Enterprise Architecture for University Based On Three Pillars of Higher Education Using Zachman Framework (Case Study: Universitas Komputer Indonesia)

Berny Indrawan

Department of Master Information System, UNIKOM
Jl. Dipati Ukur No. 112-116, Bandung, Jawa Barat, Indonesia
berny@unikom.ac.id

Abstract— ***The University is an institution that has mandatory to contribute to higher education, research, and community service as known as Three Pillars of Higher Education. University also has the right to manage their institution. In order to improve their business process based Three Pillars of Higher Education, University-based on Information technology (IT) needs to planning blueprint IT to support the alignment process between IT strategy and organization business strategy. Universitas Komputer Indonesia (UNIKOM) as a private university in Bandung City, already implemented IT infrastructures and managed by appropriate division. However, IT management in UNIKOM more complicated and separate of IT management affects that IT Infrastructure was unable to adapt and response the rapid change of business needs.***

This research follows the Zachman Framework to design Enterprises Architecture to improve process business and IT infrastructure based on the Three Pillar of Higher Education in UNIKOM. However, in this research, only follows the first three rows of Zachman Framework, consist of Planner's View, Owner's View and, Designer's View and first three columns of Zachman Framework, consist of Data (What), Function (How) and Network (Where). By adopting Enterprise Architecture using the Zachman Framework, it can produce a blueprint that can be used as a reference for University to make better decisions and alignment of business and IT processes in the future accordance Three Pillar of Higher Education.

Keywords: Three Pillars of Higher Education, Enterprise Architecture, Zachman Framework, Blueprint

I. INTRODUCTION

Universitas Komputer Indonesia (UNIKOM) as a rapidly growing private university must be able to compete with other universities by running business processes that can support the improvement of the quality of education and service to the needs of UNIKOM stakeholder. As a university-based on information technology, UNIKOM has been provided IT infrastructure services that can be utilized by the academic community to support the information needs of UNIKOM stakeholders. But along with the rapid growth and development of IT and business processes in UNIKOM make management of IT infrastructure at UNIKOM face various problems and was unable to adapt and follow the change of IT and business processes that have been run. It also makes the process of usage of IT infrastructure that has been running not aligned with business processes implemented by UNIKOM. Therefore, the required business process design that can be aligned with the IT infrastructure in UNIKOM.

Based on government regulations of the Republic of Indonesia Number 60, year 1999 Higher education has a primary business goal namely conducting educational/academic besides that universities are also required to conduct research and community service activities. This regulation is also known as the Three Pillars of Higher Education. It is also supported by the Law of the Republic of Indonesia Number 12, year 2012 Article 1 Paragraph 9 regarding implementation of the Three Pillars of Higher Education as liability for the Higher Education. Based on these rules, researcher assume that the Three Pillars of Higher Education can be used as a success indicator of Higher Education. Therefore, to support efforts to improve service quality at UNIKOM, UNIKOM must have a business process that refers to the Three Pillars of Higher Education. Where this business process should be supported by appropriate IT infrastructure, so that alignment of business processes and IT Infrastructure can be created [1] [2].

In the research conducted by Heri Santoso, he believed that to support the activities of the Three Pillars of Higher Education, a good information system was needed in order to increase the effectiveness of any existing business activity. The planning for information systems will be built, should be in line with the needs of the organization, and align with the vision and mission of the organization, by using Enterprise Architecture (EA). The research about enterprise architecture planning information systems for universities using the Zachman Framework method, has been carried out by previous researchers, where the EA design using the Zachman Framework can produce a blueprint which essentially contains the company's strategic plan to be implemented and build an information system [3] [4] [5].

Based on several research about EA the researcher considers that the design of EA using Zachman Framework is needed to create a blueprint that can align IT Infrastructure and business processes in accordance with the Three Pillars of Higher Education. The existence of the blueprint is expected that the achievement of business processes carried out by UNIKOM can run according to its functions, so that, UNIKOM can make decision-making easily when implementing business processes in accordance with the Three Pillars of Higher Education and can improve quality and provide the best services for all UNIKOM stakeholders.

