Towards Successful Improvement of Students' Residential Management Processes using the Enterprise Architecture Maturity Model

Golooba Moses
Department of Information Systems
International Islamic University
Malaysia

Mahmoud M. Musleh
Department of Information Systems
International Islamic University
Malaysia

Karama M.A. Nofal
Department of Information Systems
International Islamic University
Malaysia

Azizah Hassan
Department of Information Systems
International Islamic University
Malaysia

Khansa Monther
Department of Information Systems
International Islamic University
Malaysia

Abd. Rahman Ahlan
Department of Information Systems
International Islamic University
Malaysia

Abstract— In this information age many institutions have resorted to using information systems to handle most of the business processes. However, well as many of them spend huge resources on implementing information systems to solve their problems, many times the value for money invested in putting up these information systems is not optimally realized because more often these systems fail to fully address the problems they were intended to solve. This article examines how organization such as a University, can use both e-management and LEAN management principles to improve their business processes and the overall enterprise architecture; with an aim of improving the business process at the University through redesigning the current enterprise architecture based on Service oriented Architecture (SOA). It is hoped that the redesigned enterprise architecture knitted around the above principles will go a long way in improving the satisfaction levels on the side of students, and other stakeholders like staff and senior management, reduce on wastage, improve on agility of business processes, increase productivity on the side of employees and thus result into happy managers and students. The methodology was qualitative which involved conducting in-depth interviews with students and senior managers from business process owners' side, data owners and senior managers at the Information Technology Division of the University. The following findings and recommendations were based on a single case study conducted at University X where students are not satisfied with the current quality of service they receive from the University's hostel management.

Keywords- Enterprise Architecture; Enterprise Integration; Business Process Improvement; Service-Oriented Architecture; E-Management Principles.

I. INTRODUCTION

This study investigated the main causes of dissatisfaction among students of University X with the quality service being provided by the hostels managers. Particularly the study examined the weaknesses within the existing IT architecture. The study's aim was to find ways of improving hostel management processes in particular within the University and other business process in general through redesigning the current University architecture based on Service oriented Architecture (SOA) and aimed at addressing the requirements of the enterprise architecture maturity model proposed by [1].

A. Background of the University's Accommodation

University X is a publicly-funded University in Malaysia; the University has 16 hostels, and provides accommodation to over 14,000 students both local and international. These hostels have brocks allocated to either undergraduate students or postgraduate students. There are mainly three types of rooms, i.e. single rooms, 4-person-sharing rooms and elite rooms.

This paper is organized as follows: Section 2 discusses on methodology, Section 3 discusses our findings, and in Section 4 the analysis of current enterprise architecture is made, followed by section 5 where recommendations are made. In section 6, the proposed model is explained. This paper ended with conclusion and future implications in section 7.

II. METHODOLOGY

Data was collected using semi-structured questionnaires and in-depth interviews conducted by a project team of four members. A series of interviews were conducted with students from different hostels, and staff from various business units including IT Department (ITD), and hostel Management office. Investigations were made to find out the problems with the current system. This included finding problems with the current business process, IT systems and problems related to people.

III. FINDINGS

The findings of this study include problems faced by students mainly related to getting a room, payment process and registration. Other related problems due to filing systems, software and data management system.

A. Problems related to getting a room

The current Information systems do not show availability of the rooms, and do not have any provisions for international students to book rooms before they leave their countries. Thus, usually international students have to suffer, until the day of official manual registration. At the back-end the management can see the room availability yet the students who want these rooms do not have access to this information. Likewise there is no intelligence in the current system to inform students and hostel managers in advance when certain rooms will fall vacant, and no automated means of informing students of room availability.

B. Problems related to Payment

Currently, there is no direct automation or real-time transfer of information between most of the existing IT systems within the University. For example when a student pays fees in a bank - after standing in a queue for hours, he/she then has to physically take that receipt to the finance division for clearance. But even after depositing the receipts at Finance division, updates are not effected on other systems until after some days or weeks, implying that if the student's portal account was blocked due un-payment, it will have to remain blocked until after sometime, even after paying.

