

SOA-based Campus Administration Management System using Multi-layered Architecture : Campus-SIA

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Abstract: Administration management in academic front has been realized one of the challenging issues as service provided in the administration has crucial role for the development of student and organization itself. Further, data obtained in the administration requires proper saving and management system which is difficult with traditional monolithic tools. However, we witnessed that saving, managing, reporting and manipulating of data in campus administration are still practiced with monolithic tools due to lack of proper collaborative tools. In this paper, we are highlighting the shortcomings of monolithic tools and proposing the new tool of web based Campus-SIA that we implemented during our research. Furthermore, we propose the concept of social administrative software that is introduced in Campus-SIA in order to maximize the collaborative management. To support efficient handling of multiple management tasks, we further recommend the concept of social software and the service oriented architecture in order to extend our major business components into a multi-user setting. By architecting the entire system into multi-layered architecture, extensive security and high performance results are achieved and are considered highly efficient and provably secure.

Keywords: Service Oriented Architecture, Social Administrative Software, Role Based User Management, Reporting Architecture, Customization Capability

1. Introduction

Administration management requires the effective usage of ICT technology not only in business and industrial societies but also in academic front. Several trends in software technologies are opening up for effective data management and administration management that uses either monolithic desktop based tools or web based system. There is also a trend of using “software as a services” (SaaS) a newly adopted computing architecture, transforming data centers into pools of computing service on a huge scale. This trend of using SaaS in order for data management is still rising in positive scale.

However, in academic front, there are still pools of institutions, colleges and Universities that utilize the traditional desktop based tools and web based tools to capture, analyze and to format the reports required for management and auditing purpose. Storing and managing growing amounts of student data requires administrators to apply intelligent data management tool that helps reduce management costs and to achieve enhanced efficiency and fulfill the effective service for students.

In this paper we will highlight the effective administration management through Campus-SIA (Campus Student Information Application) that we built in this research. Campus-SIA is a web enabled software application that utilized service oriented architecture [1], [2] which leverages the management of student data

thereby enabling the administration to enter the academic and financial data related to the student through web browser that ultimately enhances the overall productivity of the administration [1]. The objective of this paper is to describe the effective administration management that can be achieved through the deployment of Campus-SIA [1] in campus administration. We achieve effective management by introducing Campus-SIA in the administration of Wakkanai Hokusei Gakuen University. We describe our practical approach of administration management on the basis of our experience gained through the deployment of Campus-SIA. Further, we will highlight the modules and the architecture adopted during the implementation of Campus-SIA. The major data modules are personal information management, student financial management, student career management and dynamic reporting components as major modules by which campus administration can extract maximum utility in order to enhance the productivity. Before going into detail of this work, we summarize the major contribution of the work:

- (1) We presented a component oriented architecture that can be applied for the development of any campus administration and management system.
- (2) We demonstrate how to assign roles and responsibilities to academic staff to manage academic and financial data enabling them to be more accountable.
- (3) We highlight the role of social administration software [1], [3], [7] and its importance to retain the collective knowledge of campus administration for future business process.

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1.1 Data Management in Campus-SIA

Campus-SIA provides users to enter student specific data with file upload functionality containing image data. The currently supported formats include CSV (Comma Separated Values), different spreadsheet formats (Excel and pdf). To achieve ease of use, the number of steps a user needs to go through before the data is in the systems is reduced remarkably by enabling the system through tab based data entry form. Rather than having the user go entry from form one to next the implemented system provides the tab based entry form automatically and it provides verification of each data entered through the tab based from.

In addition, even though data insertion into the database is done in the background, we try to maintain a responsive import process also. This importing of data is done by the system automatically. Further, the system does not ask the user to specify data types for the entry field provided. Instead, as we describe shortly, it attempts to provide the required data type by pre-defined data set.

1.2 Problem Scenario at Campus Administration

Campus administration task should be associated with security aware, responsiveness and well managed task in order to maximize quality of service and the performance of administration that can pave the way for the academic success of each student and also the management of the University. However, these very determining features of effective management are often ignored by administration staff knowingly or unknowingly due to the lack of proper management tools and expertise.

