Using Services Oriented Architecture to Improve Efficient Web-Services for Postgraduate Students

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***Abstract*—**The main aim of this paper is to present the research findings on the solution of centralized Web-Services for students by adopting a framework and a prototype for Service Oriented Architecture (SOA) Web-Services. The current situation of students' Web-based application services has been identified and proposed an effective SOA to increase the operational efficiency of Web-Services for them it was necessary to identify the challenges in delivering a SOA technology to increase operational efficiency of Web-Services. Moreover, the SOA is an emerging concept, used for delivering efficient student SOA Web-Services. Therefore, service reusability from SOA Web-Services is provided and logically divided services into smaller services to increase reusability and modularity. In this case each service is a modular unit by itself and interoperability services.

***Keywords*—**Services Oriented Architecture (SOA), Web-based Application services, and Web-Services.

I. Introduction

THERE are a number of universities which are providing Web-based Application services to postgraduate students. Several types of online services help the students to communicate with each other and also to communicate with the academic and support staffs. On the other hand, for administration services, there are many types of students' information which need to be considered such as students' information records and these types of information should be organized by using the facilities of management services. To achieve these services with high students' satisfaction, the Web-based Application services were developed to serve a single purpose. The difficulty with this challenge is that universities do not provide all the services that are required by the students, that is why we attempt to use a multiple purposes supporting various online activities approach. Multiple online contents and services allow customization of user activities. As a matter of fact, the current Web-based Application services are cost-intensive and take a long time to process. Moreover, there are many difficulties to upgrade the current system because of the fast changing requirements like number of specializations. Thus, the universities must determine what the students' expectations are and how it can be made more effective. Those matters have been measured by three main factors: cost, time and satisfaction of students by using the current Web-based application services.

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II. SOA Web-Services for Postgraduate Students

Service Oriented Architecture (SOA) helps the organizations by making the business processes more agile, quicker creation of new application, more flexibility in application construction and also by composability of new functionality. Over time, this will more flexible, quicker, and more dynamically support their business as it adapts and grows [1].

Higher education, like many large enterprises, suffers from high IT (Information Technology) maintenance cost. Much of this high cost is due to isolated legacy systems that are difficult to work together. Too many times different departments maintain their own applications that do not support integration. Worse yet, multiple versions of the same data are often kept in different databases. Human intervention is too often needed to integrate different applications and to synchronize multiple versions of the same data [2].

Moreover, the key benefits of adopting SOA architectural principles are: More agile business processes, through faster composition of those processes from business-level services; Quicker creation of new applications through re-use of libraries of existing services; More flexibility in application construction through a single design approach that connects legacy systems to new systems using one design paradigm; Composability of new functionality through the modularity that services offer as a design concept [3].

Traditionally, universities have been operated as highly decentralized enterprises, with faculty and business units allowed considerable autonomy to choose their computing systems, business rules, and operating practices. As a result, university wide assets (e.g., the brand) and operating budgets may face compromises not necessary in a more centrally run environment [2].

Reference [4] argues that the competition for qualified students is increasing among universities nationwide, just as federal funding for public institutions decreases. In an effort to meet these demands and cost-effectively deliver more services

to candidates, students, staff, and faculty, University of Colorado (CU) sought an information technology (IT) system that would help it reduce duplicate data entry, promote data access and reusability, improve transparency and compliance with federal regulations, and increase student recruiting and retention.

At the same token, there are many universities which are implementing SOA Web-Services for their systems are observed. Depending on the benefits and promises of SOA, some universities implemented SOA to develop their Web-based application services in many fields such as: financial management; Systems projects; Asset management and facilities management; Student administration; Portal; Campus solutions data warehouse; Online learning; Administrative support to every student; Data warehousing and a variety of smaller tools such as endowment management.

Based on the above-mentioned fields, the researchers propose that the Postgraduate Students Department (PGD) and the different faculties should convert the present Web-based application services and some of the manual services to SOA Web-Services. Table I shows the criteria of converting the PGD at a University in Malaysia and different faculties' services before and after using SOA Web-Services.

TABLE I
PGD'S AND DIFFERENT FACULTIES' SERVICES BEFORE AND AFTER USING SOA WEB-SERVICES

Type of service	PGD and faculties (Present Services)	SOA Services	
		PGD and faculties (SOA Services)	New Services based on SOA
On-line Services	Applying to study at the University.	SOA using to centralize all the On-line present services which are provided by PGD and different faculties.	* These are the new On-line services which are based on SOA: questionnaire Survey, Vacancy Advertisement and Check Application Status.
	Registering for semester courses.		
	Paying registration fees.		
	Publishing researches.		
	Providing campus email		
	Check course table.		
	View course materials.		
	Check exam table.		
	Evaluate lecturers.		
	View grades of each course.		
Manual Services	Paying registration fees.	* Some of the Manual service has been changed to On-line based on SOA Web-Services.	
	Registering for Language courses.		
	Providing a permission to sit for Exams.		
	Applying for Visa (for International student).		
	View grades of each course.		
	* Check application status.		
	* Vacancy advertisements.		
	* Survey Questionnaire.		

