



# Designing a conceptual model of university Enterprise Architecture

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**ABSTRACT:** Today, Enterprise Architecture and its related issues have gained special importance in educational organizations and it is expected that after a few years of using Enterprise Architecture in a university, it will have a significant difference from other universities that for some reason can benefit from they have not had it. Since in order to move universities towards Enterprise Architecture, it is necessary to create and develop the required platforms; In order for Enterprise Architecture to be successful in using an optimal Enterprise Architecture, it is necessary to identify and evaluate the required platforms. According to what was mentioned, the purpose of this article, which is written in a review and documentary form, is to design a conceptual model of academic Enterprise Architecture. Academic Enterprise Architecture can be studied based on the following: components of academic Enterprise Architecture, predictions of academic Enterprise Architecture, results of academic Enterprise Architecture. Based on the results, the university Enterprise Architecture components were divided into three categories: business architecture, information systems architecture, and technology architecture. Application services layer, data layer, infrastructure layer and standardization layer were proposed as predictors and strategic layer and operational layer as output. Finally, based on the stated components, the conceptual model of university Enterprise Architecture along with predictors and output was proposed. Presented

**KEYWORDS:** Enterprise Architecture academic; business architecture; architecture of information systems; technology architecture; Conceptual Model

Received 06 Apr., 2023; Revised 18 Apr., 2023; Accepted 21 Apr., 2023 © The author(s) 2023.  
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## I. INTRODUCTION

Today, Enterprise Architecture is one of the most important challenges in organizations, especially educational organizations such as universities. The biggest challenge facing universities today is that information technology has become a very important equation for almost all organizations. Because it is believed that this technology will improve the effectiveness and efficiency of the useful processes of the organization, including universities. To achieve this goal, good and correct information technology management is needed to support the organization's success in achieving its goals. Based on this, how can the direction and goal of development be carried out in accordance with its vision and mission, both state and non-state universities. To answer this challenge, the organization must carry out the strategic planning of the Enterprise Architecture by preparing a framework [36]. According to some people; since university units have complex structures and dimensions and are physically extensive, it is necessary to have a map and a general plan to properly control changes and coordinate with the general goals of the university. University Enterprise Architecture is considered as an effective method in matching strategic goals with all activities and components of the university and communication and information technologies. In other words, university Enterprise Architecture is a method for organizing business processes, information technology infrastructures and reflecting the integration and standardization of requirements related to the operational model of universities [34]. In general, various reasons have caused the use of Enterprise Architecture in universities, which include; Lack of coherence between data, lack of coherence in existing resources, lack of updating and standardization of technology, time-consuming and costly current processes in the organization. On the other hand, one of the important issues in organizations is the challenge in the competitive field.

The university is a vast and complex educational system, the success of this system requires a detailed strategic plan in all university units, in order to be able to compete with competitors. For the effectiveness of strategic goals, there should be precise coordination and integration in all activities and fields, including business, information, application and infrastructure of the units so that it can compete in competitive supply against its competitors. Among the appropriate solutions to solve it is the use of Enterprise Architecture and, accordingly, the use of the latest technologies because competitive advantage is a key factor for business success. An Enterprise Architecture refers to providing a strategic concept for the evolution of the information technology system in response to the constantly changing needs of the business environment. In the business world, all levels of organizations need brief planning. With the rapid progress of globalization and the process of competition, it is necessary to push organizations towards creating integrated software systems using the most up-to-date technologies. Considering that the industry, services, favorable public image, student satisfaction, employee satisfaction, geographical scope, future directions, scientific goals and the role of the university in its development, etc. are among the university's mission statements [24] In this regard, considering the extent and dispersion of university units, it is necessary to have a plan and a general plan in order to coordinate with the goals of the university and control the changes. Therefore, it can be said that one of the important missions of the university is alignment, coordination, coherence in activities and processes [1] And the emergence of university Enterprise Architecture is a response to this challenge. In other words, university Enterprise Architecture leads to problem management based on the ITI framework [32]