There are numbers of student management system developed and used in software industries which vary in size, scope and capability, from packages that are implemented in relatively small campuses to cover student records alone, to enterprise-wide solutions that aim to cover most aspects of running large multi-campus organizations with significant local responsibility [1]. Many systems can be scaled to different levels of functionality by purchasing add-on modules and can typically be configured by their home institutions to meet their local needs. However, most of the times, the industry standard tools can not meet the specific requirement of the university due to their inflexibility while configuring the system.

We have developed and demonstrated Campus-SIA system, which is dynamic and can be easily customized, based on the size and need of the organization (e.g. departments or divisions or the entire university).

2. Motivation and Related Works

We believe that academic success of a student is also associated with the quality of service that the campus administration provides. The purpose of this paper is to provide a prototype for supporting the establishment of effective management-focused campus community so that campus may achieve adequate yearly progress, ensuring that all students achieve adequate services in a timely manner [1].

Campus SIA is a distributed system developed with object oriented development approach. The web enabled system comprised of a centralized database that allows users to handle all daily operations of campus administration includes entering new enroll-

ments, tracking student personal information, tracking and monitoring fee payment, processing student's status (e.g. enter, drop, expelled and other). It allows campus staff to update, share, and use student information among academic staff in a secured manner.

2.1 Requirements of Social Administrative Software

We have focused on the introduction of social administrative software concept [1], [3], [7] in order to foster the tacit knowledge that is gained in the administration. From our long past experiences in corporate and academic institutions we can conclude that the accessibility in technology and personal behavior of the staff are the principal characteristics of a public administration that can impact to the nature of society and organization, whereas the tacit knowledge [14] determines the actions and service quality of organization. The knowledge gained during management cycle has a greater role to create explicit knowledge artifacts to be accessible to others in the organization growing process.

Knowledge management cycle determines the quality of service in public administration. In order to socialize these services in terms of knowledge sharing among the staff in the organization, we have decided to incorporate the social characteristics into the software system and try to define this concept. We agree that it is difficult to incorporate all kind of features of social characteristics into the software however we must agree to the point that tacit knowledge of the organization can be lost due to the lack of proper preservation tools.

Thinking insufficiency of this feature, we realize to incorporate the social features in Campus-SIA. Nonetheless, we do not incorporate all of the features of social software rather introduce new features that were lacked in prevailing social software which could depict the concept of optimization of internal administrative processes of campus through a simple, effective and efficient web enabled application at which all staff can work together in collaborative manner [2]. We have seen very positive effect in terms of knowledge sharing and the administrative businesses process is possible to operate within a friendly environment. This sort of working environment was lacking in previous infrastructure however we regained it by introducing Campus-SIA it and due to of which the staffs are constantly on the move and closely working together.

2.2 Desktop Oriented Monolithic Management Tools

As discussed in previous sections, knowledge preservation could not take positive effect in the absence of proper tools. Though, for the past decades or so, ICT technology has revolutionized the way we expect the services in the organization. We cannot ignore the fact that the tools that are being utilized to manage the data in Universities or other organizations are desktop oriented monolithic tools. In academic front, we are working with new generations of students who use more ICT tools and services and who has greater expectations of service quality. For example, this generations use emails, blog, wiki, message board, twitter etc. for communications at which message can be sent to recipients instantaneously. In this way, this layer of users is much more connected and in result we are facing new challenges also. The

new challenges in the area of services and communication sectors arisen due to new tools cannot be addressed with traditional monolithic tools. The problem of monolithic tools such as Exceles and other desktop oriented tools [3] used in the administration has limitations for effective data management such as organizing, sorting, deleting, and version control. In terms of data management, there are lots of campus staffs who still use Microsoft access; however, these tools have lots of difficulties and the campus staffs were compelled to encounter these difficulties as follows:

- (1) The prevailing monolithic tools are only accessible to limited number of campus staff and could not update the data at the same time
- (2) It requires numbers of redundant tasks as per the change of each academic year.
- (3) These tools are entirely static and are very inflexible due to monolithic design and require IT expertise to upgrade and change with business requirements.
- (4) It involves large paper work to support key business activity such as enrollment, course adjustments, handling records of finance, student information and other reports.
- (5) The system does not have relations with other software applications used by the university such as financial management, human resource management and schedule systems.

