



Enterprise Architecture Development of Mercu Buana University Based on TOGAF: An Introduction

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Abstract— This paper proposed TOGAF to develop enterprise architecture of Mercu Buana University due to sharp increasing in number of students. This development must keep in line the business goal and information system used in University to support all business function. The framework to develop architecture was TOGAF ADM. The model developed in this research could be used as a guidance to develop next enterprise architecture. Step of activity in TOGAF such as Business Architecture, Data Architecture, Application Architecture and Technology Architecture. We take account the Principle of Business such as : Advance of Business, Satisfaction of Stake Holder, Information System was responsible of all Academic Department, Sustainable of Business, Follow the State's Regulation, Responsible. In Data Architecture Model all data principle were taken account such as: data is our asset, data must could be shared, data could be accessed, data security, data definition. Applications Architecture takes account all application principle such as: application is Technology Independent and easy to use. And the last in Technology Architecture we take account all Technology Architecture principle such as: change based on need, quick response to change, interoperation. The proposed enterprise architecture model is guidance for Mercu Buana University to develop its enterprise architecture while keeping in line with business strategic.

Keywords— application architecture, data architecture, enterprise architecture, TOGAF ADM

I. INTRODUCTION

This paper proposed the TOGAF framework to redesign and to develop the enterprise architecture of a private University. As a private University Mercu Buana must modify its business process due to student body growing and the number of the lecturer. Mercu Buana is one of big Universities in Jakarta with student body moreless 30,000 students. Time to time the students always increased sharply. These two growings enabled The University to modify the enterprise architecture. Recently there are so many methodology or framework to choose, and this fact make The University has a difficulties to choose the optimal methodology. Beside that, the private University had to keep in line the strategic management and strategic IT planning. The University had to develop the enterprise architecture which could give the framework, this is really important to make a decision about the future of IT planning regarding the University development in the future from all point view or all stakeholder.

As we know the Enterprise Architecture is one of tools which has used to keep in line between two domains, business and IT planning. This convergency of two domain could be succeeded. When we develop an enterprise architecture, every step or every phase must be related to business process itself. In this case all business process of University have been identified or fixed. The recent technology in hardware could be judged as base of data or information architecture even the computer network and all infrastructure. In this development the business fixed by all stakeholder lead or guide the development of architecture enterprise. The business process in private University is really unique comparing to other business process. Information Technology was planned to support the Academic Process, Financial, Operational and Management [1]. Academic process had huge of process such as learning process, lecturer and student activity, e-learning, number of active student etc. Daily process in Academic was to prepare the availability of lecture room, laboratory, and all equipment need to support learning process. The last audit by using COBIT described Mercu Buana University had a lack of maturity level [2]. As mentioned before this paper proposed the possibility to redefine the enterprise architecture of Mercu Buana University, to get inline the Management and IT strategic planning. The framework for redefine this enterprise architecture was Togaf. We have some method or framework to develop the enterprise architecture such as Zachman Framework, The Open Group Architecture Framework(TOGAF), Architecture Development Method (ADM) and Enterprise Architecture Planning (EAP) . We focus on TOGAF ADM to develop the enterprise architecture of Mercu Buana University. Working based on TOGAF ADM would have a clear step how to develop the best architecture.

II. MATERIAL AND METHOD

The good enterprise architecture will guide the University to achieve the vision and mission and the strategic goal. The output of this redefine of enterprise architecture was the blue print of Information System development . The blue print of this Information System Development was the holistic which regarding all the unit or component in the campus not partially or only for a certain unit.

A. ENTERPRICE ARCHITECTURE

Enterprise Architecture generally was a description of mission created by all stake holder including the information, function, location of organisation and performance index . Enterprise Architecture was the image of the planning the development of the system or integrated system [3]. The organization, in this case the campus, had to adopt or to use the method to develop its enterprise architecture. Based on this method the campus could govern the complex system properly and keep in line the bussines goals and future Information Technology invested. This is really important that University had to know. Recently Enterprise Architecture Framework has 4 frame works such as Zachman Framework, The Open Group Architecture Framework (TOGAF), Federal Enterprise Architecture (FEA) and Gartner (Meta Framework). Enterprise Architecture could be grouped as Bussines Architecture, Data Architecture, Information System Architecture and Technology Architecture. These group had a function to support the goal of the University, from point view management, vision to operation is shown in Figure 1.