II. RESEARCH METHODS

The research method used in this research is a method of Enterprise Architecture Planning (EAP) that is mapped into the Zachman Framework. EA is a logical organizing for business

processes and IT infrastructure needs related to the integration and standardization of a company's Operating Model. One of the main artifacts of EA is EA model, which provides a holistic view of the organization and supports EA stakeholders to create added value [6]. In research [7] states that the EAP methodology serves as the basis for many modern EA methodologies. The EAP method that will be used in this study has four stages of flow, namely: 1) Planning Initiation, 2) Business modelling, Current Systems & technology, 3) Analysis of data architecture, application architecture, and technology architecture, 4) Implementation / Migration Plan. The four stages of the EAP method flow can be seen in figure 1:

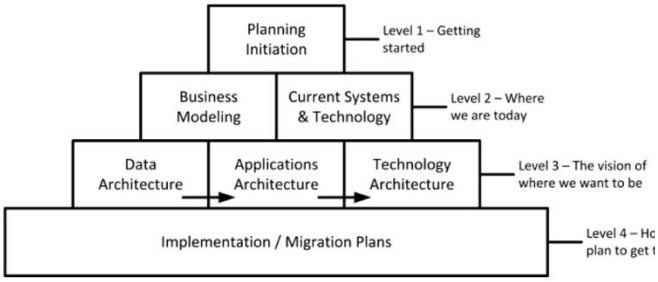

Figure 1. The Flow Stage of EAP Method

Zachman Framework is a scheme to clarification the organizing architectural artifacts [8]. The Zachman Framework is designed to include representations of information system architecture for all parties involved in the development, management, maintenance and usage of information systems of an organization. Each perspective provides a unique and valuable perspective for enterprise architecture [9].

According to [10] the Zachman Framework describes the architecture of organization in general and describes it as a complex enterprise system. In the business world, organizations are required to make change management. The purpose of change management is related to the competitive advantage between the organization and its competitors. In this research, only follows the first three rows of Zachman Framework, consist of Scope (Planner's View), Business Model (Owner's View), System Model (Designer's View) and first three columns of Zachman Framework, consist of Data (What), Function (How) and Network (Where). The relationship between Zachman Framework and EAP is the process of defining the two top levels of Zachman Framework, so if it is mapped into the Zachman Framework, EAP will be in the first row and the second line is the perspective of the planner and owner. The aspects discussed in EAP are in the three columns of the Zachman Framework, that includes data, functions and networks of information system [4] [11]. The relationship between the Zachman Framework and EAP can be seen in Figure 2 [12]:

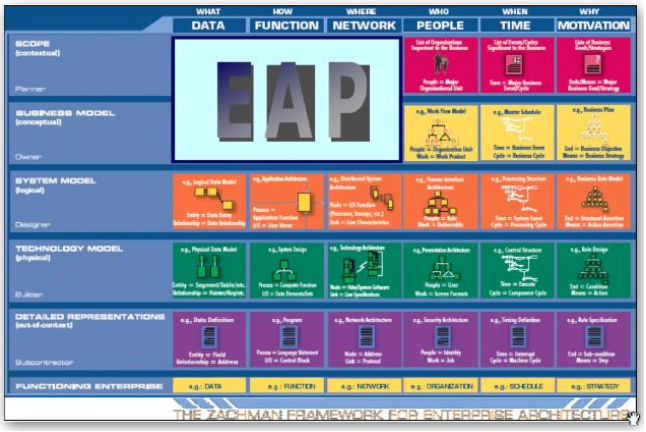

Figure 2. Zachman Framework Model

Supporting data used in this research was based on data from the Executive Information System (EIS) UNIKOM.

2.1 Research Framework

The stages carried out during this research are shown in figure 3:

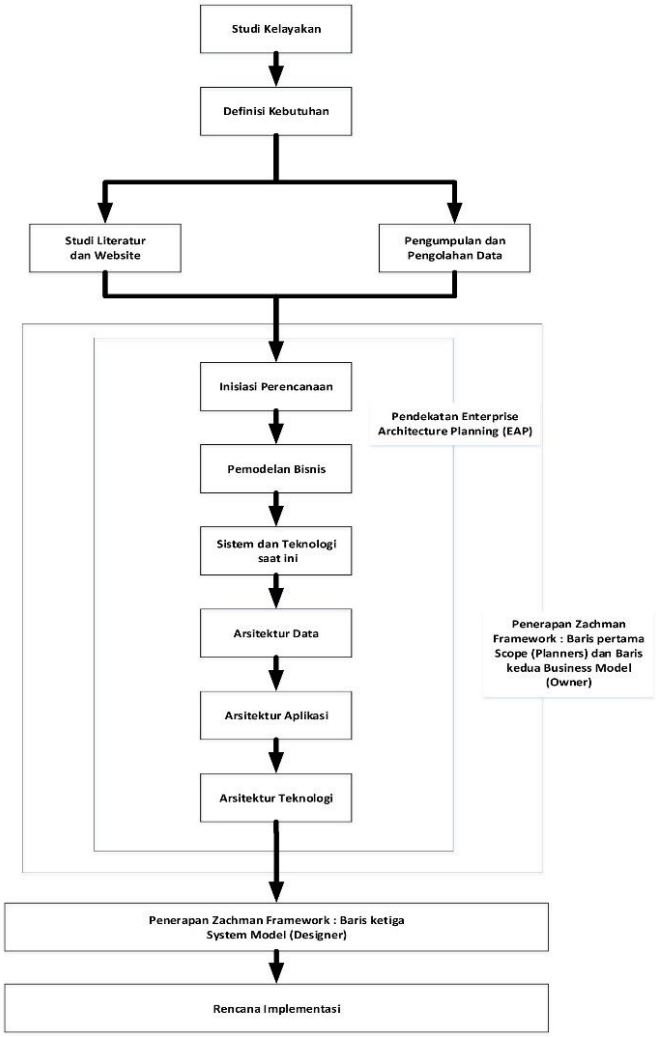

Figure 3. Research Framework

2.2 Value Chain Model

In this research using value chain model as an analysis method. Value Chain according to [13] was introduced by Porter (1985) which consists of a series of activities that create and build a value that can produce an added value margin for the organization. The research conducted by Michael Porter, produced a concept called the concept of Porter's value-added chain [14], the concept aims to divide the main functions in the organization into two major groups, namely primary activities and support activities.

The identification of the primary activities and support activities of UNIKOM can be indicated using the value chain that can be seen in figure 4.

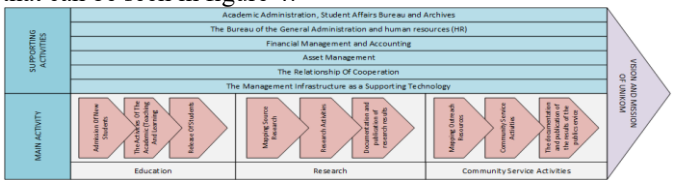

Figure 4. UNIKOM Value Chain as Higher Education

III. RESULTS AND DISCUSSION

The implementation of Zachman Framework in this research can be seen based on the steps taken to define and creating a blueprint that makes alignment between IT infrastructure and business processes of organization in accordance with the Three Pillars of Higher Education. The steps that must be done are defining layer 1 (starting position), layer 2 (current position) and layer 3 (desired position in the future) with the perspective lines on the Zachman Framework used in this research only The perspective of Planner, Owner, Designer and columns of Zachman Framework, consist of Data, Function and Network.

3.1 Layer 1 (Starting Position)

At this stage the first thing to do is to initiate a plan that serves to prepare the implementation of EA. This stage becomes the main point that is considered important because this step can specify any workmanship measures should do by researchers to determine the next step process that has to be done. The outputs that can be generated from this stage are:

1. Can define the scope of the design of EA by making Three Pillars of Higher Education as Scope of this research.
2. The goal of EA design is to create an IT blueprint with the Scope Three Pillars of Higher Education.

In accordance with the existence of UNIKOM as a Higher Education, the indicators of the success of the vision and mission that have been made by UNIKOM, can be seen from the success of running the Three Pillars of Higher Education. Therefore, the decisions and determination of business strategies should be run by UNIKOM must refer to Vision, Mission and Three Pillars of Higher Education.

3.2 Layer II (Current Position)

The stages in this layer aims to provide an overview of the current state of the enterprise, where activities carried out in this stage include: Business Modelling and the current System and technology.

In this research, business modelling that will be applied must refer to the Three Pillars of Higher Education, so that the primary activities that must be carried out by UNIKOM namely Education, Research and Community Service with support activities namely Three Pillars Support. The business modelling that will be applied is described using a Value Chain can be seen in Figure 5.