2.3 Related Works

Much research has identified component architecture as a key resource for Student Management System. Campus-SIA complements this work by introducing the configuration and customizable technique which is more users friendly and can be handled with relatively less effort. Campus-SIA is scalable due to its dynamic feature in its architecture. One can add, delete or update number of campuses with this system without modifying the application as it has been architected with easily customizable components. In academic front, we have observed number of campus management system and we found very similar kind of research done at Fiji National University [4].

The management system developed in their research is called FNU-CIS [6] which has similar functionalities in terms of security, performance, and accessibility. In commercial front, we have done a case study of Campus-SQUARE [12], A2zcampus [13] implemented by NS-Solutions and CYBROSYS technologies respectively; however, we found that their research and solutions also did not indicate about the dynamic configuration of the modules such as fee structures and reporting architecture required for documentation in the campus administration. For example, the fee structure of the campus may change in the future academic years; however, due to their static nature of tuition fee structure; those systems are not adaptable for changing structure of the tuition fee.

In contrast, Campus-SIA implemented in our research can support the changing structure of tuition fees and other financial modules as per the configuration thereby provide easily customizable tools for each successive year in order to automate and minimize the administrative tasks.

3. SOA-based Management System (Campus-SIA)

In the case of monolithic oriented management system, we highlighted the shortcomings and the lack of co-operative management process characterized by collective management strategy. Collective management process could not be well practiced with monolithic management tools due to its inflexibility and less adaptive feature. Business process of any organization characterized by less adaptive strategy with changing environments has direct or indirect role of monolithic tools. In order to succeed enterprises including academic institutions, the essence of flexible business processes can be taken as key success factor. Flexible business process cannot take substantial pace in the business cycle without flexible business strategy and which is only possible with the applications and the architecture applied in the business process that supports such feature. Often, these business processes are directly coupled with the business strategy adopted in the organization and these processes can smoothly executed if the architecture of applications are built with the concept of service oriented architecture (SoA) [2], [5], [16]. Rainer discusses that SoA based management concept is very well suited to support flexible business processes and application systems because capabilities (in form of services) can be composed in the most efficient way to achieve a high level of agility [15]. However, the management of SoA-founded application systems is often neglected in academic intuitions too.

Thus, we present an SOA based approach that enhances the underlying traditional business process and concept with additional management functionality, e.g. role based management and dynamic reporting system. Campus-SIA supports and execute most parts of a university administrative business processes and the modules mentioned above are architected with SoA concept. Business process flexibility strongly depends on the flexibility of the underlying applications and IT architecture.

3.1 Overview of Campus Administration Management

Campus-SIA (Campus Student Information Application) is a web enabled software application for the management of student data. It enables the administration to enter the academic and financial data related to the student through web enabled browser that ultimately enhances the overall productivity of the administration. Productivity has been enhanced due to its feature of collaborative management at which all campus staff can work together which has created better chance to address the given task in the administration efficiently[5].

3.2 Role-based User Management

Resources are generally allocated through some application, which enforces access control restrictions by allowing only authorized access [8], [10]. Allocating resources in case of Campus-SIA [1] is carried through by settings some real rules [9] or applying the concept of role on the basis of administration policy in the administration. For example, each staff member having certain responsibility in administration can be assigned one or more roles as per the policy of administration. A role determines the

Table 1 User Role

Name of Role	Particulars
Financial Administrator	<ul style="list-style-type: none"> View Report Component Configuration (Financial Section) Student Account Management
Career Administrator	<ul style="list-style-type: none"> Student Career Management View Report
General Registered User (Manager)	<ul style="list-style-type: none"> View Report Only

nature of tasks the staff can perform in the system and what information he or she can view.

This architecture covers certain tasks and access capabilities associated with the Campus Administrator and Super administration roles. The role assigned to each user is shown in Table 1. These roles can be assigned to each user during user creation as per the policy of the administration.

3.3 Dynamic Reporting System

Reporting is an important part of document management which determines the overall performance scenario of the institutions. Report documents are necessary not only at the time of creation but also for the future purpose that's why it is equally important to archive well and should be availed while necessary.

However, we often see situation in the institution that the generating process of which is not given sufficient attention. In order to increase the end output of the institution it is also important to improve reporting process. We have achieved good reporting output by improving reporting process by introducing the reporting architecture and by making the reporting process more dynamic.