The vision of the campus was to be the best private University within globalization era . To achieve this vision, campus had to breakdown the vision into mission. The three mission of the campus were; do the best education system, research and community social responsibility, do the best campus management and do the best way to create the entrepreneur and high quality competency.

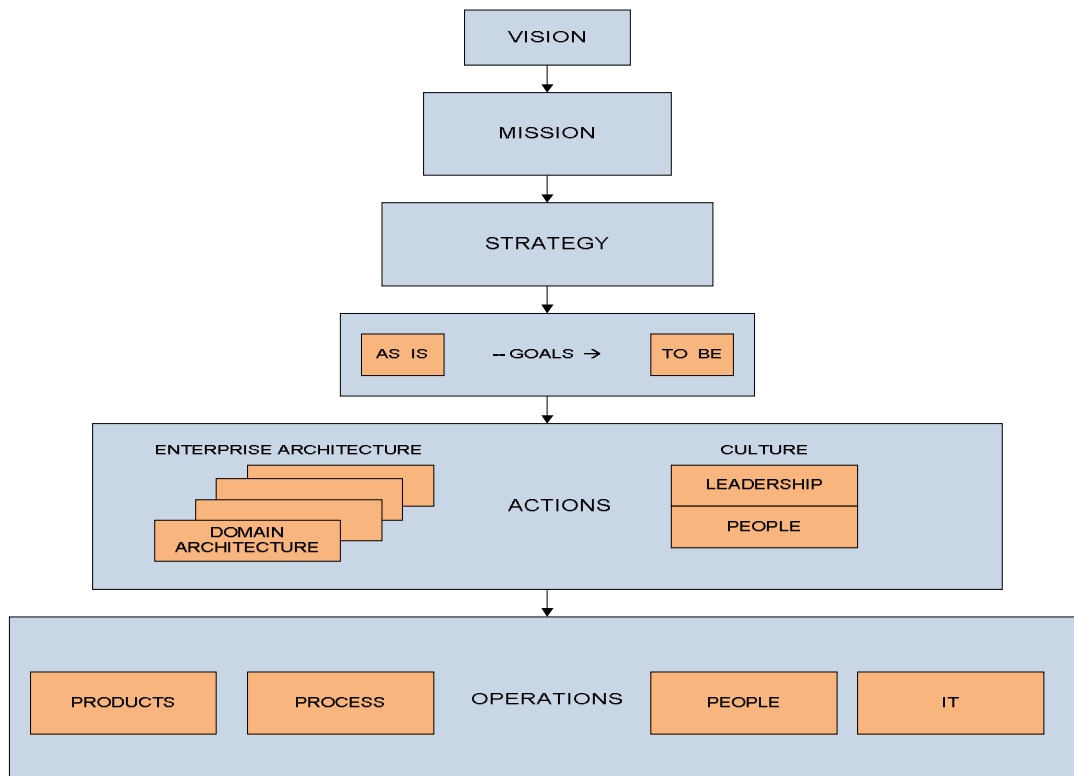


Figure 2.1. Vision to operation of Mercu Buana University

B. THE ACTIVITY IN DEVELOPMENT

The activity to develop the architecture were design of Bussines Architecture, design of Data Architecture, design of Information System Architecture or Application Architecture and design of Technology. The activity in Bussines Architecture were Organization Catalog, Service/ Function Catalog, Location Catalog, Bussines Function Matrix, Functional Decomposition Diagram. The activity in Data Architecture were Data Component Diagram, Bussines Function Matrix, Class Diagram, Data Dissemination Diagram, Data Migration Diagram. The Activity in Application Architecture were Application Portofolio Catalog, System/Function Matrix, Application Communication Diagram, Application Migration Diagram Environment and Location Diagram.