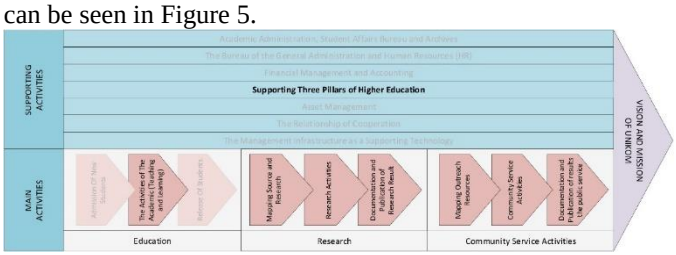

Figure 5. UNIKOM Value Chain Based on Three Pillars of Higher Education

The purpose of the stages of current system and technology are currently being carried out to get an overview of systems and technologies that run in the form of Information Resouces Catalog (IRC) is obtained by determining the relationship between applications and technology with the current business functions. This stage aims to find out which business functions have been supported by applications and technology and what systems have been supported by technology.

3.3 Main functions of UNIKOM Hierarchy Chart

The main functions of UNIKOM hierarchy chart focuses on primary activities based on Three Pillars of Higher Education and support activities of Three Pillars of Higher Education which can be seen in figure 6.

1. Proses Akademik/Proses Belajar Mengajar	2. Penelitian	3. Pengabdian Masyarakat	4. Penunjang Tri Dharma
Tahapan ini dilakukan pada pengelolaan operasional proses belajar mengajar yang merupakan aktivitas pokok dari pendidikan.	Tahapan ini merupakan proses perencanaan identifikasi potensi penelitian, kebijkan dan misi penelitian.	Tahapan ini merupakan proses perencanaan mengidentifikasi potensi pengabdian masyarakat, sumber daya pengabdian.	Pada tahapan ini merupakan proses pelaksanaan penunjang Tri Dharma Pergurun Tinggi
1.1 Perencanaan Pengembangan Kurikulum	2.1 Perencanaan Sumber Penelitian	3.1 Perencanaan Sumber Daya Pengabdian Masyarakat	3.1 Menjadi anggota profesi / panitia
1.1.1 Evaluasi Kurikulum	2.1.1 Identifikasi potensi penelitian	3.1.1 Perencanaan potensi pengabdian	3.2 Mewakili pergurua tinggi dalam panitia antar lembaga
1.1.2 Pengembangan Kurikulum	2.1.2 Kebijkan dan Misi Penelitian	3.1.2 Pengelolaan aktivitas aktivitas sumber pengabdian masyarakat	3.3 Menulis dan menerbitkan buku untuk tingkat pendidikan SLTA kebawah
1.1.3 Penetapan Kurikulum	2.1.3 Inventarisasi data dan berjaanama penyedia dana penelitian	3.1.3 Inventarisasi data sumber dayn pengabdian	
1.2 Kebijkan Akademik	2.2 Kegiatan Penelitian	3.2 Kegiatan pengabdian masyarakat	
1.2.1 Penyusunan Kalender Akademik	2.2.1 Pemilihan tema riset	3.2.1 Pemilihan tema pengabdian	
1.2.2 Penyusunan Jadwal Kuliah	2.2.2 Pengajuan proposal penelitian	3.2.2 Pengajuan proposal pengabdian	
1.2.3 Perwalian Akademik	2.2.3 Persetujuan pelaksanaan penelitian	3.2.3 Monitoring pelaksanaan pengabdian	
1.2.4 Pengelolaan Rencana Studi	2.2.4 Monitoring pelaksanaan penelitian	3.3 Dokumentasi hasil pengabdian masyarakat	
1.2.5 Perubahan Rencana Studi	2.3 Dokumentasi hasil penelitian, kompilasi abstrak dan publikasi		
1.2.6 Pencetakan KTM (Kartu Tanda Mahasiswa)			
1.2.7 Administrasi Cuti Akademik			
1.3 Pelaksanaan PBM (Proses Belajar Mengajar)			
1.3.1 Pelaksanaan, Pengawasan dan Evaluasi PBM			
1.3.2 Pelaksanaan Ujian			
1.3.3 Pelaksanaan Sidang			
1.3.4 Pelaporan Akademik			

Figure 6. Main functions of UNIKOM Hierarchy based Three Pillars of Higher Education

3.4 Layer 3 (Desired Position in the Future)

This layer describes the position of the desired system in the future. Where the depiction is explained in the form of data architecture, applications and technology.