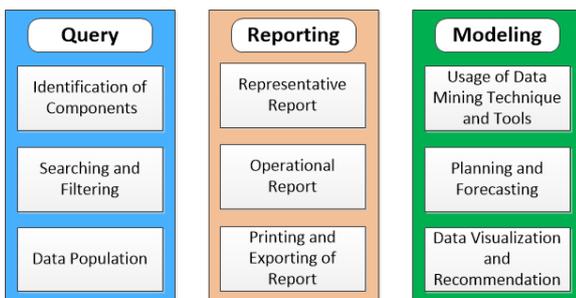


Fig. 1 Reporting Architecture

The Dynamic Reporting system implemented in Campus-SIA allows data to retain in the database through web enabled entry form provided in the interface. The data entered by the administrative staff can be changed as per the requirement and accordingly the reports are generated automatically.

Fig.1 shows that layering architecture of Campus-SIA enables you to group the reporting system into two different categories. We have defined these categories as operational group and representative group. Operational groups of reports are the reports at which administrative staffs can work and manipulate their data as daily work. Whereas, representative reports are the report which has specific format that meets the format of administration. These

reports are submitted to the city educational council and the ministry of education, science and technology.

As shown in Fig.2, we have modeled our reporting architecture into 3 different layers such that our reporting process starts from capturing data via query process. We have designed reporting process that starts from query modules followed by reporting modules and finally end up with modeling modules. However in the current architecture we are not able to fully implement modeling part of the architecture.

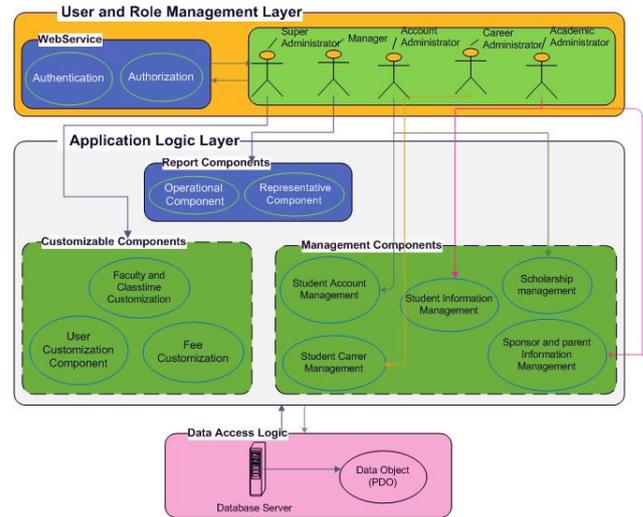


Fig. 2 Reporting Layers

3.4 Customization Capability

During the architectural design phase, we have architected Campus-SIA such that it could be reconfigured easily and enhance its capacity to meet the changing structure of organization. As per the needs of the University, Campus-SIA can be customized and configured. All of its components are capable of resizing and reconfiguring in order to re-structure, which gives any institutions flexibility to make changes and add options to meet their specific needs. For example, university may increase or decrease its campus, faculty or department; in such case the administrator of this system can easily customize the system to Campus-SIA thereby providing a highly customizable and flexible platform, where one can tailor everything from data entry screens to reports generation.

4. Multi-layered Architecture Design

This paper proposes a multi-layered architecture with three fundamental layers. We have categorized those fundamental layers as user interface layer, business logic layer and data base layer.

The first layer can propagate user interface with multiple sets of data entry form followed by configurations thereby providing data entry functionalities that is posted to database layer. Accordingly, this layer is enhanced with the functionalities by which user can view different kinds of reports. This layer is implemented using HTML and PHP. The dynamicity on usability of the user interface is added using JQuery and AJAX Technology. The user interface is totally managed from the user role management which means the interface will be changed dynamically

according to the role of the logged in user. For example, the user management interface is only displayed for the super administrator, student account management and scholarship management interface will only be displayed for account administrator and so on.

The other layer is consists of database servers. The major work of this layer is to store the data captured at user interface layer and also stores the data manipulated by application logic. We have designed the database so as to keep data neutral and independent from application servers or business logic. Providing data base layer as separate entity also improves scalability and performance.

