

An Enterprise Architecture Planning for Higher Education Using The Open Group Architecture Framework (TOGAF): Case Study University of Lampung

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Abstract— University is an organization that obliged to provide higher education, research, and community service (Tri Dharma), it has autonomy to manage their institutions. In order to realize Tri Dharma, University should made a planning of information technology (IT) infrastructure to support alignment process between organization business strategy and IT strategy. University of Lampung (Unila) as a government university in Lampung Province, already had IT infrastructure and managed by special unit. IT management on Unila nowadays more complicated, disintegrated of IT management has an effect that IT infrastructure was not adaptive to response the quick change of business needs. This research aimed to design an adaptive IT infrastructure based on enterprise architecture framework The Open Group Architecture Framework (TOGAF) Architecture Development Method (ADM) on Unila. The results of this research found that there are 3 core business activities, and 6 supporting activities identified on this campus. We also proposed 12 application to developed, all applications should be modular and integrated with other.

Keywords— *togaf adm; information technology infrastructure; adaptive enterprise architecture*

I. INTRODUCTION

Higher Education according to Indonesia Republic Law No. 20 2003, is an organization that is obliged to provide education, research, and community service (Tri Dharma), and has the autonomy to manage its own institutions [1]. In order to realize the process of quality in Tri Dharma then Higher Education must also plan the infrastructure of information technology to make sure alignment process of application and Information Technology to the organization's business strategy. An important component and determining the reliability of IT services in an organization is the information technology infrastructure that used, but to have a reliable technological infrastructure, organizations have to spend considerable cost, so many organizations cannot afford to

deploy IT infrastructure independently due to budget and resource constraints. University of Lampung (Unila) as a state university in Lampung already has an IT infrastructure and managed by special unit. Until now, IT in Unila has become complex, from the observation result there are dozens of main server, various brands of network devices, various switches are distributed, various access point devices, and other supporting devices that are spread over all work units [2]. Every year there is often physical and nonphysical damage device, the various types/brands of devices require special handling for Administrator to learn the characteristics of each device. Several research on Unila Infrastructure can be found on works [3][4][5][6][7], exploring various brand network devices.

The information systems used are still work independently and have not been integrated, the application of Academic Information System (Siakad) that has been built since long ago, has not been integrated with other applications such finance system, employee system, planning system, that impact to delay process of tabulation data when leaders or stakeholders request reports all over the work unit. The current IT infrastructure is not sufficiently adaptive to answer solutions for the fast change of business and application strategy. Appeared at the time when several new applications need to deploy, it takes extra time for Administrator to activate it, starting from the server installation, operating system, database installation, etc., impact also to the increased responsibility for managing the physical server by Administrator. This study focused on the design of adaptive information technology infrastructure using the framework of The Open Group Architecture Framework (TOGAF).

II. RELATED WORKS



Figure1. TOGAF Architecture Development Method (ADM)

TOGAF is a detailed framework and a set of support tools to develop an organization's information technology architecture. This framework provides a classification for linking concepts that describe the real world to concepts that describe information systems and their implementation [8]. According to Bruce [9] an adaptive IT infrastructure is something that is structured using certain patterns to support the application of information and is easy to adapt to the circumstances. The need for an adaptive IT infrastructure is how the infrastructure can follow every change in the business environment. Manifestations of adaptive IT infrastructure according to Bruce was; efficiency, effectiveness, and agility. Cloud computing is an internet-based service technology that can be used to support business processes. Cloud computing is a combination of the use of computer technology and Internet-based development [10].

Minli on work [11] adopted TOGAF ADM framework for building information technology infrastructure in coal-dressing companies, TOGAF was selected for its detailed completeness and guidance in translating architectural forms and information technology options ideal for running existing business processes. Several work on TOGAF framework can be found on research [12][13][14][15][16][17][18], all of those research confirm that TOGAF appropriate with enterprise architecture development on organization.

David defined that companies should be able to quickly modify and adapt business processes to maintain a company's competitive advantage, business process integration and management is key to building and managing adaptive e-business infrastructure [19]. Gavin on work [20] explains how the change of IT strategy undertaken at CERN in order to anticipate various strategic organizations, management finally decided to switch to using cloud computing technology as the main IT infrastructure in their data center [20].