C. Physical Files

Although there is a computerized system, but still each hostel keeps a physical file for each resident, this in away explains why management does not encourage students to shift from one hostel to another so as to avoid the problems related to movement of the physical files.

D. Problems related to check-in out

Continuing students have to physically line up during check-in and check-out activities usually conducted at every beginning and end of semester and during semester breaks. Also when students want to make reports, or raise any complaints they have to physically go to the Hostel office yet this is something that can easily be done online though, it is said that there is a students' reporting/complaint system which is under pilot study at one of the hostels.

E. High expenditure on software

Currently the University spends huge amounts of money on the off-shelf software licenses, and hiring of consultants who maintain those proprietary systems.

F. Data redundancy

Apparently there are various database management systems being used by the University, including Oracle, My SQL, among others; which have duplicated data. This scenario has led to data inconsistence something that greatly affects the quality of data.

IV. ANALYSIS OF THE CURRENT ENTERPRISE ARCHITECTURE

Enterprise Architecture can be defined as [1] *"The organizing logic for an organization's IT infrastructure and business process capabilities to address a firm's need for IT and business process integration and standardization."*

According to [1], organizations with mature enterprise architecture possess a strong foundation for execution. This foundation results from carefully institutionalizing IT infrastructure and coupling it with digitized business processes. The use of maturity models simplifies this task and provides a pragmatic, structured approach for measurement [2]. High levels of enterprise architecture maturity are said to be a strategic weapon that gives organizations better customer intelligence, higher employee and senior management satisfaction and lower IT costs [1].

A. Current Business/IT Alignment

Currently the University is still at the "Coordination Stage" which is the first stage of the four stages of maturity of the business and IT alignment model proposed by [1]. At this level the Business Process Integration is considered to be high but the Business Process Standardization is low. Also at this stage there are unique business units with a need to know each other's transactions and the key IT capabilities at this stage are; access to a shared data through standard technology interfaces. However, University X has put up efforts to integrate the business process, but this is being done on ad hoc basis without a proper change strategy. The result is that despite these efforts, the general picture of the Business/IT alignment is still faint and therefore cannot produce the required results.

B. Current IT Architecture

Currently the University's IT architecture is divided into separate clusters of IT systems that are owned by individual

business units like the Finance Division, Center for Postgraduate Studies, Academics and Records Division among others, and supports the specific business needs of each of these business. In other words, each cluster of the current IT systems operates within its own silo. Like many other organizations, this University's IT architecture has evolved over a long period of time to include a diverse mix of IT systems running on different platforms and employing diverse technologies. The current System architecture is a combination of tightly coupled systems, whereby the database management system is tightly tied together with the application and the processing logic, like in the case of Oracle finance and Human Resource Management (HRM) among other, as stated in Fig.1. However, there is also another architecture of relative loosely coupled systems whereby there is one database being shared by many applications these include the security management system, students residential management systems.
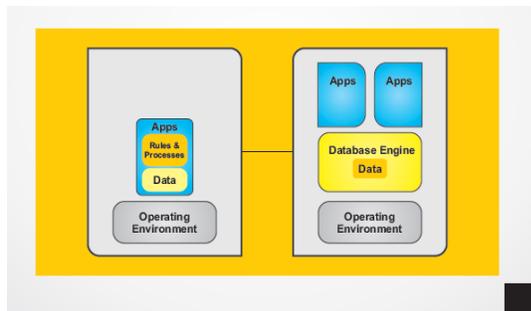

Figure 1. The current IT Architecture

C. Existing Application

Currently, the University has many IT applications for handling various University processes, however, these applications are largely unstandardized (e.g., different applications use different data sources) and there is a general lack of proper integration strategy i.e. not all applications can coordinate with one another. This is mainly because some systems are still stand alone (not connected to any other systems), others use a point-to-point approach of integration while the rest use enterprise messaging style of integration. The University has over seventeen applications for students which were built using oracle forms and the data is stored in Oracle database. Some of these applications run on Linux Red hat operating system environment and others run on windows server operating system environment. There are also the staff applications that consist of thirteen applications which use three types of database (oracle database, oracle suite database and MySQL database). Moreover, some applications for handling issues relating to staff were built using oracle forms and others were built with PHP programming language.

