

Presenting an Enterprise Architecture Model for the Islamic Azad University, East Azerbaijan Province

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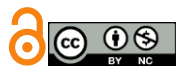
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ABSTRACT

Objective: The objective of the present study was to propose an enterprise architecture model for the Islamic Azad University, East Azerbaijan Province.

Methodology: This study employed a mixed-methods approach (qualitative-quantitative) and was applied in nature. In the qualitative section, the research population consisted of academic experts, from which 21 individuals were selected through purposive sampling. The research instrument was semi-structured interviews, the validity and reliability of which were examined. Data analysis was conducted using coding methods. In the quantitative section, the statistical population included all faculty members and staff in the fields of management and educational management at the Islamic Azad University, East Azerbaijan Province, totaling 63 individuals. Based on the Morgan table, 56 individuals were selected through stratified random sampling. A researcher-made questionnaire, based on the components extracted in the qualitative section, was used in the quantitative section. Data analysis was conducted using structural equation modeling (SEM) with Smart PLS software.

Findings: The findings indicate that the university enterprise architecture model can be classified into three layers: business architecture, information systems architecture, and technology architecture. Additionally, the path coefficient for the business architecture component with university enterprise architecture was 0.98, for information systems architecture it was 0.85, and for technology architecture with university enterprise architecture it was 0.86 ($P < 0.05$).

Conclusion: The enterprise architecture model of the Islamic Azad University comprises three main components. Paying attention to these components can lead to the development and flourishing of university enterprise architecture. Therefore, the higher education system can focus more on educational architecture to further enhance the flourishing of higher education.

Keywords: Education, University System, Enterprise Architecture, Islamic Azad University.

1 Introduction

A university is a complex and extensive educational system. The success of this system requires a precise strategic plan across all university units to ensure competitiveness with peers. For the effectiveness of strategic objectives, there must be accurate coordination and integration across all activities and areas, including business, information, application, and infrastructure, so that the university can stand out in a competitive landscape (Curaj et al., 2018; Salman Al-Oda et al., 2024; Zamani et al., 2024).

Enterprise architecture is a method for thoroughly describing the various aspects and layers of an organization in either its current state or its desired state using standard and recognized models and techniques (Cunningham et al., 2022; Verma et al., 2023). Academic enterprise architecture is a method that can be used to fully describe the various aspects and layers of a university by utilizing standard models and frameworks, either to represent the current state, the desired state, or the transition from the current state to the desired state. Zachman also defines enterprise architecture as a set of descriptive representations of models that describe an organization in a way that meets quality management requirements, is produced, and can be maintained during its useful life (Ahmadian et al., 2014). In other words, enterprise architecture reflects the integration and standardization of requirements related to an organization's operational model, the logic of organizing business processes, and IT infrastructures. The Institute for Enterprise Architecture Development offers a comprehensive definition: Enterprise architecture is a complete statement of an organization, a grand design that provides cooperation between aspects of business planning, such as objectives, visions, strategies, and management principles; aspects of business operations, such as functions and business processes, organizational structures, and organizational data; aspects of automation, such as information systems and databases; and aspects of the technology infrastructure supporting business, such as computers, operating systems, and networks (Parsa et al., 2012).

It should be noted that implementing an inappropriate enterprise architecture not only fails to achieve organizational goals but can also disrupt business processes and lead to excessive organizational costs. Given that university units have complex structures and dimensions and are physically extensive, a comprehensive plan or roadmap is necessary to properly manage changes and ensure

alignment with the university's overall objectives. Academic enterprise architecture is considered an effective method for aligning strategic goals with all activities, components of the university, and communication and information technologies. In other words, academic enterprise architecture is a method for organizing business processes, IT infrastructures, and reflecting the integration and standardization of requirements related to the university's operational model (Ross, 2014). However, in large and complex universities today, using a defined and comprehensive framework to accelerate the university's vision and mission across all its complex aspects and dimensions is necessary. Architectural frameworks provide a method for university-oriented thinking and addressing complex systems. If we consider the university as a prism with different perspectives and facets, the way we abstract and view the university in planning and architecture is highly influential (Ahmadian et al., 2014; Mathews et al., 2020).