III. METHODOLOGY

In this research each stage will be adjusted to the TOGAF framework. Based on the stages of TOGAF ADM, it is expected to obtain an information technology architecture model that encompasses the four important components of

business architecture, data architecture, application architecture, and technology architecture. The process used from the preliminary phase to the opportunities and solutions. The TOGAF ADM phase to be used in this study as follows;

A. Phase Preliminary: Framework And Principles

This phase is the preparatory phase and the beginning to define the framework and principles, aiming to confirm the commitment of stakeholders, the determination of the framework and the detailed methodology that will be used in the development of enterprise architecture. In this study the framework used is The Open Group Architecture Framework (TOGAF) with the methodology of Architecture Development Method (ADM) to make the design of adaptive information technology architecture at the University of Lampung.

B. Phase Requirements Management

In this phase, explore the organization requirement and documenting the needs of users. The purpose of this phase provides the process of managing architectural needs throughout the phase of the ADM cycle, identifying enterprise needs, saving and then delivering it to relevant phases.

C. TOGAF Architecture Development Method (ADM).

- *Phase A: Architecture Vision.*
Define the scope, business goals, business goals, organizational profile, organizational structure, and stakeholder identification, vision of the organization's mission, and gain approval, and map out all the strategies to be undertaken.
- *Phase B: Business Architecture.*
Describe the current business architecture, objectives, and determine the gap between business architecture. In this phase, the initial condition of business architecture is defined.
- *Phase C: Information system architecture*
Emphasis on how the information system architecture built which includes the data architecture and application architecture that will be used by the organization.
- *Phase D: Technology architecture.*
In this phase defined the need for technology to process data. The first step is to determine the technological candidate to be used to generate technology selection for existing technology.
- *Phase E: Opportunities and solutions*
In this phase emphasizes the benefits derived from enterprise architecture. Evaluated gaps of enterprise architecture covering business architecture, data, application architecture, and technology architecture to further develop strategies for solutions.

IV. RESULT AND DISCUSSION

A. Phase Preliminary: Framework And Principles

The purpose of the preliminary phase is to confirm the commitment of management, the determination of the framework and the methodology to be used in the

development of enterprise architecture. Some of the early architectural principles derived from this phase activity are as follows.

TABLE I. PRINCIPLES OF IT ARCHITECTURE UNILA

No	Principle	Explanation
1	Availability	Infrastructure should always be available when needed
2	Compatibility	Infrastructure Compatibility must be able to adapt to fit the business needs of the organization
3	Accessibility	Must be accessible anytime and anywhere, and use any media
4	Standardization	All infrastructure must use standardized technology
5	Integrity	Integrity and services should take precedence
6	Security	All technology and information assets must be properly protected
7	Reliable	Infrastructure used to function well and reliable
8	Optimal	Optimization of utilization of all IS/IT resources
9	Accurate	The information provided should be accurate and accurate
10	Effective	Infrastructure must be run effectively in accordance with the needs and responsive in overcoming business challenges
11	Efficient	Infrastructure that run should be efficient in accordance with the principle of accuracy and usefulness

B. Phase Requirements Managements

The purpose of this phase is to provide the process of managing architectural needs throughout the phase of the ADM cycle, collecting, inventorying and identifying all enterprise needs, storing and delivering it to the relevant TOGAF ADM phase, this data was gathered by several working units and Faculty member at Unila, that are;

- *Architecture Vision*

Vision of Unila, in 2025 Unila becomes the Top 10 University in Indonesia. To realize that vision, the strategic plan undertaken by Unila is with 3 pillars of educational activities at Unila [21], equity and access extension, quality improvement, relevance, strengthening governance, accountability, and public imagery [21].

- *Business Architecture*

Business architecture is an overview of the activities undertaken every day in a systematic way based on the vision and mission of the organization. With business architecture can be known business processes related to the process at Unila.