D. Enterprise Integration

Enterprise Integration has been defined by [3] "*as a strategy for sharing data and capabilities of an*

organization's software assets across the enterprise; enterprise system integration involves a complete system of business processes, managerial practices, organizational interactions and structural alignments; and knowledge management." It is an all-inclusive process designed to create relatively seamless and agile processes and organization structures that are aligned with the strategic and financial objectives of the enterprise [3].

Enterprise Integration has many advantages such as; giving real time information access among systems, streamlining business processes and helps raise organizational efficiency, maintains information integrity across multiple systems, and also helps ease of development and maintenance, reduce costs, and enhances customer satisfaction [4], [5] and [6]. However, Enterprise Integration can also have disadvantages such as, high initial development costs, and up front business design,

E. Status of Application Integration

At first each business unit within the University had independent monolithic applications, but with time, some business units realized the need to share data with other sections, so they devised means of making connection and sharing of data possible. However, there is no proper strategy for application integration; in other words, systems are being integrated on ad hoc basis as the need arises. At first they opted for point-to-point communication interfaces between applications and then moved to enterprise messaging.

F. Point-to-point communication interfaces

Point-to-point communication interfaces connect monolithic applications to share data in order to complete the desired business function [6] and [7]. In this case a certain application Y would be hooked into another application, say Z using some communication protocols, as stated in Fig. 2. However, this approach was found to have many shortcomings, for example, when an update is made in application Y, it would take days or weeks to be updated in other systems. Another scenario is when a student pays fees at the bank, he is required to take the receipt to the Financial division for recording and update, however, even after entering that information at the finance division it can take days or weeks before the same update is replicated to other system, implying that if the student's account was blocked due to non-payment, it may remain so for some weeks even after paying.
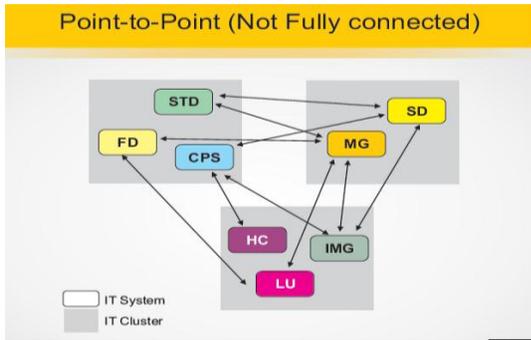
Figure 2. Point-to-point Communication

Another problem with point-to-point integration approach is that as the number of applications joining the network grows, the entire network becomes very confusing and unmanageable as can be seen from the figure below. Similarly, each connection requires a distinct interface resulting into many interfaces, on top of being costly to build such a number of interfaces. The diagram in Fig. 3 shows a fully connected point-to-point integration approach.
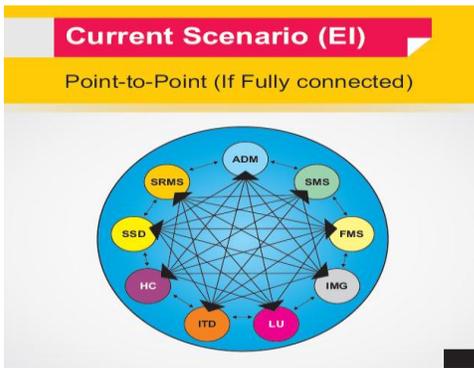