, key data management [29] , reducing technological complications and increasing efficiency in order to achieve organizational goals [19] , reducing IT complexity and cost throughout the organization and local innovation [22] reducing information technology complexity and excellent technology performance [46]

, reducing the complexity of technology deployment and efficiency in achieving organizational goals, reducing energy consumption in computer systems [17], reducing the costs of planning, designing and implementing architecture and reducing the complexity of the design process [38] , reducing the cost of training, innovation management and gap analysis of the current situation and ideal [25] , improving agility, increasing the speed and reducing the cost of more innovation and effective return on investment, as well as reducing the risks and costs of implementing organizational resource planning in organizations, reducing complexity and cost systems and making cooperation more efficient [10] reducing crises and improving agility and cooperation in organization [30] reducing the process execution time [39] Therefore, such a university will act faster, more coherently and more efficiently in the face of problems And on this basis, the Enterprise Architecture not only causes the integration of processes and better data management and speeding up the solving of problems. Rather, it can lead to results such as attracting efficient faculty, attracting more research projects to improve income in the university, attracting more students, more efficient implementation of information technology in the university, better return of capital, reducing risk in future investments, faster preparation. become simpler and cheaper [21] . In general, more monitoring of the performance of educational institutions in achieving goals shows the importance of Enterprise Architecture in organizations [7] . Therefore, the most important question that arises is, which performance indicators should be used to control the performance of organizations in achieving organizational goals?

Other questions include paying attention to which performance indicators in the organization will cause more integration of processes and reduce time and costs? What method can be used for optimal use of resources, especially hidden resources in the organization? How can you stand out among your competitors? The following questions are answered in this article.

## **II. Materials and methods**

The current research is a review of the studies conducted in the field of Enterprise Architecture, which have been published in English and Farsi-language scientific journals inside and outside the country, and have investigated Enterprise Architecture in organizations, especially in universities. The method of data collection in this study was that first, relevant keywords were selected using Mesh in the PubMed database. By using the keywords layers - Enterprise Architecture in education - Enterprise Architecture Enterprise Architecture - Framework Enterprise Architecture in Scopus, Science Direct, Google scientific information and Web of Science, PubMed, Margin, Ir.doc, SID, civilica Scholar, 186 articles with title or abstract They had the mentioned keywords, were extracted. After reviewing the abstracts, there were 87 articles about Enterprise Architecture in organizations. From all reviewed articles, 35 articles that met the appropriate criteria for inclusion in the study were selected and their findings were analyzed. The study inclusion criteria included full-text articles published between 2004 and 2020 that examined Enterprise Architecture in educational centers. The exclusion criteria included studies that were not in line with the purpose of the research, outside the scope of the inclusion criteria, including Enterprise Architecture in centers other than educational centers. Since all the

studies searched in this research were not homogeneous, the combination of their results was avoided quantitatively. This research, which was conducted in a review and analytical manner and integrated with the study of valid scientific articles, including conference articles and foreign and domestic databases, to provide a conceptual model for university Enterprise Architecture. Based on this, by examining the studies conducted in this field, Enterprise Architecture indicators were identified and categorized in educational organizations. In the following, the investigated components in university Enterprise Architecture were investigated as predictors and also, the outcome of university Enterprise Architecture. Finally, based on the identified cases, a conceptual model was developed.