The key layer of Campus-SIA is application logic layer which implements the main business logic of the entire system. This layer takes input from user interface layer and stores information in the database layer according to applied business logic. The input data are logically separated according to the business logic which has divided whole Application Logic Layers into 3 major components. Various components are used to customize the business logic itself. The faculty and class time customization, user customization and fee customization is used to configure the parameter of business logic. Each management components are dedicated to their respective tasks and responsibility. Report Components are the output for the User Interface layer generating the report by joining the datasets from different table to make data analysis task more easy and effective.

4.1 System Architecture and Use Case

In order to develop the system properly, we must agree with the requirement document. We had done number of discussion to analyze requirement document with the administration. Accordingly, we discussed about the access policy as one of the motivation of our research was to implement access control policies which can adapt rapidly in order to follow organizational needs. Such requirements demand skilled policy administrators, who are able to change policies to support ad-hoc collaborations, while ensuring that the policies full fill their fundamental purpose, for example they can control authorized and unauthorized access.

After analyzing access policy that meet the requirement, we architected the system and the part of it that reflects role based resource allocation is depicted in the use case diagram in Fig.3.

4.2 The Fully Web Enabled Model

In the case of campus administration of Wakkanai Hokusei Gakuen University, there are still numbers of offices at which, the job of an administrator is seen as monolithic: to perform a collection of tasks that are, with few exceptions, carried out alone and the status of tasks are obscured from their colleagues. In most colleges and universities, this kind of repetitive and monolithic approach can be labor-intensive and cost ineffective, thus needs to be transferred with web enabled application that is more transparent [1]. Individual administrative member can work with this web enabled Campus-SIA and deliver multiple works, each of which can be assisted and monitored by other colleagues. This type of web-based applications can be used largely as supplemental resources for administrative efficiency and productivity.



Fig. 3 Use Case

4.3 Transparency of Workflow

Campus-SIA provides accountability at all levels thus data entered in the system will be opened by the top level management. It makes all staff accountable towards the data and thus, the management can have a closer look on the activities of the campus.

Campus-SIA has been built in such a way that it can automate redundant tasks and ensures that uncompleted tasks are followed up and their status are updated to all staff that have privileges to monitor, modify or update the tasks. The system reflects the steps required for the completion of each task and produces report of corresponding task that has been completed. We emphasizes in creation of report for each business process as it is one of the troublesome for campus staff who need to produce the report in timely manner and requires much effort. Unless documentation and report creation is performed properly, both systems and administrative processes will become a black box somewhere in the workflow. Campus-SIA is capable of generating reports automatically, which enables the transparency of a vital feature for an efficient workflow

5. Implementation and Practical Usage

In this section we briefly introduce about our experience of deployment and practical usage of Campus-SIA in the administration of University. Nowadays, not only the business of enterprises and industries but also the business process of Universities relies on networked computer systems to support distributed applications. To plan for the required level of management, two basic areas must be considered to address the data management of University. One of which is the security and the other is number of potential users and scalability. Accordingly, we need to plan the hardware specification and network topology. The servers that we need to plan in the case of Campus-SIA are data base server, web server, and authentication servers. In our case, we separated our servers from our main data center and design a small network nearby the administration. The picture of datacenter is provided at the Fig.4 which is separated from the LAN at which Campus-

SIA resides.



Fig. 4 Data Center of Wakkanai Hokusei Gakuen University

This separation of network from our datacenter adds up extra security layer as our firewall and natbox resides in the main data center and the campus-SIA in separate LAN. In this practical scenario we have virtually and physically separated campus-SIA and make it more securely located inside the administration. We have tested Campus-SIA in 2 ways. At first, we have separated data base server, authentication server and apache web servers. We can replicate each server to increase the availability. However, allocating different servers as shown in Fig.9 for different purposes depend on the numbers of users and the scale of administration.

Considering the fact of WAKHOK administration, we centralized each server and design the simple network as shown in Fig.5.