III. SOAPGS: USING HOWCROFT-CARROLL METHODOLOGY

Since the emergence of the Internet and the Web, the education industry has been in the midst of a transformation of business and learning processes [5]. Web Service has been used very often recently. Web Services (or simply Services) are a new breed of Web application, and they are self-describing, Modular applications that can be published, located and invoked across the Web [6]. Web services can combine software and services from different companies to provide an integrate way to communicate [7]. Also, SOA allows different platform and implementation technologies that may be used in different parts of a company to inter-operate [1].

The SOA Web-Services Postgraduate System (SOAPGS) provide most of the services required by postgraduate students in their daily academic life. Howcroft-Carroll methodology was used, which consists of four phases: analysis, design, generation and implementation. The implementation approach of SOAPGS is discussed below:

A. System Analysis

This phase is the most crucial phase of the development methodology. It concerns the development strategy, in order to reduce any risk that might happen during the development and setting in place some strategic goals and objectives in designing the system [8].

First, determining the three core elements that describe the goals of the system, these elements are:

- What the PGD and the different faculties expect from the improvement of Web-based application services? The answer is, they wish to deliver efficient services to students by making them more satisfied.
- Where are the PGD and the other faculties now? This depends on the data analysis of the data that has been collected from the survey and the interview for the PGD support staffs.
- How the PGD and the other faculties can achieve the target of improving their Web-based application services? By adopting the postgraduate SOA Web-services system.

Secondly, choosing SOA Web-services technology as a strategic planning, that will help to achieve the objectives of the system effectively. Consequently, the main objective of the postgraduate SOA Web-services system is to provide an efficient service to postgraduate students by reducing the cost and time when the postgraduate students use the services. In that way it will offer more satisfactory services for them.

Finally, in order to achieve the objectives above there are several tasks. The analyses include facilities such as: the tools and requirements to construct the system.

B. System Design

After the analysis has been completed, the development process can move on to the design phase. Thus, depending on the objectives those were determined at the system analysis phase, the design of the system needs two steps:

First, the information that helped to design the CGI (Common Gateway Interface) has been identified by determining the user's modules and database by using PHP

and MySQL tools software. Furthermore, the graphic for the interface is designed by using Photoshop software.

Secondly, testing design part in the early stages helped to discover some inconsistencies which in turn helped the research to meet the objectives that were determined in system analysis phase. After the testing has been done in the design part, it will produce acceptable information which is required by the user.

C. System Generation

The generation is the third phase of the system development which is supported by the result that is taken from design of the system. This process has four steps:

First, by selecting the resources for the development of the prototype, all software, hardware and other requirements which are related to SOA Web-Services framework have been selected. Moreover, the technical specifications have been examined to ensure compatibility.

Secondly, after the resource selection has been done. The available resources were compared with the result of the design part to ensure the design can be achieved with the resources selected. As a result, it was found that they are compatible.

Thirdly, by using PHP the coding has been generated and all the software needs installed into the Web Server. This step included some complex tasks, such as database communication.

Finally, as far as testing for this Web application development is concerned, we have conducted testing not only at the end but also during the development design. Functional testing has been done to carry out for the modules and all the system. Each and every part of the system has been checked to ensure all the links are linked correctly and error free.

D. System Implementation

This phase is the simplest phase which is run throughout the lifecycle of the web development. There are two steps in this phase:

First, the maintenance step should be done to the system regularly to update or by adding new entries

Secondly, as future work the researcher will assess new technologies as they become available, that will assist the objectives outlined in system analysis phase.

IV. Adopting Development Framework of Web-Services Based on SOA

The architecture used to adopt the framework in the design phase is SOA Web-services by using Howcroft-Carroll's system development methodology. This underlying SOA-style IT infrastructure easily permit connecting services to organizational information from a variety of sources. This new style of application development is much quicker and less expensive than previous forms of development and permits the business to be much responsive [1]. Based on the Fig. 1, the adopted framework design is based on two core technologies which are Services Oriented Architecture and Web-Services.