Figure 3. A Fully Connected Point-to-Point Diagram

G. Enterprise Messaging

In trying to address the problems related to point-to-point communications, and applications integration issues, the University opted for the messaging protocols approach [6] and [7]. Messaging protocols are built on top basic transport protocols like HTTP, TCP, and UDP among others [5]. However, this approach also has its own issues. For example, if the communicating applications have different data formats, it is not easy to reconcile data from one application to the next. Also business and logical transformations are difficult; for example, if staff in oracle finance is identified in the customized University system using staff ID, and other systems use SSN for example as the primary identifier of staff, this brings about conflict, leading to data inconsistence.
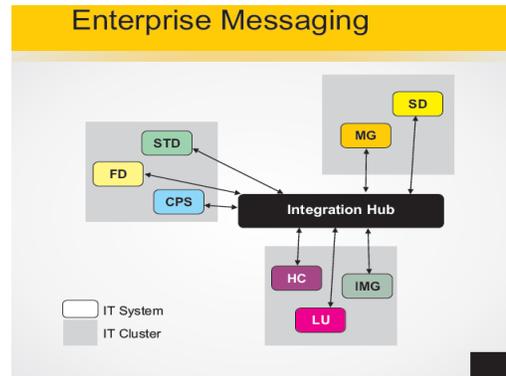

Figure 4. Enterprise Messaging Diagram

Another challenge is that some of the system, like most off- the-shelf applications are tightly coupled though there is relatively loose coupling among the in-house built applications, refer to Fig. 5.
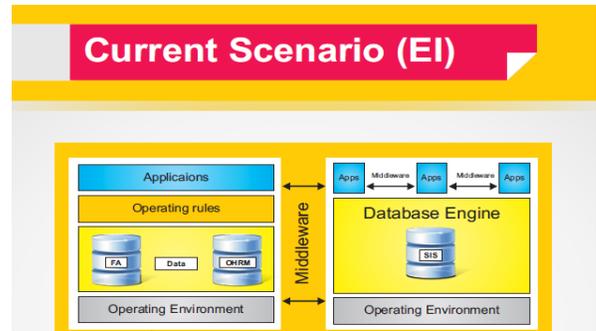

Figure 5. Current System: Coupling Layers

H. Status of Database Integration

The University has many database management systems from different vendors like Oracle, MySQl, SQL server among others. On the other hand there are so many software applications both in-house built and off-shelf applications also from different vendors. Overall the IT systems are broken down into the students systems to handle student issues and the staff systems to handle issues related to staff management. These individual highlands of databases being interconnected cannot easily support end-to-end business. Further, there is a problem with real time update of the fragmented data stored in different databases; this creates inconsistencies and serious data quality concerns.

I. Analysis of the Current Enterprise Architecture Maturity

According to [2] *"There are six steps for successfully evolving enterprise architecture maturity, such as formulate a strategic vision for enterprise architecture and gain long-term commitment from top management; involve central and local groups; take an evolutionary, rather than a revolutionary, approach; have a strategy for supporting IT systems and business processes; require local accountability for implementing global objectives; and implement an*

effective performance management program." The various stages of enterprise architectural maturity as illustrated by [2] are explained below:

1) Business silos: In this stage, an organization develops and deploys disparate IT applications that address the needs of local business units and functional entities. These applications are not necessarily integrated, and they typically do not share enterprise-wide data sources.

*2) Standardized Technology***:** In this stage, an organization develops and implements a set of standards that helps it implement different IT applications and improve its data capabilities throughout the organization. The primary objective of such standardization is to reduce disparate local efforts of developing or modifying IT applications. Instead, the core IT standards are shared by all IT applications, which improves organizational efficiency and cost effectiveness.

3) Rationalized processes: When firms reach this stage, they begin implementing enterprise-wide IT systems that support standardized business processes for their core business operations. These systems are built on top of the standardized technology introduced in Stage 2, resulting in better enterprise-wide sharing of data and processes.

4) Business modularity: In this stage, an organization begins to develop and leverage capabilities to integrate customized and/or industry-standard components for greater organizational benefits. The key characteristic of this stage is achieving a "plug-and-play" capability of integrating internal or external business processes.

In view of the above and based on our Investigations it is evident that University X does not fully conform to the modern enterprise management standards, such as it neither fully conforms to e-management principles nor LEAN Management principles. But like [1] observed "companies have architecture, but usually not the right architecture." Based on the observable characteristics we conclude that University X does not have the "right" Enterprise Architecture and thus a need for a drastic surgery on the current Enterprise Architecture. For example, if analysis is done based on [1] model of enterprise architecture maturity which includes four stages, i.e. Business Silos, Standardized technology, Rationalized Processes, and Business Modularity, and comparison is made with the above findings about the current University's enterprise architecture, then it becomes evident that University's enterprise architecture maturity is still in its infant stages, i.e. the University is just moving from the first stage of business silos to the second stage of standardized technology.