The last is activity in Technology Architecture, there were Technology Standars Catalog, Technology Portofolio Catalog, System Technology Matrix, Platform Decomposition Diagram. The activity described in Table 1.

TABLE 2.1.
ACTIVITY ON DEVELOPMENT OF ENTERPRISE ARCHITECTURE

BUSINESS ARCHITECTURE	DATA ARCHITECTURE	APPLICATION ARCHITECTURE	TECHNOLOGY ARCHITECTURE
ORGANIZATION CATALOG	DATA COMPONENT CATALOG	APPLICATION PORTO POLIO CATALOG	TECHNOLOGY STANDARD CATALOG
SERVICE CATALOG	BUSINESS FUNCTION MATRIX	SYSTEM MATRIX	TECHNOLOGY PORTO POLIO CATALOG
LOCATION CATALOG	CLASS DIAGRAM	APPLICATION COMMUNICATION	SYSTEM/TECHNOLOGY MATRIX
BUSINESS FUNCTION MATRIX	DATA DISSEMINATION	APPLICATION MIGRATION DIAGRAM	PLATFORM DECOMPOSITION DIAGRAM
FUNCTIONAL DECOMPOSITION DIAGRAM	DATA MIGRATION DIAGRAM		

III. TOGAF ADM FRAME WORK

TOGAF ADM had eight steps to do such as; Architecture Vision, Bussines Architecture, Information System Architecture, Technology Architecture, Oppurtunities and Solutions, Migration Planning, Implementation Governance and Architecture Change Management [5], [9]. These steps are shown in Figure 3.1. Architecture Vision had an objective to align the opinion how importance to have enterprise architecture to achieve the objective or the goals of organization in strategic form and to limit the scope of architecture that will be developed.