Looking at the experiences of model countries, we can see why leading countries in the field of architecture have developed frameworks and established supervisory and governance institutions at the national level to guide organizations in implementing architectural projects and e-government initiatives. However, in Iran, after years of pursuit, the Service-Oriented Enterprise Architecture Laboratory was finally established in 2011 with the support of the Information Technology University and the follow-up of the architecture team at Shahid Beheshti University. This laboratory aimed to develop frameworks and reference models for architecture, evaluate architectural projects, and promote knowledge, culture, and capacity building (Ahmadian et al., 2014). Reference models and architectures have paved the way for architects, resulting in significant time savings in implementing enterprise architecture projects and reducing financial costs (Appiah et al., 2020). One of the activities that can help organizations make proper use of enterprise architecture is the development of reference architectures specific to a particular industry. Reference architectures present ideal elements for a specific industry in a standard form. Each organization can customize the reference architecture specific to its field of activity with minimal resources and benefit from its advantages. In a study, a service-oriented reference architecture plan was developed for Iranian e-learning universities based on the TOGAF framework, providing a clear policy for Iranian e-learning universities. By using the elements of this architecture, e-learning universities can meet their needs most efficiently with minimal resources. This study focused

solely on the information layer (Mathews et al., 2020). In this case, Wahju and colleagues (2019) pointed out that implementing enterprise architecture in a university is a long-term effort that must be carried out by higher education institutions (Wahju et al., 2019).

Given that the Islamic Azad University is a university with extensive and widespread units, the necessity of having a comprehensive plan and roadmap to coordinate with the university's goals and control changes is essential. It is anticipated that the proposed model of this research, given its unique features, will have a high degree of compatibility at the university level and will lead to resource savings, the use of hidden assets, and increased effectiveness of related activities. In fact, the Islamic Azad University can, by using this model, compete with other universities, integrate activities, and make optimal use of financial and human resources to attract more students and research projects, thereby increasing its revenue. Based on the aforementioned points, the primary objective of this study is to present an enterprise architecture model for the Islamic Azad University, East Azerbaijan Province.

2 Methods and Materials

Table 1

Open, Axial, and Selective Coding

Selective Code	Axial Code	Open Code
Business	Strategic Layer	Architectural vision, strategic capability, strategic analysis, strategic planning, strategic selection, strategy implementation planning, strategy review, strategic governance, support and investment
	Core Layer	Core capability, services, communication, culture, management, human, structure, integration of normative documents, regulation of educational processes in the curriculum, obtaining an overview of user learning processes, local innovation, processes, teaching, research, social services, centralized management, existing systems, integration of university processes by systems, job implementation plan, readiness assessment, business transformation, coordination between business layers, training specialists, behavior
	Support Layer	Support capability, support, IS/IT resource management, human resources, human resource development, resources, finance, accounting, financial management and auditing, asset management, public relations, collaboration
	Control	Regulations, informal IT evaluation, environmental management, standard goals, processes, and indicators, communication
Information Systems Architecture	Application Services Layer	Application interfaces, application systems, basic services, shared services, infrastructure services, SOA security services
Technology Architecture	Data Layer	Data, data management with distributed transactional hubs
	Equipment	Infrastructure, technology, the impact of IT management on network evolution
	Standardization	IT regulations, adherence to a few simple rules, application of principles and standards, standards

To examine the normality of the distribution of variables, the Kolmogorov-Smirnov test was used. The null hypothesis in this test is the normality of the variable distribution. If the significance level of the test is greater than 0.05, the null hypothesis is confirmed, indicating that the distribution of

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3 Findings and Results

Table 1 presents the process of open, axial, and selective coding from the perspective of the participants.

the data is normal. Based on the obtained significance levels, it is concluded that the data for the business architecture component (strategy, industry relations, motivation, core layer, support layer, control), the information systems component (application services layer, data layer), and the

technology architecture component (infrastructure and standardization) have a normal distribution (significance level greater than 0.05).

Before conducting factor analysis, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were

examined to ensure sampling adequacy and the significance of data sufficiency. Table 2 presents the results of the first stage confirmatory factor analysis.