### **III. Findings**

#### **1- Academic Enterprise Architecture and vocabulary definition**

Various definitions have been provided for the term Enterprise Architecture; Enterprise Architecture is a method to fully describe the different aspects and layers of an organization in its current state or desired state using standard and well-known models and techniques. Enterprise Architecture can be classified based on time (current situation, desired situation), field (management or technology) and architectural aspects (information architecture, application architecture) [41]. In fact, architecture is a special and comprehensive attitude [40] which indicates the existing or desirable state of that organization [2]. In other words; A method for organizing business processes, information technology infrastructures and reflecting the integration and standardization of the requirements related to the operational model of the organization [34] And it is a defined and comprehensive framework for accelerating the vision and mission of the organization in all its complex aspects and dimensions. The framework is the heart of the architecture that evolves over time. Five generations of Enterprise Architecture thinking since 1980 are; 1. The first generation of Enterprise Architecture; Zackman matrix 2. Second generation; Completing the Zackman framework 3. The third generation of Enterprise Architecture (stage of paying attention to the change and development plan) 4. The fourth generation of Enterprise Architecture (the stage of paying attention to the existing and desired architecture and transition) 5. The fifth generation of TOGF Enterprise Architecture (which is based on a repeatable process model) [45]. Enterprise Architecture frameworks are generally divided into four main categories: 1. General Enterprise Architecture frameworks (all-purpose) 2. National (government) Enterprise Architecture frameworks 3. Military Enterprise Architecture frameworks 4. Enterprise Architecture frameworks specific to industries (banking, insurance, telecommunications) are divided. The most famous national (government) Enterprise Architecture frameworks are as follows: Korean Government Enterprise Architecture Framework, Australian Government Enterprise Architecture Framework, Singapore Government Enterprise Architecture Framework, New Zealand Government Enterprise Architecture Framework, Federal Enterprise Architecture Framework, United Kingdom Government Enterprise Architecture Framework, New Zealand Government Enterprise Architecture Framework, Finland Government Enterprise Architecture Framework, Bahrain Government Enterprise Architecture Framework, Saudi Arabia Government Enterprise Architecture Framework, Oman Government Enterprise Architecture Framework, Jordan Government Enterprise Architecture Framework, Ethiopian Government Enterprise Architecture Framework. Each of the main divisions also has sub-frames. The most famous of these Enterprise Architecture frameworks that were used in the last twenty years; They are: Zackman Framework, Federal (FI AF), Gartner (GF), TOGF, Dodaf, Sea Four Racer, TAFIM, TIAF, LAF, ETO OF, URASEL (OF) and Enterprise Architecture frameworks of higher education [43] pointed out. The elements that are examined and analyzed in the Enterprise Architecture and consequently in the reference Enterprise Architecture (frameworks), They are usually secreted into different layers. These elements include the basic building blocks of an architecture and logical validity among them. The rules and principles governing this architecture and its life cycle affect all layers and they are set in detailed architectures and according to specific organizational needs. This point is observed in all Enterprise Architecture frameworks. Although layers in different frameworks and perspectives sometimes have differences with each other, However, the following four layers are usually considered as the main layers of the enterprise architecture: business layer, information layer, data layer, infrastructure layer [39], we can say; Representing the existing or desirable state of an organization from various elements such as process, function, organizational unit, organizational role, business service, product (organization output) is called business layer. The application layer is one of the layers of the Enterprise Architecture and includes the information recorded in the information systems that are necessary to meet the information needs of the organization. Any hardware, software and communication necessary for the implementation of information systems and the circulation of information and operations are used as the infrastructure layer [2]. And finally; the data layer is the art and science of organizing and classifying websites, organizational networks in order to help people find and manage information.