3.4.1 Data Architecture

The purpose of this stage is to define all data entities that are considered important to support the business functions that have been obtained from the previous stage, i.e. on a layer II of business modelling. At this stage the data will be used to build an application architecture that is in accordance with the Three Pillars of Higher Education.

In accordance with the condition of the value chain obtained from the previous stages, the data entity candidates obtained from the business entity can be seen in Figure 7.

Entitas Bisnis	Entitas Data	No. Urut
Kegiatan Akademik / Proses Belajar Mengajar	1. Entitas Mahasiswa	1
	2. Entitas Dosen	2
	3. Entitas Kalender Akademik	3
	4. Entitas Tahun Akademik	4
	5. Entitas Absensi Mahasiswa	5
	6. Entitas Absensi Dosen	6
	7. Entitas Mata Kuliah	7
	8. Entitas Jadwal Kuliah	8
	9. Entitas Kelas	9
	10. Entitas Kelas Perkuliahan	10
	11. Entitas Ruang Kuliah	11
	12. Entitas Nilai	12
Penetuan Sumber Penelitian	1. Entitas Dosen	
	2. Entitas Judul Penelitian	13
	3. Entitas Skema Penelitian	14
	4. Entitas Proposal Penelitian	15
	5. Entitas Panitia Penelitian	16
Kegiatan Penelitian	1. Entitas Dosen	
	2. Entitas Penelitian	17
	3. Entitas Jadwal Penelitian	18
	4. Entitas Jadwal Pengambilan Data	19
	5. Entitas Monitoring dan Evaluasi	20
	6. Entitas Panitia Penelitian	
Dokumentasi dan Publikasi Hasil Penelitian	1. Entitas Dosen	
	2. Entitas Penelitian	
	3. Entitas Dokumentasi Penelitian	21
	4. Entitas Laporan Akhir	22
	5. Entitas Jurnal Penelitian	23
	6. Entitas Panitia Penelitian	

Entitas Bisnis	Entitas Data	No. Urut
Penetuan Sumber Pengabdian Pada Masyarakat	1. Entitas Dosen	
	2. Entitas Judul Pengabdian	24
	3. Entitas Skema Pengabdian	25
	4. Entitas Proposal Pengabdian	26
	5. Entitas Panitia Pengabdian	27
Kegiatan Pengabdian Pada Masyarakat	1. Entitas Dosen	
	2. Entitas Pengabdian	28
	3. Entitas Jadwal Pengabdian	29
	4. Entitas Jadwal Pengambilan Data	30
	5. Entitas Monitoring dan Evaluasi	31
	6. Entitas Panitia Pengabdian	
Dokumentasi dan Publikasi Hasil Pengabdian Pada Masyarakat	1. Entitas Dosen	
	2. Entitas Pengabdian	
	3. Entitas Dokumentasi Pengabdian	32
	4. Entitas Laporan Akhir	33
	5. Entitas Panitia Pengabdian	
Penunjang Tri Dharma	1. Entitas Dosen	
	2. Entitas Prodi	34
	3. Entitas Penghargaan	35
	4. Entitas SK Tugas	36
	5. Entitas Buku	37
	6. Entitas Keanggotaan	38

Figure 7. UNIKOM Data Entity

3.4.2 *The Entity Set, Attribute and Relation*

To describe the relationship between each entity, the conceptual description of the relation can be described using the Entity-Relationship (E-R) diagram.

The description of the results of the relations between entities can be seen in the figure 8.