J. Implication of the improper integration strategy

This lack of standardization and proper integration prohibits hostel administrators from developing effective end-to-end business processes. For example, without coordination among admissions and records system, security, SRMS (Student Record Management System), and financial applications, each student's record must be entered into each of these applications separately. The result is fragmented or ad-hoc business processes for each student because there is no single source of University data. Different business units, responsible for different aspects of processes, may not have a shared understanding of a student's data.

V. RECOMMENDATIONS

After analyzing the current IT architecture at the University, which includes, separate business silos, some integration at both point-to-point and at enterprise messaging level, the team agreed that these approaches have too many shortcomings and therefore not sustainable, thus proposed to change the enterprise architecture all together. The new architecture should concentrate not just on the technical aspect, i.e. integration of technology, but should provide a total overhaul to the current architecture. For example, a system architecture that was designed from internal users' point of view cannot sufficiently address the needs of the clients, in this case the students and other stakeholders. To come up with the right architecture there is need to implement the e-management principles i.e. integration, automation, dynamic, paperless and artificial intelligence.

A. E-management

According to [8], e-management is a strategy for achieving organization goals though successful implementation of information systems that are integrated, dynamic, and intelligent and through ensuring that all business processes within the organization are fully automated thus eliminating any paperwork. The following sections describe how e-management principles will be practically implemented within the University X to ensure efficiency within the hostel management processes.

B. System Integration

First, the researchers propose that the University should consider an enterprise-wide integration of all the business processes, database systems and applications in order to create a more convenient environment for sharing of quality data among the different entities within the University, such as the staff, and students from the different faculties and all other stakeholders. This will involve bringing together the multiple localized integration projects that currently involve point-to-point integration and enterprise messaging between specific IT systems into what can be viewed as a single system. The proposed integration strategy should ensure that the integration process is business driven rather than technology driven, should be able to coordinate business processes within and across different parts of the enterprise, involves multiple stakeholders, and adopts a strategic rather than tactical or localized view. In future the University should

consider connecting its systems to other external systems like those of the external entities like the University suppliers, banks, government ministries, other universities, among others. In the subsequent sections a detailed explanation is made on how this proposed integration should be achieved.

C. Automation of all business processes

Automation entails process re-engineering, automatic data transfer, reduced or eliminated manual processes and reduced or completely eliminated human interference [8]. Although most of the business processes have been automated over time, however, e-management principle dictates that in order to achieve desired results there must be full automation of all processes but not just some of them. For example, although there is a hostel management system, which automates some of the business process related to hostel management however, many of the other processes are done manually, these include payment of hostel fees, hostel registration, check-in and check-out during semester breaks, application for change of room, application for change of hostel, complaints reporting, application for leaving off-campus, finding out on room availability, clearing with legal unit on hostel-related compoundable offenses, among other processes are all done manually. Therefore the researchers propose that the University considers automating all the business processes if the current bothersome manual processes are to be avoided

D. Dynamic

E-management principles emphasize the development of flexible system which can easily adapt to changes in their environment. This is due to the fact that now days both hardware and software change rapidly due to new innovations, therefore the systems built based on e-management principles must be able to adapt to the drastic changes with ease and at the cheapest cost possible. According to [8], dynamic systems should be easy to configure, customize and personalize and should allow the required scalability.

E. Artificial Intelligence

To successfully reduce or completely eliminate human interference as dictated by e-management, applications must be developed with the highest level of artificial intelligence which can enable then to do the required planning, predictions and forecasting like as on when rooms will fall vacant, the expected increase in students numbers, automatic allocation of rooms among other activities which usually require human intervention. This will drastically reduce on wastage of resources, and significantly improve the efficiency of service experience. This can be easily achieved only if all University systems are integrated and the mission and vision of the University are effectively aligned with the overall business processes. For example, a system should be able to tell when a room will fall vacant by analyzing data about the students'

academic progress which can be extracted from the student's records system. This information can help the system to know when the student will be graduating, or whether the student has been discontinued and therefore the system can allocate the room automatically or inform those who applied about the likelihood of a certain room falling vacant.

