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Enterprise Architecture Framework in Higher Education: Systematic Literature Review

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Abstract

The use of information and communication technology helps improve the quality of education and learning processes, research, libraries and information services, and university management. With the development of ICT, universities are one of the companies engaged in education, so institutions and universities need an information system planning strategy. This study presents a detailed and extensive systematic literature review (SLR) to select studies that carry out the current application of Enterprise Architecture in higher education. The method used in this research is the incorporation of various systematic literature studies on previous studies related to research objectives. The results of this literature review reveal important aspects related to the use of enterprise architecture applications in higher education, such as the most popular frameworks used in higher education, examine the reasons and determine the criteria for using application-based frameworks, and why enterprise architecture frameworks are needed to implement in higher education.



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I. INTRODUCTION

The development of information and communication technology is progressing rapidly and has changed the attitudes and behaviors of people. Information system development begins as a tool to support an organization's business decisions, and is better and better today, for businesses that are essential to an organization to make a significant impact on the organization and achieve their business goals faster [1]. The use of information and communication technology helps improve the quality of education and learning processes, research, libraries, and information services, as well as university management. With the development of ICT, universities are one of the companies involved in education, so institutions and universities need information system planning strategies. Azmi [2] stated that the competition in the world of education, especially at the private university level, requires good management to support business activities, achieve organizational goals, and further develop and build information systems as a service to stakeholders in the education world.

Universities are currently required to be able to manage information and the need for information properly, quickly, and precisely. Mature strategic planning of information systems is needed so that

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business processes at universities will be able to run well. To create planning in an information system, a framework is needed to design and manage IS/IT infrastructure known as Enterprise Architecture. The EA is more than just a tool for strategic IS / IT planning, but also EA is a tool for other business tasks as well, such as compliance management, continuity planning, and risk management [3]. Various approaches can be used to make a strategic plan for information systems. Universities need to consider the alignment between information technology (IT) infrastructures to support processes within the organization. This research discussed a literature review of enterprise architecture practices in higher education.

The method applied to this paper is a literature review based on existing studies of strategic planning and enterprise architecture. The first step taken in this research is to determine the research object of this study is to know how to find a suitable enterprise architecture framework for Higher Education. The second step is to define the database used for the literature search. After determining the literature search that will be used, then the criteria for selecting articles will be determined. The final step in the literature review is data extraction to filter which articles will be reviewed.

This study will unveil related information about the current application of Enterprise Architecture in higher education, such as the most used frameworks in higher education, the reason and criteria for using the framework, and why enterprise architecture is needed in higher education. The result of this study is needed by the universities so that universities will be able to provide a more established foundation for the development of information systems and processes and the results of their implementation can be measured. Based on the explanation, this paper aims to answer the following questions:

RQ1: What are the most popular enterprise architecture frameworks in the Higher Education field?

RQ2: What are the reasons and criteria for choosing Enterprise Architecture frameworks in Higher Education?

RQ3: Why University or Higher Education needs to adopt Enterprise Architecture Framework?

II. ENTERPRISE ARCHITECTURE

Enterprise architecture (EA) is widely used by various organizations around the world as a tool to improve the integration between business and IT. The EA has evolved into a tool for developing and managing organizational elements, providing tools for agility in planning and change. The purpose of the EA is risk and compliance management, project and organization program management, IT management portfolio, and business and IT integration [4]. As many believe, it's not just an IT issue, but an organizational knowledge issue. The EA provides enterprise analysis and documentation in both current and future (target) conditions from an integrated strategic, business, and technology perspective. Identify the business functions and processes that carry out or support the organization's mission and define how IT resources enable or mature those functions and processes.

The ability to establish new conditions in an organized manner and the knowledge architecture for reporting and analysis by all stakeholders are the benefits of Enterprise Architecture [5]. The EA is more than just a tool for strategic planning, but also EA is a tool for other business tasks as well, such as compliance management, continuity planning, and risk management [3]. EA helps organizations transform their business visions and strategies into effective business changes by having a clear understanding of what is happening now (as-is) and what is expected to happen in the future (to-be) [6].

III. METHODS

The method applied to this paper is a literature review based on existing studies of strategic planning and enterprise architecture. This study follows Kitchenham and Charters [7] practical guidelines. The steps of the literature review are documented below.