- *Information System Architecture*

In this phase more emphasis on how the information system architecture developed. Requirements management in the phase of information system architecture viewed from 2 aspects, which are application architecture and data architecture. Aspects of application architecture and data architecture are described as follows:

a) *Application Architecture.*

The needs on application architecture is that the management requires applications for supporting the activities of Tri dharma in order to runs well and also online.

b) *Data architecture*

In data architecture, management requires centralized and integrated data sources with the aim of improving coordination and synchronization of data processing operations and can provide multilevel, cross functional, timely, accurate, relevant information. With integrated data it is expected that information will be presented correctly and accurately.

- *Architecture Technology.*

At technology architecture, focused on the development of technology architecture required. Management expects the current technology to be more optimized for system development and usage. Management will support the addition of technological equipment in accordance with the need for the development of information systems.

- *Opportunities and Solutions.*

In the phases of opportunities and solutions, management wants to create a planning for the development of Tri Dharma Unila information system. With the planning, information system development and information technology investment will be more focused and according to the business needs of Unila.

C. TOGAF Architecture Development Method (ADM).

- *Phase Architecture Vision*

Before undertaking the design of enterprise architecture, it is necessary to identify requirements management for architectural vision. Identification done in this phase is represented through aspects of vision and mission, business goals, business objectives and scope. (Data taken from the Unila strategic document).

- *Phase Business Architecture*

This phase aims to understand the current state of Unila's business processes and further make proposed improvements by modeling the business architecture. The steps undertaken in this phase include:

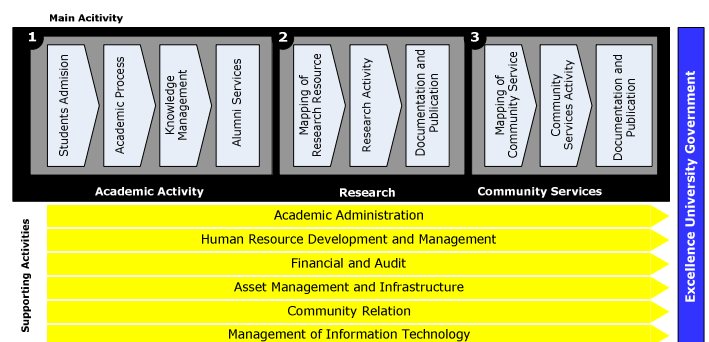


Figure 2. Value Chain Analysis at University Of Lampung

From Fig.2 shown there were 3 core business activity and 6 supporting activity identify on Lampung University.

1. *Core Business Activity*

- *Education Activity*

Admission of new students; this activity is a routine activity at the beginning of the new school year held by Unila. *Academic activities*; this activity is conducted to ensure the learning

process can run well, covering the preparation of lecture schedules, courses, curriculum, graduation. *Knowledge management assets*; this activity is the management of knowledge assets to support academic interests, such as collection of books, journals, scientific papers, and other sources. *Alumni services*; activities related to the management of alumni data in the form of data tracer alumni study.

- *Research Activity*

Mapping of research resources; activity that serves to map the characteristics of expertise of lecturers / researchers, reading opportunities of various research research on various fields of science. *Research activities*; research activities on a particular field of knowledge in accordance with the level of expertise of the researcher itself, can involve many stakeholders from both internal Unila and external components. *Documentation and publication*; activities in the form of identification, documentation and publication of research results that have been done, to determine the weight of quality and quantity of research

- *Community services*

Mapping of service resources; activity that serves to map the characteristics of expertise from lecturers/researchers, read opportunities various possible devotion to various fields of science to society and other organizations outside Unila. *Activities of dedication*; activities devoted in accordance with certain fields of science either involving personnel / groups from Unila, or involving from outside Unila. *Documentation and publication of the results of dedication*; activities in the form of identification, documentation and publication of the results of devotion has been done, to determine the weight of quality and quantity of research.

2. *Supporting Activities*

Academic Administration, HR management and development, financial management, management and asset management, community relations and cooperation, management of information technology resources /information systems.

▪ *Phase information system architecture*

This phase aims to gather existing condition of information system architecture shown on table 2. We made a mapping of current information system and future information system, shown on table 3.