F. Paperless

As already mentioned above, currently most of the business processes that relate to hostel management involve a lot of paperwork. This include; application for a room to stay, application for living in hostel during vacation, hostel registration, application to leave off-campus, check-in and check-out during semester breaks, application for changing room and changing hostel, reporting and complaint, notification and many other related activities all involve paperwork, and the advertisement and announcement relating to the above activities are printed on paper and pinned on all over the wall. All this must change, whereby all this activities should be done online. The elimination of paperwork will not only improve on the quality of service delivery but is will also go a long way in reducing on wastage.

However in order to successfully implement the e-management principles; the University should embrace Service Oriented Architecture (SOA). Therefore we are proposing to the University to gradually change the existing enterprise architecture based on SOA with an aim of addressing all stakeholders' needs within the architecture instead of solving them in piecemeal.

VI. THE PROPOSED MODEL

The proposed model is based on Service Oriented Architecture (SOA) and Event Driven Architecture (EDA). This model takes a holistic view of the entire organization addressing issues relating to IT governance, business processes, technology and the organization data or information. The Fig. 6 below demonstrates the model.
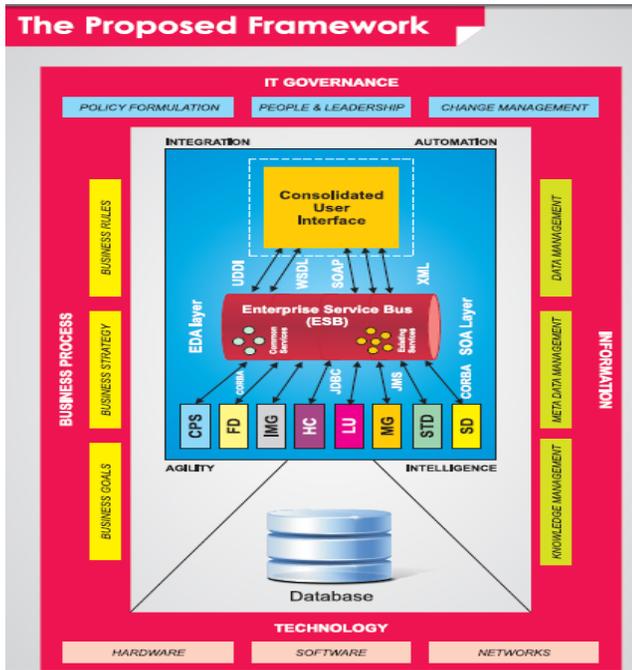
Figure 6. The Proposed Framework

The roadmap should start with identification of the different stakeholders, i.e.; the process owners, data owners, system owner, end-users and the external entities. Data owners are usually those people, who have the rights and privilege to create, read update and delete data. On the other hand system owners are those responsible for designing and deployment of the information systems and maintenance of these systems, in this case it is the information and technology Division (ITD) of the University. Process owners are those who own the various processes like admission, visa processing, among other. The end-users are the students, staff and other stakeholders. Then next step should be the development of a strategy for standardizing the business process; seek a solution for eliminating problems related to database by migrating all independent database within the University into a single repository; and then formulation a strategy for application integration and laying out a strategy for IT governance.

A. Business Process Improvement

The process should begin with business process improvement [9]. Business Process Management should be focused on aligning all aspects of an organization with the wants and needs of clients. Business process management enables organizations to be more efficient, more effective and more capable of change than a functional focused, traditional hierarchy management approach.

To have standardized Business Process organizations must have a proper balance between Business Process Integration (BPI) and the Business Process Standardization (BPS). In [1] explains that by having a proper balance between BPI and BPS; organization can feel the real impact

of IT solutions. These model which is broken down into four parts namely Diversification, Coordination Replication and Unification.