A. Research Objectives

The research object of this study is to know how to find a suitable enterprise architecture framework for Higher Education. This study focuses on what kind of EA framework and the criteria of EA Framework are

needed by the universities. In this case, the goal of the literature review is to analyze existing studies based on the research object.

B. Literature Search

To fulfill the objective purpose of research objectives, the next step is to determine the criteria of previous literature searches that will be reviewed in this paper. The database used for the literature search can be seen in table 1.

Table. 1 Result of Literature Search

Resource	URL
Science Direct	sciencedirect.com
Emerald	emeraldinsight.com
IEEE Xplore	ieeexplore.ieee.org
Google Scholar	scholar.google.com
Research Gate	researchgate.net
IOP	iopscience.iop.org

The keywords used for the literature search are “Enterprise architecture for University”, “Enterprise architecture Framework for University”, “Enterprise architecture for Education”, and “Enterprise architecture framework for Higher Education”.

C. Inclusion and Exclusion Criteria

There are two kinds of criteria made in this research, that is inclusion and exclusion. The first criteria relate to the format of publication, the language of publication, the type of publication, and the ranking of the journal. The publication language chosen is English. In addition, technical reports, white papers, and the publication of unfinished research developments are also ignored.

The second criteria of inclusion and exclusion criteria relate to the content of the study. These criteria can be seen in Table 2, where these criteria ultimately determine whether research will be included in the literature review.

Table. 2 Inclusion and Exclusion Criteria

Inclusion Criteria	<ul style="list-style-type: none"> • Publication that discusses enterprise architecture applications in higher education or the education field • Paper published in 2012-2022 • The language of publication is English • The studies related to the research objectives of this study
Exclusion Criteria	<ul style="list-style-type: none"> • Publications that discuss enterprise architecture applications but not in the higher education or education field • White paper • Technical report • Thesis • Books

D. Data Extraction

Every article and publication included in this systematic literature review has been read in depth by the authors to obtain the data. There are four steps in the process of selecting papers to be included in this study. The procedure is as follows:

1. Literature search: article or publication which appears on the database search with predetermined keywords.
2. Studies Found: Article or publication that matches with predetermined keywords.
3. Candidate Studies: Article or Publication that has been chosen based on the title and abstract and inclusion and exclusion criteria.
4. Selected Studies: Article that has been read thoroughly, starting from the introduction, analysis results, and the conclusions of the paper.

The result of the literature search can be seen in table 3 below.

Table. 3 Results of Literature Search

Resource	Literature Search	Found	Candidates	Selected
Science Direct	20,813	8	2	0
Emerald	791	0	0	0
IEEE Xplore	3,340	13	8	3
Google Scholar	239,000	21	6	4
Research Gate	10,000	10	7	5
IOP	500	6	4	3

IV. RESULTS AND DISCUSSIONS

A. RQ 1 - What are the most popular enterprise architecture frameworks in the Higher Education field?

Universities are currently required to be able to manage information and the need for information properly, quickly, and precisely. An enterprise architecture framework is needed to design and manage IS/IT infrastructure.

Based on the analysis of 15 papers, it is found that there are two commonly used enterprise architecture frameworks for education. These two frameworks are TOGAF (the open group architecture framework) and Zachman’s Framework. Table 4 represents the details of the frequency of used enterprise architecture framework based on the results of the literature review.

Table. 4 The Mapping of EA Framework

No	EA Framework	Resources
1	TOGAF	[8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20]
2	Zachman’s Framework	[21] [22]

Table 4 showed that TOGAF (the open group architecture framework) is more widely used as an enterprise architecture framework in the field of education. TOGAF framework was applied in 13 studies, representing 86,7% of the application. Followed by Zachman’s Framework, applied in 2 studies representing 13.3%. In conclusion, TOGAF is one of the enterprise architecture frameworks that is used the most in the education field.

B. RQ2 - What are the reasons and criteria for choosing Enterprise Architecture frameworks in Higher Education?

The EA describes what, why, and how a company does, including the types of business analysis, Functional support from IT to business, and EA helps companies define changes or improve the needs from the current state of the company to the future state of the company or organization that it wants in the future.

86,7% of papers chose TOGAF as an Enterprise Architecture methodology with different choice criteria, even though some are not explicitly stating it. While 13,3 % chose Zachman’s Framework.