## 2- Frameworks and layers of Enterprise Architecture

Researchers in the field of Enterprise Architecture have proposed a diverse range of Enterprise Architecture. which varies in the form of two- to seven-component (layer) frameworks, including the two-layer framework, we can refer to the Zackman framework and the Luff framework presented; In 1987, John Zackman created a framework called the Zackman matrix; It consists of two main dimensions The first dimension includes the columns that indicate the aspects of who? Who and why? What? How? Where? And the second dimension or the rows represent the viewpoint of the organization's stakeholders, including the planner, owner or owner, designer, builder, contractor, and operator [15]. Lough's Enterprise Architecture framework is influenced by the combination of Zackman's model and Spaak's views and includes two layers of infrastructure (software and hardware) and an information systems layer [43]. Among the three-layer frameworks, we can refer to TOGF framework, Gartner framework, University of Birmingham Enterprise Architecture framework, C4 Racer architecture framework, Dodaf architecture framework; Gartner's framework is a strategy and this framework is a practical framework based on three business, information and technology perspectives. [15]. University of Birmingham Enterprise Architecture in three layers; the business layer (business capabilities, business processes, demographics), application layer (application models, portfolio, management) and technology layer (infrastructure, technical standards) were introduced [13]. The US Ministry of Defense's C4 Racer architecture framework introduces a comprehensive framework including documentation of rules, guidelines and product descriptions for the development of Enterprise Architecture. To express the different levels of a system, it introduces three types of technical, operational and systems perspectives with the aim of ensuring the integrity of different architectures and communicating between these three. Dudaf's architecture framework is a version of the well-known architecture framework of the US Department of Defense, Sea Four Racer, based on three operational perspectives, system perspective and technical standards. The TOGF framework was presented in 1995 as a standard method for enterprise architecture. The latest version of this framework covers the development of four business, data or information, application and technology architectures in the organization. It includes three main components of architecture development methodology (MADA), value chain and Tofef resource base. [39]. Among the four-layer framework, Tiaf's Enterprise Architecture framework can be mentioned. In 2000, Tiaf's Enterprise Architecture framework was modeled on the information systems architecture framework and the federal framework It included four functional layers, information, organizational, and infrastructure. In 1994, he presented a model with five factors, these five factors are: structure, management processes, people and roles, technology and strategy [12] and in 2002, the Federal Enterprise Architecture Framework (FIAF) created A customer-oriented and citizen-oriented government for technology-based investments to achieve better and more outputs was the goal and mission of the organization. This framework has five reference models; Business, services, components, technology and data. Was [15]. In general, many studies have been conducted on Enterprise Architecture, and the table below shows some of these studies that have been conducted in the field of Enterprise Architecture in universities.

Innovation	Infrastructure	regulation	Services	Technology	Data	Application layer	integrity	Business	Structure	people	motivation	Culture	Support	Strategy	
	*		*										*	*	Ghasemi (2018)
	*	*	*	*			*					*	*	*	Sharifi (2016)
	*	*													Tragi (2016)
															Abbasi SpuGani
				*	*			*	*	*	*	*	*	*	Faqih (2014)
								*						*	degree (2013)
				*	*			*							Malek Lozadeh (2013)
		*		*	*	*	*	*						*	Ahmadi (2013)
	*			*	*			*	*	*				*	Golshani (2012)
	*	*	*		*	*	*	*							Ali Ahmadi (1385)
	*			*	*			*							Lulu and... (2020)
	*	*		*	*	*	*	*							Yule May and... (2020)
	*			*	*	*	*	*						*	Farja La and... (2019)
			*		*	*	*	*							Yoon...(2019)
							*	*						*	Alameri and... (2018)

			*				*					*	<b>Alamia, S... (2017)</b>
			*						*			*	<b>Parmensov (2017)</b>
													<b>Adnan (2017)</b>
													<b>Abbasi (2016)</b>
	*	*										*	<b>Wahjo Rah...2019)</b>
												*	<b>Gigi... (2017)</b>
												*	<b>Anderson (2016)</b>
						*	*	*				*	<b>Razavi (2016)</b>
		*			*								<b>Harvard (2016)</b>
			*		*	*							<b>Birmingham (2014)</b>
										*			<b>Ayer (2014)</b>
		*											<b>Pasiga and... (2014)</b>
			*						*		*	*	<b>Simon and...(2014)</b>
						*							<b>Pandro Sher... (2014)</b>
						*							<b>Guess and... (2012)</b>
				*		*	*	*	*	*	*	*	<b>Loe and Linger (2012)</b>
			*	*	*	*	*	*		*			<b>Italy (2011)</b>
*													<b>Theo Wekor... (2010)</b>
					*							*	<b>Salamat and... (2009)</b>
		*	*										<b>Dreyfus and... (2008)</b>

Based on the results obtained regarding the investigated indicators of Enterprise Architecture in universities, they can be classified into three components and six layers and the conceptual model of Enterprise Architecture can be drawn as below.