B. Service Oriented Architecture

Service oriented Architecture is an innovative approach to enterprise application integration that increases the benefits of Enterprise Architecture Integration by means of standardizing the application interface. SOA is able to provide better design, agility, reusability, and maintenance savings [7]. Some of the advantages of SOA are including a shorter development cycles; whereby an organization is able to rapidly create IT applications from the reuse and composition of existing services; the overall costs of IT are lowered due to the reuse of existing services; and there is a simplified system Integration due to the fact that IT systems expose their functionality as a set of services which makes them more easier to integrate with other IT systems that are able to tap into those services.

There is also increased in Business Agility in a way that an organization can respond to changing business requirements more effectively because it is able to create new services and IT applications more quickly; as well as improved Quality of Service: whereby customers and end-users experience an improved level in the quality of service because SOA allows poorly performing services to be easily substituted with improved services without affecting other systems [10] and [11].

1) The proposed IT architecture:

In the current architecture some systems like oracle finance and oracle HRM among others have a tight coupling between the application business logic and the data. In the new architecture the researchers propose a loose coupling for these different layers i.e. there should be a separation between the database and the application and between the applications and the business logic as in Fig. 7.
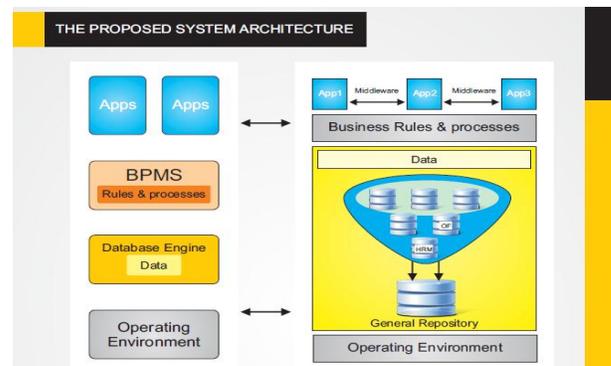

Figure 7. The Proposed System Architecture

2) Databases Architecture:

The researchers propose a single database for the entire University; this is because in e-management environment the entire organization is required to have a single integrated source of data. This facilitates easy sharing of data, efficient update of data, minimizes redundancy and data inconsistence and thus leading data integrity [12]. However, redundant systems need to be put in place because there is a high risk related to a single centralized database.

3) Application Integration:

According to [8], applications developed based on e-management principles must address all the characteristics of e-management i.e. integration, intelligence, automation, agility, paperless. All of the applications should be built on top of a single enterprise-wide database so as to be able to share data from a single source. For proper integration of the applications we propose that the University uses web services. A Web Service is a software application that can be accessed remotely using different XML-based language [13] and [14]. Web services are used by a program to interact with another program. Web services are accessed over SOAP which is Simple Open Access Protocol. It covers all the details necessary to interact with the services; including message formats transport protocols and location [15] and [14].

C. Risk and Change Management

The proposed approach poses a risk to the University data , especially during the process of migrating data, therefore necessary measure must be put in place to mitigate all possible threats to the data during the process of making these changes and thereafter. In this case an integrated risk management procedure for the entire organization and a change management committee needs to be set up, that should work out a proper strategy for change management [16] and [17]. For example, while migrating data from the various databases to a single in-house built oracle system, necessary guidelines must be adhered to, such as strategic risk assessment and analysis must be made in order to ensure that no mistakes are made that can lead to loss of this critical data [18]. Also security reviews must be made to ensure that critical data is not exposed to abuse during the change period. Likewise, there must be measure put in place to ensure that University business is not jeopardized during the process of making these changes.

VII. CONCLUSION AND FUTURE IMPLICATION

Focusing on improvement of hostel management business processes within University X; this study explore on how e-management principles and LEAN management principles can be implemented as a business processes improvement measures within an organization; and improving the overall enterprise architecture. The benchmark used for measuring the level of successful improvement was the enterprise architecture maturity model proposed by [1].