TABLE II. TABLE 2. INFORMATION SYSTEM AS ..IS PORTOFOLIO

No	Application	Code	Work Unit	Status
1	SIM- Academic	SIKAD	BAK	Critical
2	SIM- Graduation	SI-WO	BAK	Critical
3	SIM- Finance	SI-KEU	BUK	Critical
4	SIM- Employee	SI-PEG	BUK	Critical
5	SIM- RKAKL	SI-RKAKL	BUK	Critical
6	SIM- Aset	SI-ASET	BUK	Critical
7	SIM- Higher Education Database	SI-PDPT	BUK	Critical
8	SIM- EPSBED	SI-EPSBED	BUK	Critical
9	SIM- SIMAK BMN	SI-SIMAK	BUK	Critical
10	SIM- Procurement	SI-LPSE	BUK	Critical

11	SIM- RKAKL	SI-RKAKL	BUK	Critical
12	SIM- SERDOS	SI-SERDOS	BUK	Critical
13	Website Work Unit	SI-UK	Faculty	Critical
14	SIM- LEMLIT	SI-LEMLIT	LPPM	Critical
15	SIM- Community Services	SI-LPM	LPPM	Critical
16	SIM- Quality control	SI-MUTU	LP3M	Critical
17	SIM- Library	SI-OPAC	Library	Critical
19	SIM- Journal	SI-JOURNAL	TIK	Critical
20	E-Learning	SI-LEARNING	LP3M	Critical
21	SIM- Students Admission	SI-SPM	TIK	Critical
22	Portal Unila	SI-WWW	TIK	Critical
23	SIM- Repository	SI-REPOSITORY	LP2M	Critical
18	SIM- Help Desk	SI-HELPDESK	TIK	Support
24	SIM- VoIP	SI-VOIP	TIK	Support
25	SIM E-mail	SI-MAIL	TIK	Support
26	SIM- Network Monitoring	SI-NETMON	TIK	Support
27	SIM- Wireless LAN	SI-WIFI	TIK	Support

We identified portfolio of future application (to ... be). The app portfolio is a list of apps proposed for implementing at Unila. Table 3 shown the list of future application.

TABLE III. INFORMATION SYSTEM TO..BE PROPOSED PORTOFOLIO

No	Integration Information System	Several Modul Should be Used	Status
1	INTEGRATED ACADEMIC INFORMATION SYSTEM (SIKAD-T)	SI-SIAKAD	CRITICAL
		SI-WISUDA	
		SI-BEASISWA **	
		SI-KP **	
		SI-KKN **	
		SI-LAB **	
		SI-LEARNING	
2	E-LIBRARY	Aplikasi OPAC **	CRITICAL
		Aplikasi Warintek **	
3	INTEGRATED ADMINISTRATIVE INFORMATION SYSTEMS (SIPADU-T)	SI-REPOSITORY	CRITICAL
		SI-KEUANGAN	
		SI-ASET	
		SI-PDPT	
		SI-MUTU	
		SI-EPSBED	
		SI-SERDOS	
		SI-REMUN **	
4	APPLICATION SINGLE SIGN ON (SSO)	SI-RKAKL	CRITICAL
		SI-PEG	
4	APPLICATION SINGLE SIGN ON (SSO)	SI-SSO	CRITICAL

5	INTEGRATED RESEARCH AND COMMUNITY SERVICE INFORMATION SYSTEM (SIPPM-T)	SI-LEMLIT	CRITICAL
		SI-EJOURNAL	
		SI-LPPM **	
6	INTEGRATED MULTIMEDIA APPLICATION & CONFERENCE SYSTEM (MNC-T)	SI-VOIP	SUPPORT
		SI-VIDEO CONFERENCE **	
7	INTEGRATED APLIKASI NETWORK OPERATION CENTER (NOPEC-T)	SI-BWMGT	SUPPORT
		SI-FIREWALL	
		SI-PROXY /WIRELESS	
		SI-DNS	
		SI-HELPDESK	
		SI-FILE SHARING	
8	CRM	DATAWARE HOUSE **	SUPPORT
		SI-SMS GATEWAY **	
		SI-STUDENTPARENT S **	
		SI-COOPERATE **	
		SI-ALUMNI **	
		SI-Carier Management System **	
9	INTEGRATED MANAGEMENT PORTAL (PMS-T)	SI-PORTAL WORKING UNITS	CRITICAL
		SI-PORTAL WEB UNILA	
		SI-SOCIAL NETWORK **	
		SI-MOBILE INFORMATION **	
		SI-FORUM **	
10	EMAIL SYSTEM	SI-MAIL	SUPPORT
11	DECISION SUPPORT SYSTEM (DSS)	DATAWARE HOUSE **	CRITICAL
12	KNOWLEDGE MANAGEMENT SYSTEM (KMS)	SI-KMS **	CRITICAL