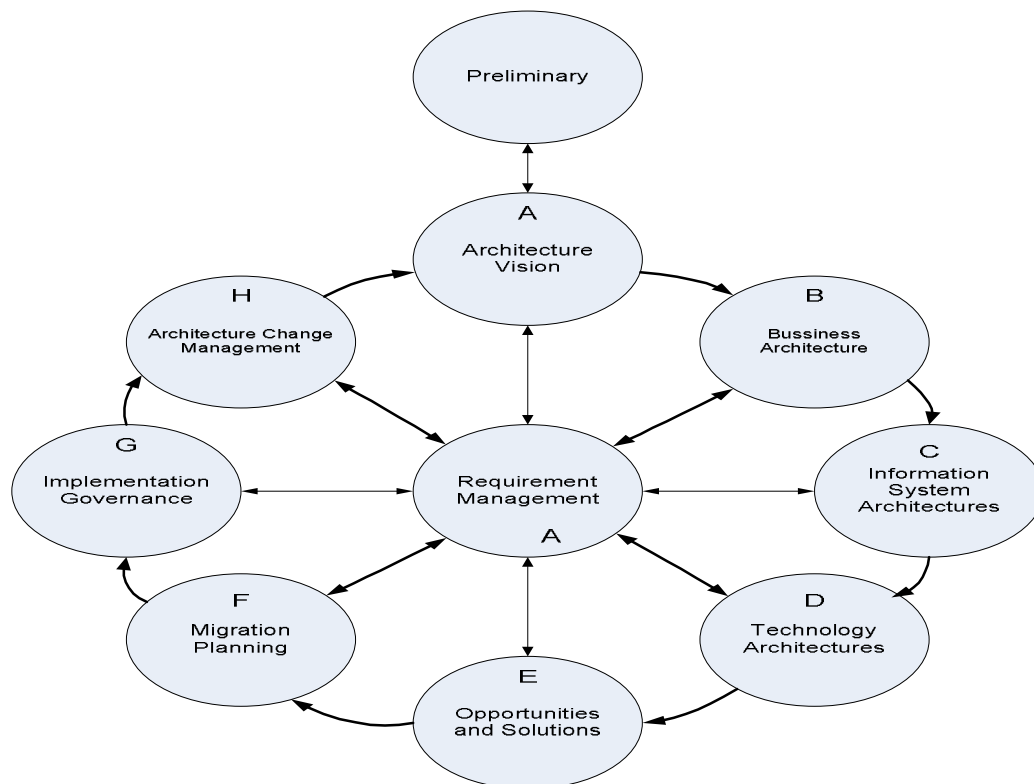


Figure 3.1. TOGAF ADM

This step had lots of question to discuss by all stake holders. Bussines Architecture defines the initial conditions, determine the business model or business activity desired by business scenario. At this stage, the tools and methods of common for such modeling: BPMN, IDEF and UML can be used to build the necessary model. Recently many companies have been using Business Architecture for long time. Such companies off course have used different frameworks developed by stake holder or industry leaders from different angles: Business and IT. Well-defined processes are required for operationalizing business goals and aligning IT and people.

Companies using Business Architecture as a management method have found that different representations of processes are needed according to the level of detail that managers want to know [7]. Information System Architecture more emphasis on how the activity of architecture developed information system. Defining architecture information system in this phase include architectural Data and application architecture that will be used by the organization. Data architectural focuses more on how the data is used for the needs of business functions, processes and services. Techniques that can be used with namely: ER-Diagram, Class Diagram and Object Diagrams. The data model explaining the structure of the database in terms of data entities and their relationships is another example. Among other practical purposes, the data model serves as the blueprint for the physical database, helps implementation of the data access layer of the system, and has strong impact on performance and modifiability [6].

In the application or information system architecture is more emphasis on how planned application requirements by using Application Portfolio Catalog, as well as focusing on the model application to be designed. Techniques that can be used include: Application Communication Diagram, Application and User Location Diagram and others. Technology Architecture starting from the determination of the type of candidate technologies required to use the Technology Portfolio Catalog which includes software and hardware. This stage will also consider alternatives required in technology selection. Technical used include Environment and Location Diagram, Network Computing diagram, and others. From point view of Opportunities and solutions, TOGAF ADM can give the benefits derived from the enterprise architecture includes business architecture, data architecture, application architecture and technology architecture, so that it becomes the basis for stakeholder to select and specify the architecture that will be implemented. To model this stage in Project engineering design may use Context Diagram and Benefit Diagram. Migration planning step has a critical condition whether this new enterprise architecture will be implemented or not. In this step the modeling usually use marking matrix or evaluation matrix and decision, refer to main and other needs to implement Information System. Implementation governance step will recommendation and schedule to keep running well the implemented governance including organization governance, IT governance and architecture governance [4]. The last step is architecture change management; in this step the new system of architecture management plan is fixed by supervising and regarding the technology development and organization change including internal and external factor. Last thing to be regarded is whether architecture will be developed in the future or not.

IV. RESULTS AND DISCUSSION

A. BUSSINES ARCHITECTURE MODEL.

Every University, State or Private, has the same base bussines proces, Tridharma Perguruan Tinggi or three function of higher education. This Tridharma was a Government regulation on education system of University. Tridharma regulated about three function in University, learning, research, and community service. In best practice this Tridharma could not run effectively without the support of Management. Figure 4.1 described the Business process of Mercuri Buana University. In this Business Architecture Model we take account the Principe of Business such as : Advance of Business, Satisfaction of Stake Holder, Information System was responsible of all Academic Department, Sustainable of Business, Follow the State's Regulation and Responsible.