A comparative analysis was done between enterprise architecture maturity model and the current level of the universities enterprise architecture, this was based on a number of factors including; e-management and LEAN management principles application within the hostel management process. Result showed that University X is still at its infant stages, just moving from level one such as business silos towards level two; the standardized stage.

As the outcome, proposals have been made to improve the current hostel management process and the entire enterprise architecture which should include redesigning the enterprise architecture based the service oriented architecture (SOA) and observing to e-management principles. Future research should consider looking at how this integration can be expanded to involve other universities, in what can be termed as Federated Identity; a term defined as the means of linking a person's electronic identity and attributes, stored across multiple distinct identity management systems [19].

REFERENCES

[1] J. W. Ross, P. Weill, and D. Robertson, Enterprise Architecture as Strategy: Creating a Foundation for Business Execution, Boston, Massachusetts: Havad Business School Press, 2007.

[2]   V. Venkatesh, H. Bala, and S. Venkatraman, "Enterprise Architecture Maturity: The Story of the Veterans Health Administration," MIS Quarterly Executive Vol. 6, No. 2, 79-90, 2007.

[3] J. M. Myerson, Enterprise systems integration. Florida: Auerbach, 2002.

[4]   J. W. Ross, "Gaining competitive advantage through enterprise architecture," in Case western reserve executive seminar, New York: MIT Sloan CISR, 2011, pp. 1-23.

[5] R. B. Ferguson, and D. Callaghan, "Tools to ease integration," eWeek, Vol. 19, p.12, 2002.

[6] B. Gold-Bernstein, and W. Ruh, Enterprise Integration: The Essential Guide to Integration Solutions, Boston: Pearson Education Inc., 2004.

[7] W. Lam, and V. Shankaraman, Enterprise Architecture and Integration methods, implementation, and technologies. US, UK, Information Science Reference: an imprint of IGI Global, 2007.

[8] L. Yao, A. B. Othman, A. N. Aballama, and O. R. Mahdi, "E-management development and deployment strategy for future organization," African Journal of Business Management, Vol. 5, Issue16, 2011.

[9] P. Weil, "Innovation with Information systems: What do the agile firms in the world do?," Sixth e-business conference - PwC & IESE, Bacelona, Spain: Center for Infromation system research, 2007, pp. 1-4.

[10] N. Venkatraman, "Valuing the IS contributions to business," Computer Sciences Corporation, 1999.

[11] T.R. Gulledge and R.. Sommer, "Public sector enterprise resource planning," Industrial Management & Data Systems, Vol. 103 Issue No. 7, pp. 471-83, 2003.

[12] B. Prusinski, "Migrating to Oracle: Expert secrets for migrating from SQL server and MySQL," retrieved 18 November, 2011 from: http://www.rampant-books.com/book_0801_migrating_oracle.htm, 2006.

[13] J. Kalagnanam, H. Chang, "QoS-Aware Middleware for Web Services Composition", IEEE Computer Society, Vo. 30, Issue 5, 2004

[14] T. Gulledge, "What is integration?," Industrial Management & Data, Vol. 106, Issue 1, 5-20, 2006.

[15] H. Kreger, "Web services conceptual architecture," IBM Software Group, retrieved 20 November 2011 from http://www.csd.uoc.gr/~hy565/newpage/docs/pdfs/papers/wsca.pdf, 2001.

[16] E. D. Robert, "Governing IT: Policy formulation and enforcement," retrieved from http://it.toolbox.com/blogs/security-governance/governing-it-policy-formulation-and-enforcement-43612

[17] A. Mansur, "Measuring IT Governance effectiveness using ITG diagnostic diamond: A case study of Information Technology Division, IIUM," Journal of Proceeding 3rd International Conference on ICT4M, C1-C6, 2010.

[18] B. Tricker, Corporate governance: Principles, Policies, and Practices, Oxford: Oxford University Press, 2008.

[19] H. Gomi, M. Hatakeyama, S. Hosono, and S. Fujita, "A delegation framework for federated identity management," In Proceeding of the ACM CCS 2005 Workshop on Digital Identity Management, New York, USA, 2005, pp. 94-103,