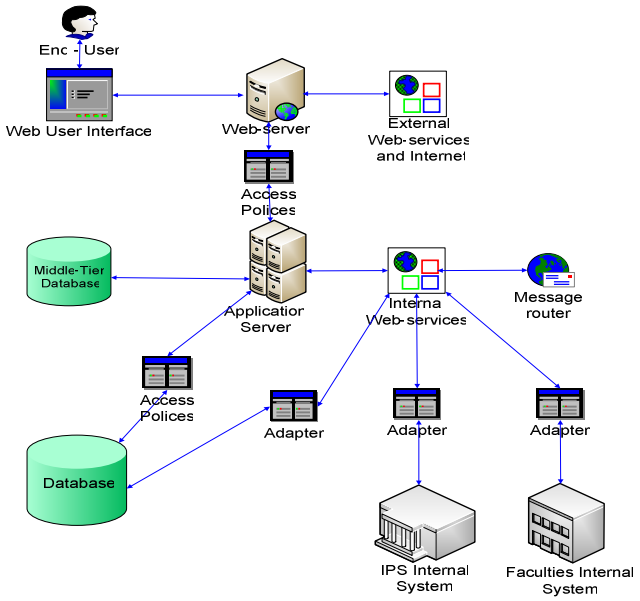

Fig. 1 Adopting development framework of Web-Services based on SOA

Furthermore, a SOA Web-Services concept was used to explain the sequence of messages at each service. And that is based on Message Exchange Patterns (MEPs) which helps to define the sequence of messages in a service call or service operation, specifying the order, direction, and cardinality of those messages. MEPs are general concepts to describe communications between different systems. Because of space constraints, MEPs concentrate here on MEPs in context of SOA [9]. For example, this service is one of the new services that SOAPGS converted from manual to SOA Web-Services. Therefore, based on the MEPs "Request/Response Versus Tow One Way Messages" approach, when a student (Consumer side) want to submit an application to PGD or different faculties by using SOAPGS without the need to go through many steps to reach the administrator (Provider).

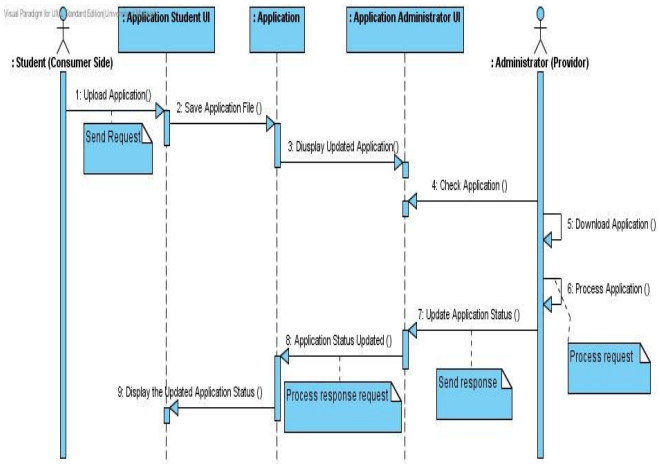

Fig. 2 MEPs sequence diagram for check application status services

From Fig. 2 it is shown that administrators check the students' application and then change the application status depending on the progress of the application. Therefore, this helps the students to check their applications in a cheaper and faster way.

V. Future Direction of SOA Web-Services for Higher Education Institutes

The SOA Web-Services framework is the evolution in system development. This was very important for this research. Therefore, many new Web-based application services can be added to the postgraduate system which can improve it. There are many interactive Web-based services need to converting them to SOA Web-Services such as: links of audio and video online courses and international Web-based services centers. Also, PGD needs to covert the other manual services to SOA Web-based application services such as: paying registration fees, registering for language courses and providing a permission to sit for exams

The universities should start to implement a special e-learning SOA which is Service-Oriented Learning Architecture (SOLA).

Finally, it was also observed that there are not many published studies related to SOA and its implementation in Higher education.

VI. Conclusion

It is observed that postgraduate students always face a lot of difficulties while using the present manual system provided by the university and Web-based application services. At the same time the number of postgraduate students is increasing day by day. As a matter of fact, there is a need to enhance these services by providing impartial and professional information, advice and guidance to students. Delivering hi-tech services has increased the satisfaction of the students. These new services are up to date, relevant, accurate and accessible.

The adoption of SOA Web-Services framework and the use of Howcroft-Carroll's Methodology helped to implement the prototype. The prototype developed the main components of the system and how these components connect to each other. The most suitable modules were chosen from other universities which are using SOA. There modules are: Building business process driven applications; Centralizing the services which are provided by faculties; Key tasks faster; Resulting economies; lead to lesser costs for implementation.

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