B. DATA ARCHITECTURE MODEL.

Data architecture must be able to identify the data supporting business functions such as defined in the business model and describes the structure of data entities and their relationships. To define the data architecture, TOGAF ADM recommends a catalog (Component Data Catalog) which contains a collection of data that exist in the organization. Another recommendation is the Business Function Matrix which describes the relationships business functions with data entities that exist in college. Following will be explained in part Component Data Catalog in a college Entity and ERD. Existing Data at the moment in Academic Process in Mercuri Buana University are:

1. *Lecture Registration Entity.*
2. *Lecturer Entity.*
3. *Students Entity.*
4. *Academic Calendar Entity.*
5. *Grade Entity.*
6. *Curriculum Entity.*
7. *Subject Entity.*
8. *Students Presence List.*
9. *Department / Study Program.*
10. *Final Project Registration*
11. *Evaluation*

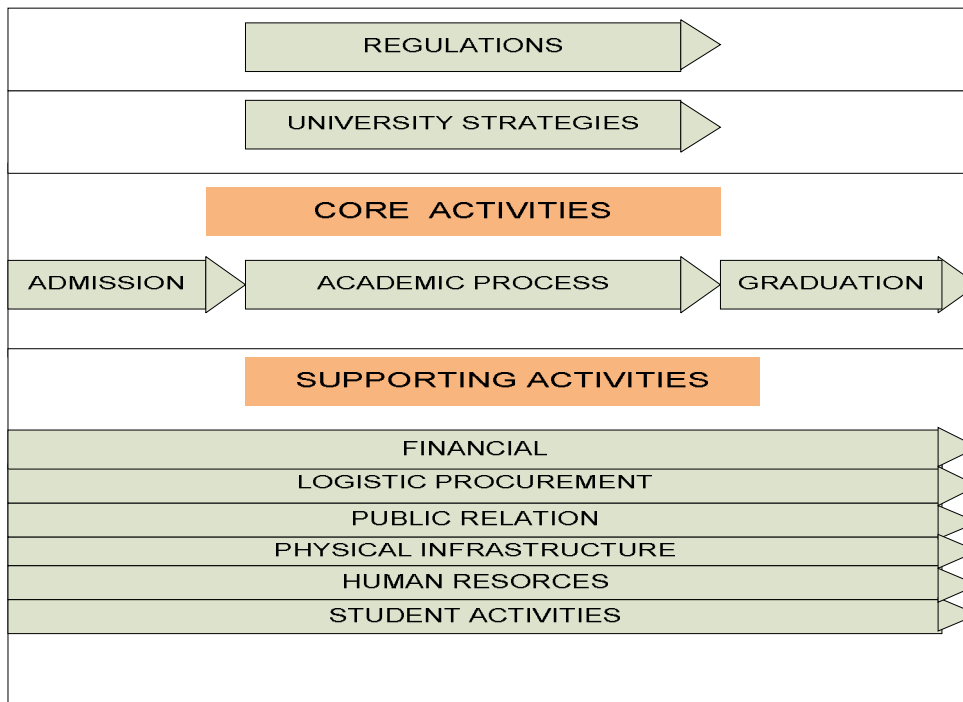


Figure 4.1. Business Process of Mercu Buana University

We added and modified the 6 exiting data that we have discussed to all stake holder such as : Lecture Room Entity to anticipate the overlapping using room, Schedule Entity due to increasing in number of students, Test Schedule Entity to anticipate one students has two examination or test in the same time, Supervisor Entity to supervise all activity of student by fiving them one supervisor for one group of student consisting of 20 persons, Leave Petition to anticipate the students drop out due to their limited academic time, Final Project Examination to be modified or upgrade by next entry student as their final project to get their diploma. The new Data Entity then become such as :

1. Lecture Registration Entity.
2. Lecturer Entity.
3. Students Entity.
4. Lecture Room Entity.
5. Academic Calendar Entity.
6. Grade Entity.
7. Schedule Entity.
8. Curriculum Entity.
9. Subject Entity.
10. Test Schedule Entity.
11. Students Presence List.
12. Department / Study Program.
13. Supervisor.
14. Leave Petition.
15. Final Project Registration
16. Final Project Examination.
17. Evaluation.

We used conceptual data model to represent all new data architecture. An architectural view in general is first drafted with very little detail. It's the model best suited for communication with stakeholders in general. Figure 4.2 shows a fragment of a conceptual data model of Academic Process. In this Data Architecture Model we toke account all data principle such as: data is our asset, data must could be shared, data could be accessed, data security, data definition.