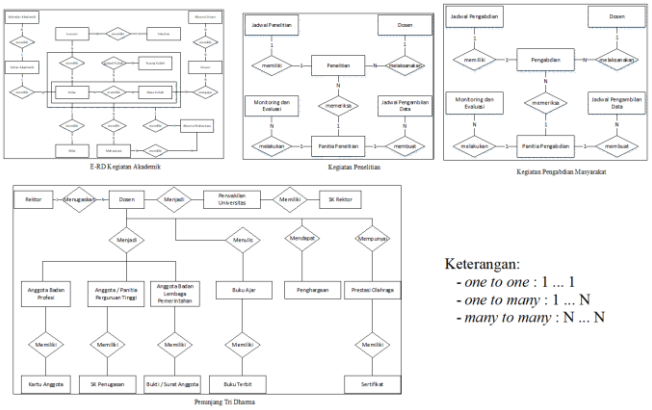

Figure 8. ERD of Three Pillars of Higher Education

3.4.3 *Application Architecture*

Development of application architecture is useful for identifying and defining application systems that are needed for data management and supporting enterprise business functions [15]. At this stage the application candidates are defined by making a candidate list of applications based on the matrix of business function relationships and data entities that will support the primary activities and support activities based on the Three Pillars of Higher Education. Defining applications based on decomposition of business functions that have been done before, this definition can be seen in figure 9.

Kelompok Aplikasi	Aplikasi
Proses Akademik dan Belajar Mengajar	1. Manajemen Kurikulum 2. Penyusunan Kalendar Akademik 3. Penyusunan Jadwal Kuliah 4. Manajemen Perwalian 5. Pengelolaan dan Perubahan Rencana Studi 6. Administrasi Cuti Akademik 7. Administrasi Ujian 8. Administrasi Sidang 9. Laporan Akademik
Penelitian	1. Pemilihan Tema Riset 2. Pengajuan Proposal Penelitian 3. Persetujuan Pelaksanaan Penelitian 4. Monitoring Pelaksanaan Penelitian 5. Dokumentasi hasil penelitian, kompilasi abstrak dan publikasi
Pengabdian Masyarakat	1. Pemilihan Tema Pengabdian 2. Pengajuan Proposal Pengabdian 3. Persetujuan Pelaksanaan Pengabdian 4. Monitoring Pelaksanaan Pengabdian 5. Dokumentasi Hasil Pengabdian Masyarakat
Penunjang Tri Dharma	1. Pendataan Keanggotaan Profesi atau Panitia 2. Penugasan Sebagai Perwakilan Universitas 3. Pendataan Pembuatan dan Penerbitan Buku Pelajaran

Figure 9. List of candidate applications

3.4.4 *Technology Architecture*

Analysis of the technology architecture is done to define technological requirements in processing data. The final result of this analysis aims to produce the technology needed by the application, starting from software, operating systems, security technology, network architecture and the internet, this analysis serves to support the running of the application. This technology architecture analysis will compare planning and development between old technology and new technology so that it can place new technological infrastructure that will be needed to be implemented in the future [7].

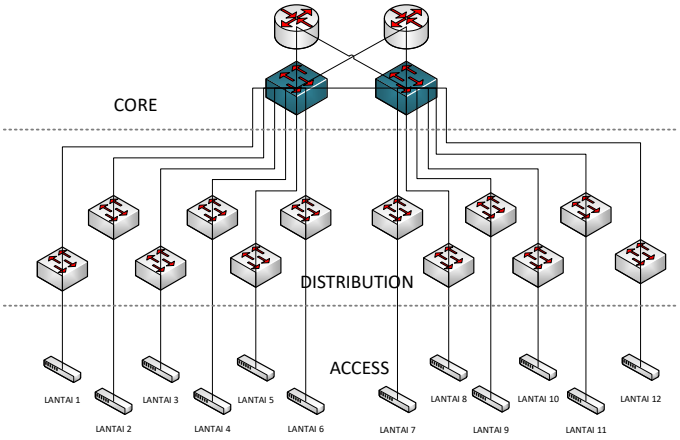

Figure 10. Proposed network architecture layer of UNIKOM

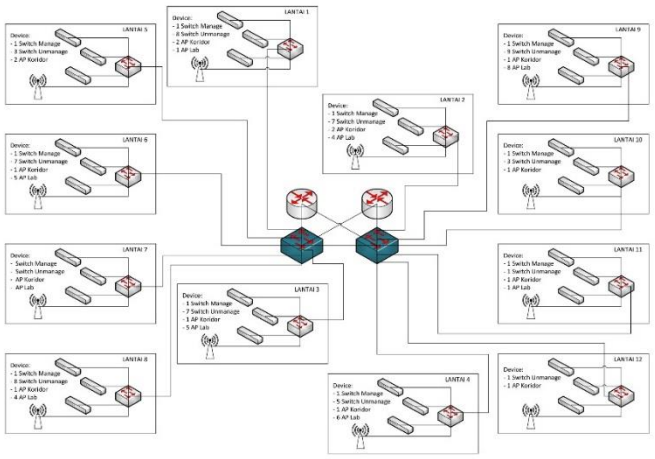

Figure 11. The Proposed Concept of Technology Architecture

The network architecture described above changes the old network design by adding:

1. Add a Firewall to UNIKOM core network to support application architecture security based online.
2. Add a backup link to avoid down time of application developed.
3. Improve the quality of service to access the information systems by separating access to internet applications and local networks.
4. Add wireless network infrastructure to provide easy access to applications developed through mobile devices.
5. Supports patterns of web-based application development.

3.5 Implementation Plan/Migration

The benefits gained from implementation planning is to prepare strategies that are required in the process of implementation of architectures designed in the previous stages. The implementation plan is the last step that must be taken to design EA. The sequence of Application Implementation plan is also important to do and this can be done by considering application grouping based on predetermined business functions.

3.6 The sequence of Application Implementations

The sequence of Application Implementation is done to get an overview of the relationship between entity data and applications obtained from the matrix between data entities and applications, as well as the matrix between applications and business functions aimed to facilitate the flow of data sharing in the application architecture and to be used as a reference to build applications according to the order of applications that generate data, and has the first priority of applications that use or need data.

The sequence of Application Implementations is needed to determine the priority of the application to be developed in accordance with the architecture that has been made. By doing this sorting, the implementation of applications using EA can be applied properly. The description of The sequence of Application Implementations can be seen in the Figure 12.

NO	APLIKASI	KETERANGAN
1	Pemilihan Tema Riset	Pengembangan Baru
2	Pengajuan Proposal Penelitian	Pengembangan Baru
3	Persetujuan Pelaksanaan Penelitian	Pengembangan Baru
4	Monitoring Pelaksanaan Penelitian	Pengembangan Baru
5	Pemilihan Tema Pengabdian	Pengembangan Baru
6	Pengajuan Proposal Pengabdian	Pengembangan Baru
7	Persetujuan Pelaksanaan Pengabdian	Pengembangan Baru
8	Monitoring Pelaksanaan Pengabdian	Pengembangan Baru
9	Pendataan Keanggotaan Profesi atau Panitia	Pengembangan Baru
10	Penugasan Sebagai Perwakilan Universitas	Pengembangan Baru
11	Pendataan Pembuatan dan Penerbitan Buku Pelajaran	Pengembangan Baru

Figure12. The sequence of Application Implementations

IV. CONCLUSION

Based on the results of the previous research stages, the conclusions is:

1. The design of EA using Zachman Framework analysis method has been successfully created and produces a blueprint containing modelling of data architecture, applications and technology that can be used as a basis for improvement and development of information systems at Universitas Komputer Indonesia (UNIKOM) to improve the quality of services to all UNIKOM stakeholders.
2. The Blueprint that has been created successfully aligns IT Infrastructure with business processes that are in accordance with Three Pillars of Higher Education
3. The design of blueprint can generate an overview of information systems and supporting technology required on the current conditions and future conditions
4. The design of the EA is needed, so that each organization has a guideline for developing information systems that can be used by organizations or companies.
5. Design of EA can provide a reference for long-term technology investment by considering the interests and functions of the business carried out by UNIKOM
6. Zachman Framework implementation for the design of EA makes it easy for users to determine every step that must be made to develop the EA design.
7. Based on the findings and observations made in this research, some student data redundancies have been found, this makes the process of managing data inefficient. Therefore, the design of EA is needed to maximize the use of IT infrastructure and business processes in order to build an application architecture that can automate data so that it is expected to minimize data redundancy that often occurs.
8. The application system currently available at UNIKOM only focuses on academic operational functions.
9. Found several applications and information systems that have functional similarities, this happens because there is no clarity of rules or policies implemented in UNIKOM. So that, with the design of EA in this study is expected to help UNIKOM in making decisions to make and determine the direction of the rules or policy.
10. The utilization of Executive Information System (EIS) usage at UNIKOM has not been carried out optimally, so that UNIKOM stakeholders get some problems to get complete information.

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