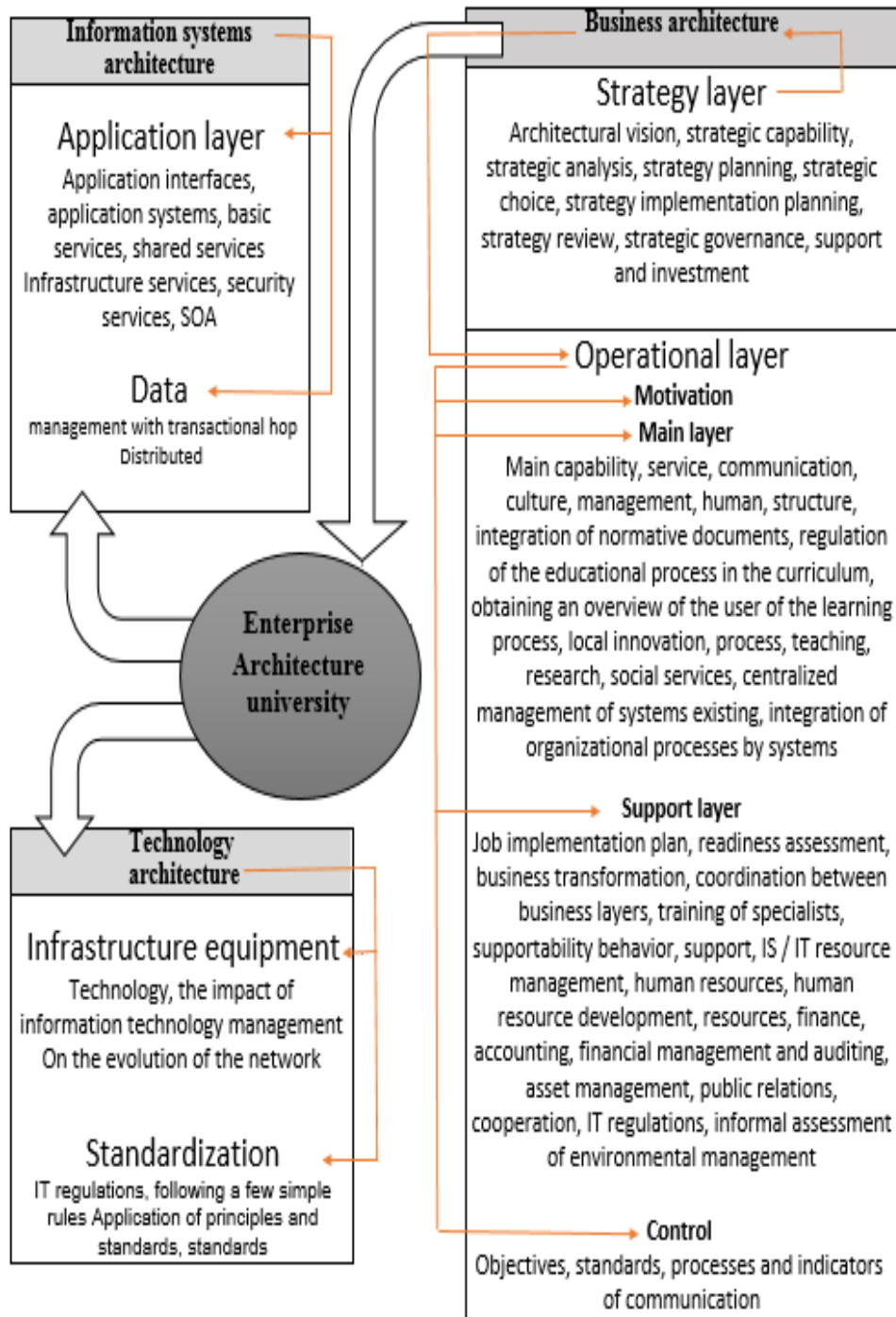
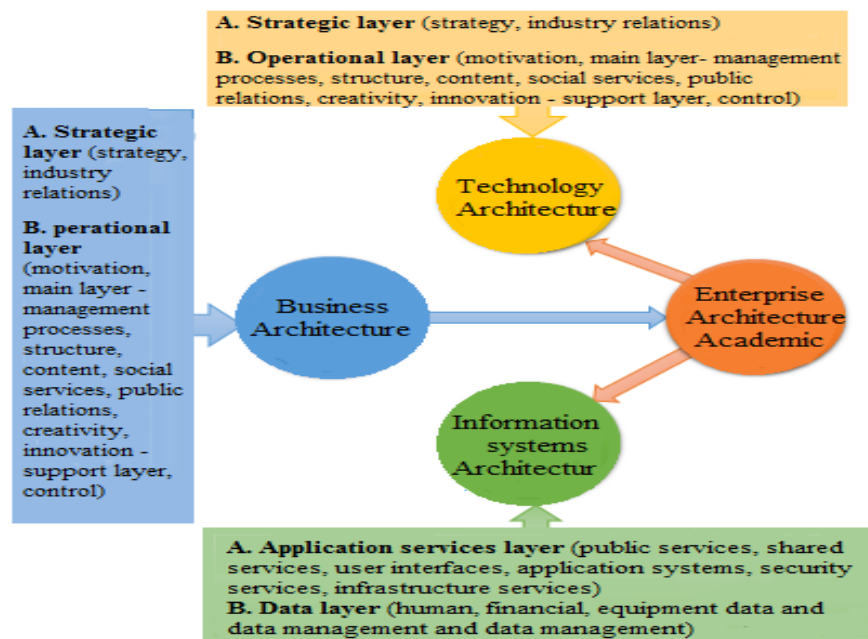