C.APPLICATION ARCHITECTURE MODEL.

In this model, Application architecture has the objective to define the applications necessary to manage data and support the Academic process. The application architecture model is the definition about the things must be done to manage data and provide information for executing the Academic Process. Application architecture can be defined by using the technology such as Application Portfolio Catalog, System / Function Matrix and Application Communication Catalog.

In Application Portfolio Catalog stage has to define all the list of applications used by Academic Process, application architecture has the objective to manage the data and functions of Academic Process in campus. Application Portfolio Catalog depicted in Figure 4.3.

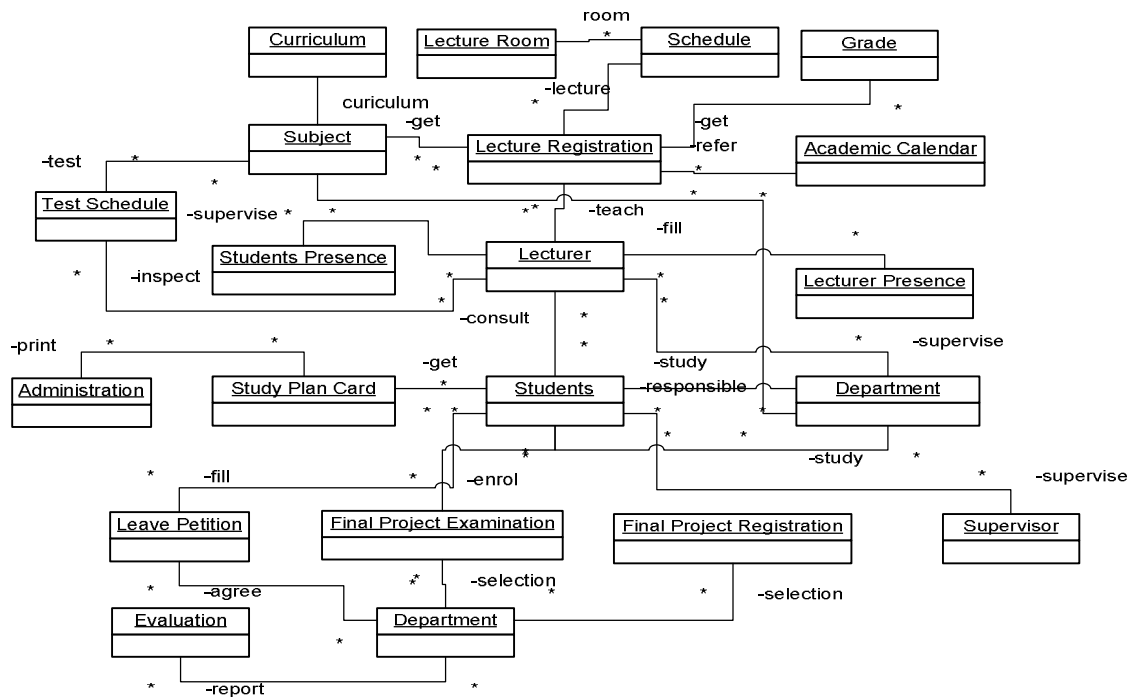


Figure 4.2. Conceptual Data of Academic Process

We add e-Learning application and we tested it, the results so far are good. We offer some e-learning subject to the students and the forum has been running well; we prepared the additional application, Reserve, to anticipate if we need more application to support Academic Process. In all these Application Architecture we take account all application principle such as: application is Technology Independent and easy to use.

D. TECHNOLOGY ARCHITECTURE MODEL

This phase had to build technology architecture, starting from the basic concept of the technology to alternative technologies required in Academic Process. Technology architecture had to define technology platform to be used for providing application environment to manage data and on the other side Technology architecture is a tool to support all business process in campus, not only the academic process. The first step is to choose the platform of technology to be used. This platform defines the concept or principle technology that will be used. The main goal of this step is the definition of technology will be clear including hardware, software, and communications. The output of this step was the concept of Technology Architecture. In general, these technologies conceptual configuration can be divided into two parts; Concept of Networks and Architecture Business Systems Architecture.