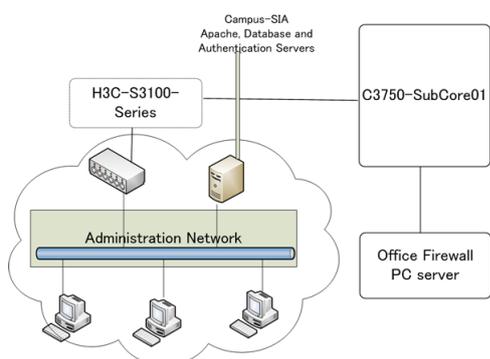


Fig. 5 Network Scenario

Campus-SIA is architected with SOA based concept. Though we tried to implement all components to be supported with Service Oriented Architecture, we were unable to support all the components with service oriented feature. However, we completely implemented our user authentication and authorization module in SOA based concept as shown in the Fig.6.

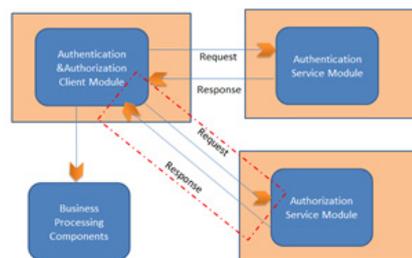


Fig. 6 Authentication Scenario

As shown in Figure 6, in order to authenticate, the client program sends the request to the server program having authentication parameters. In the case of authentication service, we pass the object of Authentication class as parameter to the JSONRPC Server. This server checks the status of user whether it is created in the database server of Campus-SIA or not. Once, it finds its existence, the server return the id of that user thereby providing login functionality. The snapshot of code is given below:

```
$auth = new Authentication();
jsonRPCServer::handle($auth)
or print 'no request';
```

Fig. 7 Authentication Code

In the very similar way, we can use the service of authorization too. The snapshot is given below:

```
$auth = new Users();
jsonRPCServer::handle($auth)
or print 'no request';
```

Fig. 8 User Authorization Code

At this time, we have created the object of Users class and which is set as parameters in the jsonRPCServer thereby requesting the authorization to the sent users. In this way, we can objectify most of the components into server modules and reduce the client side codes which are inevitable in service oriented architecture. Further, the architecture of Campus-SIA is featured by the modular type of software architecture along with separating presentation logic, web logic, business logic and data logic as desired by the users.

5.1 Case Study of Wakkanai Hokusei Gakuen University

Wakkanai Hokusei Gakuen University was established in 1987 and having only one post-secondary institution in Wakkanai city. It is a semi-public institution, and has a great contribution to promote research and academic excellence for the welfare and needs of the communities in Soya area of Hokkaido as well as communities in the region and abroad. In order to promote its ICT infrastructure the administration has decided to re-evaluate its administration management system and this research is believed to improve its overall performance after successful implementation.

From the academic year of 2012 we have introduced Campus-SIA in the administration of Wakkanai Hokusei Gakuen University. Traditionally, the administration of Wakkanai Hokusei Gakuen University used to save information data in monolithic

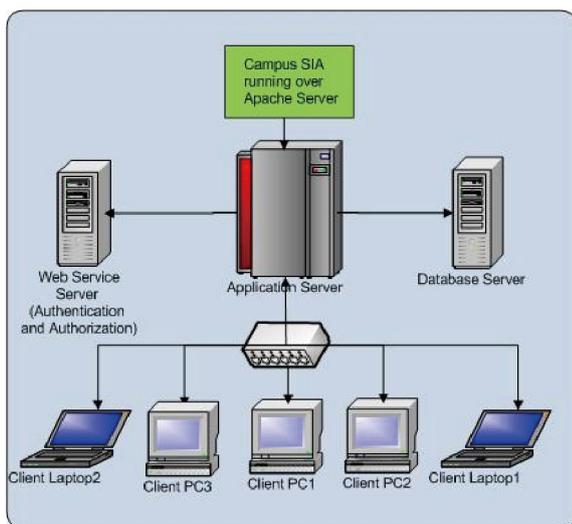


Fig. 9 Distribution of Servers

desktop based system which has lots of limitations and lack the functionalities of co-operative management. Further, the administration has faced number of bottlenecks regarding data management among the departments and sections of the University.

They have 4 sections which has direct relation with services and management of student: student support section, student career support section, maintenance section and financial section. Before introduction of Campus-SIA, these sections were working independently and numbers of redundant tasks were carried out due to lack of proper tools and software. For example, whenever there is any change in personal data of the student, each section used to enter the same data into their monolithic tool. This sort of working style due to the lack of integrated tool, obviously hamper the entire performance and business flow. These tools have also no relation with the other tools introduced in the administration.

