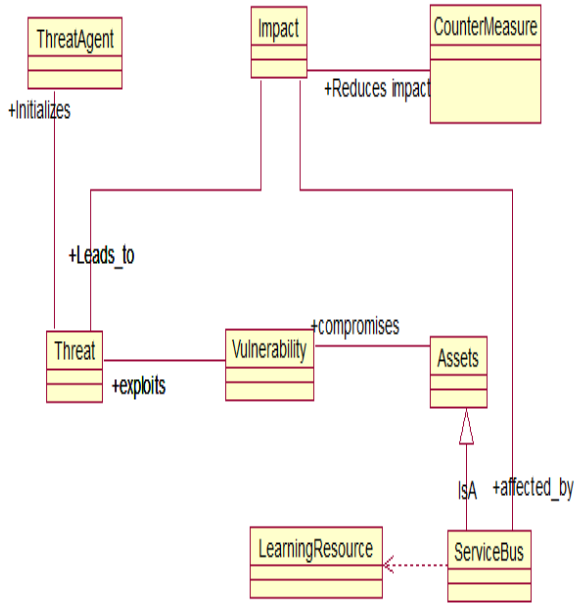

Fig.5: Conceptual model of security ontology

According to (Tsoumas, Dimitris 2005) each service offered by a system is an asset in the security ontology. There are many tools that can be used to assess service vulnerability. For example, effective logging and auditing mechanisms allow us to continuously monitor and possibly understand what risks we might be exposed to.

The security service itself should contain three major components: security engine (e.g. SOAP), security framework, and security providers (e.g. SAML, X509, and JAAS). The security architecture for a system addresses several aspects of security that include: administrative, communication, software, operating system, network, personnel and physical security, and prescribes security policies for each. The security architecture needs to deal with intentional, intelligent threats and accidental threats. It should explicitly evolve over time as an integral part of its administrative domain's evolution.

Application Services

Application services are the concrete implementation of a business process to deliver explicit business value. There are four types of application services: Entity, activity, capability, and process [13].

Entity Services

Entity Services present and manage business entities in the E-learning System. E-learning institutions must have business model documents to define its relevant business entities. For Examples of business entities include Student, employee (faculty, administrator), and class. Entity services expose the information stored in the system through service interface. The service interface support entity level service such as create, read, update, and delete and access to domain-level operations such as Search for a class by campus location. Entity Service can be implemented by using Web Service Description Language (WSDL) [15] and Business Process Execution Language (BPEL) [16]. Ontology can support entity service by providing the following:

- Management of relationships business objects.
- Description autonomous services.
- Discovery business object data structure elements that are not available from the legacy systems.

Activity services

Activity services expose specific action-centric that is unique to particular application. Therefore, access to activity services is normally managed at the application level. Activity services can be used to for sharing functionality and decomposition of e-learning scenarios [13]. An adaptive of activity-based services can offer personalize learning activities [17]. Ontology can support e-learning activity service based on:

- Reuse of intelligent learning activities.
- Facilitates the features of a personalized e-learning system.
- Create common concepts of activity services and their interactions.
- Support reusability and interoperability between different systems.

Capability services

Capability services represent a close set of functions that expose unified organizational resources. Capability services provide generic-value added services by exposing service interface main functionality. An example of capability services includes processing student electronic payments, compare text books prices, compare rates delivery time for

shipping companies, external libraries resources, and so on. Ontology-based approach enables the discovery of Web service capability specification and provides sharable specifications of environment resources in a particular domain [18].

Process Services

There are many definitions for process services, according to Kim, Suntae et al., 2005: It is the execution of business processes to achieve the business goals in an organization. [20]. Process services described as service layer "Process Service provides a mechanism to orchestrate Information Services and Application Service to work in conjunction for specific tasks." [19]. Cohen [13] presented as "Compose and orchestrate entity, capability, and Activity Services to implement business processes." Our proposed framework provides efficient management of e-learning transactions and searches a process services inventory for a transaction or message. Also, enable publishing of process services with their characteristics in standard taxonomies.

IV. CONCLUSION AND FUTURE WORK

In this paper, we proposed a generic SOA model or framework for enabling all services offered by universities' websites to offer in a generic, systematic, and convenient manner. This allows those services to be consistent, coherent, understandable and easily deployable.

University candidate viewers are classified based on their goal of using the website and the type of services they are looking for. Services are also generically described based on the general goal of those services.

In future, we are planning to design and build a website based on this generic description of requirements for building websites of universities. Once, such model is evaluated and tested, it can accelerate the process of building, modifying and updating services to those websites.

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