The concept of networks depicted on Figure 4.4. Our main campus is located in Kembangan Jakarta, and we have 2 branch campus, Menteng and Kranggan. In main campus we mostly use fiber optic for communication all router to keep the high speed. We join Telkom, the Indonesian provider, to communicate via internet and other on-line application. The lecture can see and modify the lecture transaction such as fill the grade point, fill the list of student's presence, fill the progress of student final project by using phone cell or laptop. The students can see their grade points, list of their presence in one lecture, and announcement from campus by using their phone cell. We tested this system by giving the chance to the student to see and know their presence, their grade, their number of consulting in final project, and to do e-learning. The only problem to do these activity is about the bandwidth of our new system especially when they want to see their presence in the same time, and for the lecturer some time they can't open the Information System of Academic due to disturbance in communication line that it is not our domain. We need also some protection due to our bad experiences when our web site was hacked. But generally this new system could be judged pretty well. In this Technology Architecture we take account all Technology Architecture principle such as: change based on need, quick response to change, interoperation.

E. MIGRATION STRATEGY

Gap analysis on enterprise architecture of Mercu Buana University has main function to identify differences between baseline architecture and target architecture. The differences include five views such as the business landscape, organizations of works, information, function and infrastructure.

We mentioned before in this paper we just focus on Academic Process. The assessment of entire Information System and Technology we found we need 3 new application systems to provide the 17 application system and 20 entities.