** The proposed information system

Phase Technology Architecture

This stage aims to identify the current technology platform and see firsthand the use of existing technology, shown on Fig. 3

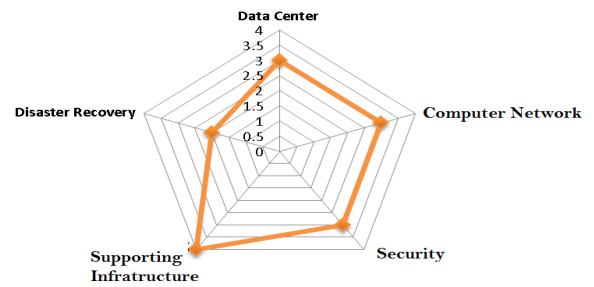


Figure 3. The results of the self-assessment in terms of infrastructure sub dimensions according to PeGI framework [22]

Phase Opportunities and Solutions.

Patterns of application development solutions. Based on the business functionality relationship, there is a description of the proposed architecture that should exist to support business services described on Fig. 4

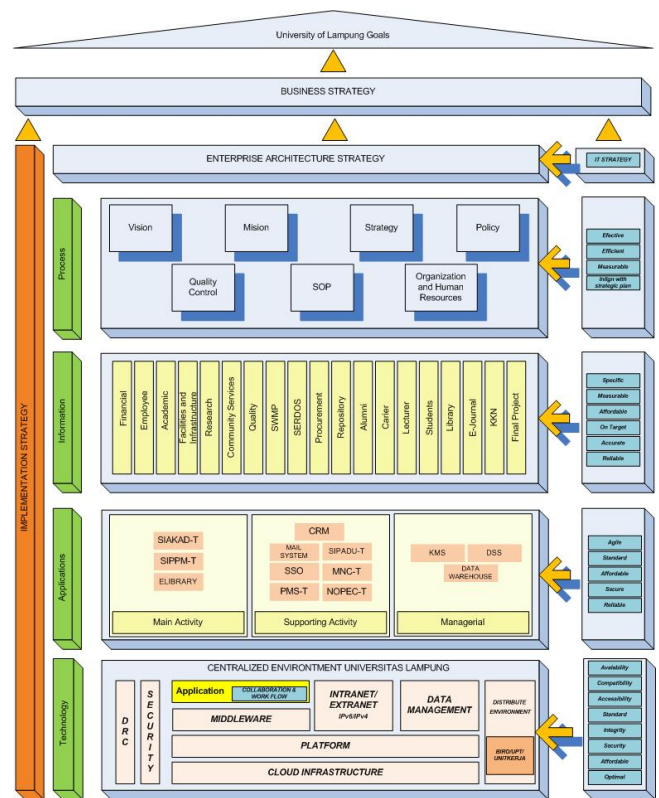


Figure 4. IT Infrastructure Architecture proposed to Unila

Infrastructure technology has a very important role to support the above services, the proposed in this paper show on figure 4, that infrastructure technology should be centralized managed by the IT unit, the unit must also implement security policies, data management, distributed system services, and running Disaster Recovery Center to provide a scalable, reliable, and adaptive service.

V. CONCLUSION

Based on the research result, we proposed several applications important to develop that are; SIAKAD-T, E-LIBRARY, SIPADU-T, DSS, SIPPM-T, KMS, PMS- T, CRM, MNC-T, NOPEC-T, SSO, EMAIL-SYSTEM.

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