Table 2

Factor Loadings for First-Order Latent Variables (Observed Variables)

Sub-component	Items	Factor Loading
Application Services	Application Service	0.824
	Shared Service	0.880
	Basic Service	0.824
	Application System	0.880
	Application Interface	0.924
	Security Service	0.929
	Infrastructure Service	0.926
Data	Data Entity	0.917
	Human Data	0.799
	Financial Data	0.911
	Equipment Data	0.790
	Comprehensive and Integrated Information Source	0.919
Infrastructure	Infrastructure	0.925
	Infrastructure Equipment	0.924
	Hardware	0.933
	Software	0.801
	Communication Channels	0.884
Standardization	Infrastructure Standardization	0.871
	IT Management Type	0.890
	Network Evolution	0.962
	Informal IT Evaluation	0.835
	Application of Standard Principles	0.959
Motivation	Adherence to Standard Principles	0.901
	Motivation	0.897
	Utilization of Existing Opportunities	0.846
	Addressing Existing Threats	0.888
	Strengthening Points	0.954
Processes	Reducing Weaknesses	0.950
	Processes	0.760
	Faculty Management	0.457
	Student Management	0.853
	Other Staff Management	0.832
	Student Education	0.859
	Research	0.868
	Student Educational Content	0.842
	Activity Coordination	0.787
	Job Enrichment Plan	0.586
	Job Implementation	0.915
	Job Readiness Assessment	0.774
	Process Integration	0.804
Innovation	Innovation	1.000
Creativity	Creativity	1.000
Public Relations	Public Relations	1.000

Service Delivery	Social Services	0.787
	Cultural Affairs	0.586
	Clinical Services	0.915
	Welfare Services for Students	0.774
	Welfare Services for Faculty	0.860
Structure	Welfare Services for Staff	0.860
	Centralization	0.926
	Formalization	0.828
	Complexity	0.936
	Structure	0.933
Culture	Senior Management Beliefs	0.757
	University Environment	0.863
	Content	0.916
Support Layer	Human Resources	0.872
	Faculty Competence	0.836
	Staff Access to In-Service Training	0.908
	Faculty Access to Academic Resources	0.925
	Faculty Job Satisfaction	0.946
	Staff Job Satisfaction	0.890
	Faculty Living Standards	0.893
	Staff Living Standards	0.865
	Financial Resources	0.870
	Financial Resource Development	0.847
	Assets and Facilities	0.877
	Equipment Development	0.865
Control	Control Activities	0.880
	Goal Control	0.880
	Standards Control	0.741
	Process Control	0.881
	Indicator Control	0.922
	Communication Control	0.906

The results of [Table 2](#) show that all sub-components have a significant correlation with the components. In other words, the structural equation modeling (SEM) shows that all sub-components have significant factor loadings.

In the second-order factor analysis model, the latent variables (components) measured using observed variables

(sub-components) are influenced by a more underlying variable, a higher-level latent variable. The results of the second-order confirmatory factor analysis are presented in [Table 3](#).

Table 3

Factor Loadings for Latent Variables (Second-Order Factor Analysis)

Row	Symbol	Factor	Factor Loading
1	S110	Strategy	0.925
2	S1019	Industry Relations	0.935
3	S2024	Motivation	0.922
4	S2552	Core Layer	0.926
5	S5364	Support Layer	0.846
6	S6569	Control	0.885
7	S7076	Service	0.976
8	S7082	Data	0.946
9	S8387	Infrastructure	0.991
10	S8894	Standard	0.997

The results of the confirmatory factor analysis and the examination of the factor loadings indicate that the values of these factor loadings are all above 0.30. Therefore, there is no need to remove any of the items or re-examine the measurement model. The factor loading coefficients in Table 5 indicate high correlations, and these items effectively measure the latent variables.

In the PLS method, after fitting the measurement models, the structural model (university enterprise architecture

model) is evaluated. Unlike measurement models, where the relationships between latent variables and observed variables are the focus, the structural model examines the relationships between latent variables, analyzing the significance of coefficients (T values), the R^2 coefficient, the effect size f^2 , the Stone-Geisser Q^2 criterion, and the redundancy criterion to assess the fit of the structural model (university enterprise architecture model).