5.2 Performance Enhancement of the Administration

The traditional administrative tools utilized in the administration for managing student records, including student financial records and other information system, has become bottle neck for the total performance of any college or university. We have witnessed such changes in campus working culture, especially due to the wide usage of Internet; have raised student expectations for the services provided by technology. However, there are still few colleges and universities who still utilize those traditional tools characterized by monolithic approach which cannot meet desired quality of services as expected by the students.

As a result, those colleges and universities are vulnerable and may lose trust from their own students. This will obviously affect future student enrollment. Information management system such as Campus-SIA can become an important management tool that builds trust among students through delivering services effectively and efficiently on a timely manner. One of the goals of development of Campus-SIA was to maximize overall performance of campus administration. Before deciding the development of Campus-SIA, we benchmarked the current performance of the administration on the basis of the tools and the system they currently used. Our preliminary assessment suggested that the ex-

isting system was inadequate and inefficient to provide necessary outputs and there is a need to develop a flexible, efficient and robust system to enhance productivity of administrative staffs. The key decision factor of this case study was to understand performance management from perspectives of different parameters and develop a framework that meets all the objectives of performance enhancement. In order to meet this goal, we developed Campus-SIA so as to enable the administration to understand all steps required in performance enhancement and examine shortcomings on each stage. The facility of providing common interface to each individual at which all members of the administration can work in the application simultaneously maximizes their performance and productivity.

5.3 Lesson Learned From Practical Usage

On the basis of our experience of development and launching of Campus-SIA at WAKHOK University in responding to the effective campus management that have been achieved over times, there are several lessons learned that can be shared with other academic institutions and organizations in their planning, deployment and response to similar situations. We have identified these lessons and practices which span several domains: administration, infrastructure, development, and architecture. We do not want to ignore the consideration of infrastructure, development and architecture, however, among of these, we would like to focus our most considerable lessons which are more of administration or management oriented. The reason of choosing this consideration is that the management of the University will measure the success or failure of project or practical research as per adherence of the project to its end-to-end project timelines as well as by the stability and performance of the application rather than by the elegance of the internal composite and attractive UML design of the system. In order to complete the research within given time frame, we have realized to give sufficient priority under this category and which are highlighted as below:

- (1) First, requirement analysis should be done with all concerned staffs who are potential users of the system. These staffs might have good knowledge of the process execution in the campus administration. This knowledge should be reflected during requirement analysis.
- (2) Second, institutions and organizations seeking to change management system by consolidating with similar management tool need to factor in the time and effort of the staff that will need to test, review, advice, and revise the business process. This preliminary testing process will examine whether the executed process reveal expected business flow or not. Accordingly, it will affect entire development decision.
- (3) Third, development team needs to investigate and evaluate the available tools such as programming language, database system and development framework. We agree that we should have utilized distributed database from the beginning though the current system can be extended with NoSQL database in the future.
- (4) Fourth, adequate considerations should be given to the new, emerging open source management tools and products in order to reduce the development time and other associated

costs. We have developed each module from the scratch.

6. Conclusion

We conclude that desktop based monolithic tools are lacking the social relation building and knowledge exchange within organizational communities. Further these tools are lacking dynamic features. Even simple changes of business processes demand a tremendous customizing effort and thus hinder the entire performance of the academic institutions.

The feature of knowledge sharing through socially aware tools has more capacity to adapt with changing environments and changing business strategies. This feature of adaptation is enhanced with SoA based architecture that we implemented in Campus-SIA. However, we faced with the condition at which some of its components are not capable of supporting SoA and these modules have broken features of SoA.

In the future, we will try to fix the broken architectures of Campus-SIA and make it fully SoA enabled. In order to internationalized University or campuses, administration and academic staffs must be ready to face with the challenging and changing environment. A crucial competitive factor to adapt with such changing environment is the ability to react quickly, flexibly, and efficiently by adapting the management strategy and business that meets new conditions and new expectations. These management strategies should be reflected in the tools and which are more achievable with flexible architectures as adopted in Campus-SIA which has supporting features to adapt with changing business process.

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