In article [8], TOGAF was used for its detailed and complete tool. This is different from other EA frameworks. Ariawan [9] chose TOGAF because it is flexible and open source. TOGAF provides a detailed methodology for creating, managing, and implementing enterprise architectures and information systems. The flexibility strategy offered by TOGAF ADM enables you to recognize the various modeling approaches applied to your planning. This method is adaptable to changing requirements and the design process. Additionally, TOGAF ADM offers a distinct vision and guiding principles for creating corporate architectures This principle is used as a parameter to assess the success of an organization's enterprise architecture development.

Guntara [12] chooses TOGAF because it provides a framework of best practices for the TOGAF standard to add value and enables organizations to develop viable solutions. TOGAF uses a special framework to process architectural designs to recognize the need for effective and efficient systems.

Eskaluspita [13] adopts TOGAF because, when compared to other frameworks, it is superior in terms of process integrity, reference model guidelines, vendor neutrality, information availability, and time-to-value realization. In addition, TOGAF provides the processes and procedures for creating the artifacts needed to design an enterprise architecture. TOGAF gives users flexibility, non-sequential, and complete stage execution as needed in existing situations.

Zachman framework was chosen by Budiman [21], because Zachman Framework describes the framework using a dimensional approach to ensure stakeholder focus and connected to each other. The Zachman Framework has six dimensions: data (what?), Functions (how?), Networks (where?), People (who?), Time (when?), And motives (why?).

C. RQ3 - Why University or Higher Education needs to adopt Enterprise Architecture Framework?

With the development of ICT, universities are one of the companies involved in education, so institutions and universities need information system planning strategies. Universities have a very complex core process. This process reveals a few unrelated definitions. Enterprise architecture helps organizations properly define each process using the concept of enterprise ontology. Table 5 shows the reason why University or Higher Education needs to adopt enterprise architecture.

Table. 5 Reason to Use Enterprise Architecture

No	Reason	Resources
1	Planning of Information technology infrastructure	[8] [9] [14] [15] [16] [17] [18] [21] [22]
2	Integrating information systems	[8] [11] [12] [13]
3	Creating an appropriate business strategy	[13]
4	Effectiveness and efficiency in the application of IT	[14] [18]
5	Reduce disparities in the system development process	[14]
6	Increase the competitiveness of technology compared to other universities	[17]
7	Reduce costs and improve the integrity of business and information technology	[17]
8	To support every business need	[19]
9	Increasing the performance of the system	[19]
10	Achieve the mission and objectives related to the education process	[20]

From the mapping done in table 5, it is found that planning a good information technology architecture was the most reason for adopting enterprise architecture frameworks. Most of the articles want to build an integrated information system that enables to share the data for the entire enterprise. An enterprise architecture framework is needed to increase the Effectiveness and efficiency in the application of information technology. So, the organization will be able to create an appropriate business strategy and increase the competitiveness of technology compared to other universities to achieve the mission and objectives related to the education process.

V. CONCLUSIONS

Universities are one of the companies involved in education, so institutions and universities need information system planning strategies. An enterprise architecture framework is needed to design and manage IS/IT infrastructure. The EA describes what, why, and how a company does, including the types of business analysis, Functional support from IT to business, and EA helps companies define changes or improve the needs from the current state of the company to the future state of the company or organization that it wants in the future.

According to the literature result from 15 papers, the most widely used EA framework in educational fields is TOGAF. 13 studies, or 86.7% of the applications, use the TOGAF framework. Followed by Zachman's Framework, applied in 2 studies representing 13.3%. from these results, it can be concluded that the TOGAF Framework is more suitable to be applied in higher education.

On the other hand, the reason and the criteria for choosing Enterprise Architecture frameworks in Higher Education are their flexibility, the EA framework should be providing detailed and complete methodology, EA framework is open source, and add value to organizations. These criteria fit perfectly with TOGAF character.

University or higher education needs to adopt EA frameworks to plan a good information technology infrastructure and build an integrated information system that enables to share the data for the entire enterprise. An enterprise architecture framework is needed to increase the Effectiveness and efficiency in the application of information technology. So, the organization will be able to create an appropriate business strategy and increase the competitiveness of technology compared to other universities to achieve the mission and objectives related to the education process.

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