Figure 1:

#### IV. CONCLUSION

The success of Enterprise Architecture in the university is affected by a good strategy, in other words, business architecture. Therefore, in a complex and multifaceted academic environment, there is a need to have a good business architecture. On the other hand, one of the most important challenges in this field is the lack of suitable university architecture. Based on this, there is a need for a model called university Enterprise Architecture model that will be a guide for universities so that they can promote the coordination and integration of processes. The layers of business architecture, information systems architecture and technology are among the things that play an important role in the design of a desirable university Enterprise Architecture. It is worth noting that universities can take action to design a desirable university Enterprise Architecture by having a strategic plan and a rich business architecture. Therefore, only having a business architecture is not enough to design a university Enterprise Architecture. Rather, information systems and technology are among the

necessities of a desirable university Enterprise Architecture design. Based on the results of the research and the conceptual model of university Enterprise Architecture, the university should be able to act strongly in the field of creating strategy layer, operational layer, data layer, application layer, infrastructure layer and standardization layer. To be able to achieve a desirable Enterprise Architecture. One of the cases that is considered in the discussion of university Enterprise Architecture It is the conditions and activities that lead to the creation of university Enterprise Architecture in which the role of business architecture cannot be ignored. Business architecture to create a desirable academic Enterprise Architecture in two areas; the strategy layer operates the operational layer. The strategy layer itself includes strategy and communication with the industry, and the operational layer includes motivation, main layer, and support and control layer. One of the most important goals of university Enterprise Architecture design is to create coordination and integration in the current processes of universities Therefore, it is necessary to provide conditions so that universities can make their processes more integrated and in this regard, using the Enterprise Architecture model will be useful. Based on this and according to the results of the research, for more coordination in the processes of the university along with predictions and results, the conceptual model in the form of Figure 2 can be used.



**Figure 2- Proposed model of integration of processes in university Enterprise Architecture**

Based on the conceptual model presented in this article, it is suggested to evaluate the proposed model operationally in order to integrate the processes in the university Enterprise Architecture, along with the prediction and outcome of the university Enterprise Architecture. In this way, the layers of the university's Enterprise Architecture, which include business architecture, information systems architecture, and technology architecture, are evaluated and its impact on the level of coordination and integration of existing processes in the university should be measured. Also, in the evaluations, it was found that some processes do not have the necessary integrity. It is necessary to improve integration and coordination to the highest level with appropriate arrangements.

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