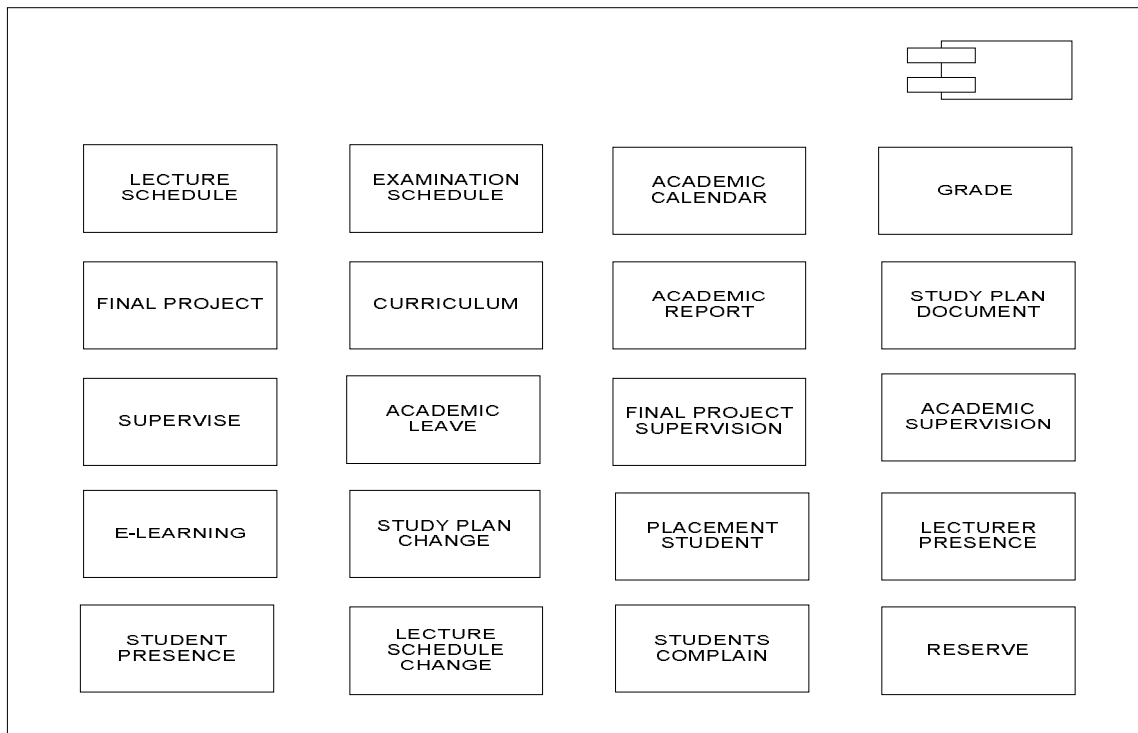


Figure 4.3. Application Portfolio

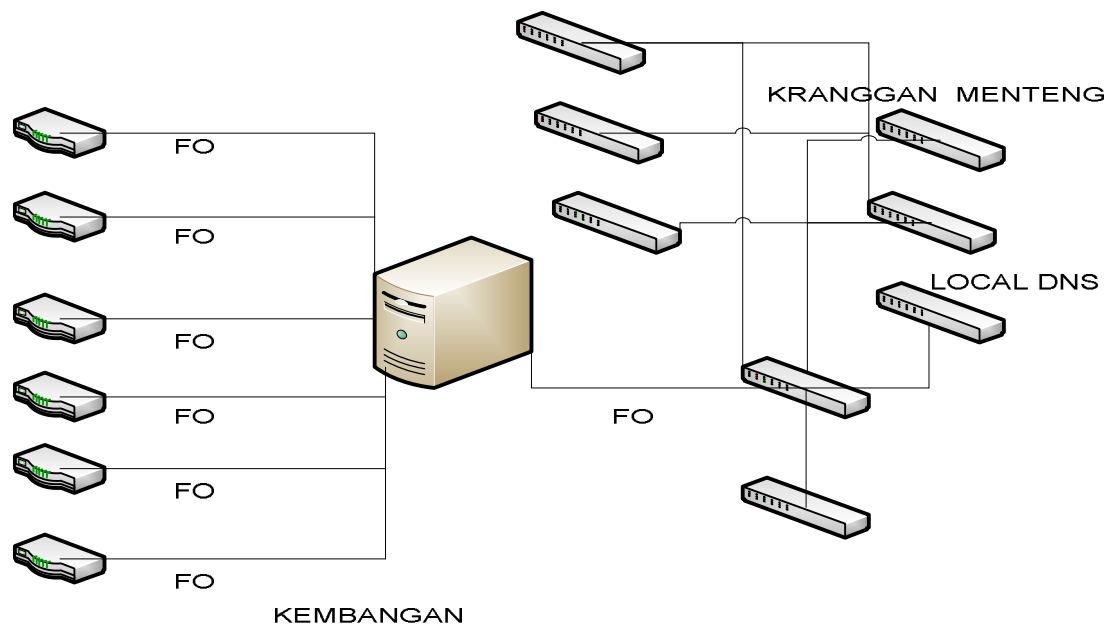


Figure 4.4. Technology Architecture

We planned to implement these applications in two years. To achieve organizational goals, Migration time stages of implementation need to be derived from the initial stage to the final stage. The migration step needs to be arranged according to the priority of the system to be implemented.

In this work we did not elaborated the migration time in detail. One of the good points of TOGAF is allows phase to be done incompletely, skipped, combined, and reordered to fit the need of the situation.

V. CONCLUSIONS

Business modelling or business process of Mercu Buana University has 2 main functions such as Core Activities and Supporting Activities. Core Activities is Academic Process which we focus on, has 3 processes, Admission, Academic or Learning Process and Graduation. Supporting Activities consist of Financial, Logistic Procurement, Public Relation, Building Infra Structure, Human Resources, and Students Activities. From Data Architecture in Academic Process we have 17 entities, and from Application Architecture we have 20 application and 3 among these application are new such as students complain, e-learning and final project supervision and at the moment we run these 3 application for test. Proposed Enterprise Architecture can be use as a guidance for Mercu Buana University to govern it's Information System. Technology Architecture for a while can handle communication between 3 campuses, center campus Meruya in West Jakarta and 2 branches, Menteng in Center Jakarta and Kranggan in West Java. In the future we have to make 1 platform application rather than multiplatform and increase the bandwidth to keep good on-line process and communication between campus and all students, lecturer and stake holder.

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