Table 4

Model Fit Statistics

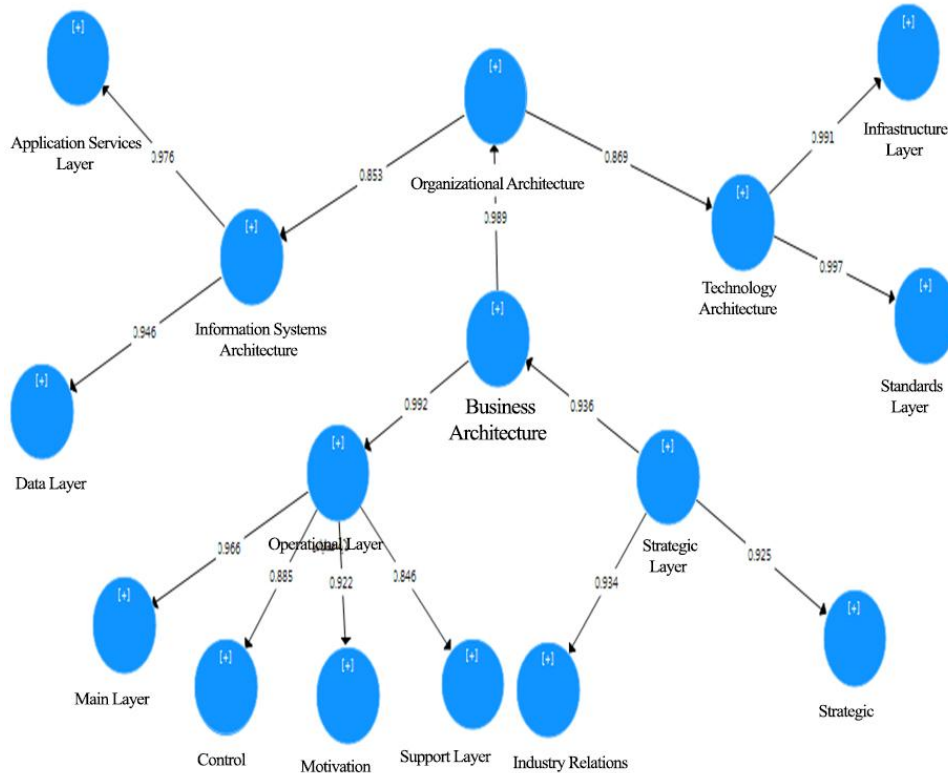
Value	Path Coefficient (B)	T Statistic	R ² Coefficient	P Values
University Enterprise Architecture	0.989	140.049	1.000	0.000
Business Architecture	0.936	19.370	1.000	0.000
Strategic Layer	1.000	38.281	1.000	0.000
Strategy	0.908	22.405	0.715	0.000
Industry Relations	0.934	36.176	0.722	0.000
Operational Layer	0.992	127.775	1.000	0.000
Motivation	0.922	19.480	0.824	0.000
Core Layer	0.966	44.693	1.000	0.000
Core Processes	0.948	32.897	0.629	0.000
Structure	0.847	11.369	0.823	0.000
Content	0.842	10.045	0.719	0.000
Social Services	0.939	22.996	0.628	0.000
Creativity	0.779	6.729	1.000	0.000
Innovation	0.573	4.689	1.000	0.000
Public Relations	0.698	2.988	1.000	0.000
Support Layer	0.885	9.988	0.781	0.000
Control	0.846	21.217	0.754	0.000
Information Systems Architecture	0.853	12.533	1.000	0.000
Application Services	0.976	112.614	0.715	0.000
Data Management	0.946	48.744	0.742	0.000
Technology Architecture	0.869	12.551	1.000	0.000
Infrastructure	0.991	277.622	0.801	0.000
Standards	0.996	460.883	0.812	0.000

The second essential criterion for assessing the fit of the university enterprise architecture model pertains to the latent variables in the model. The evaluation of the R^2 coefficient criteria is used to link the measurement section and the structural section of the structural equation modeling (SEM) and indicates the effect of an observed variable on a latent variable. The values 0.19, 0.33, and 0.67 are considered thresholds for weak, moderate, and strong R^2 values,

respectively, and higher R^2 values indicate a better fit of the model. The R^2 coefficient values are shown in Table 5 and Figure 1. Given that the R^2 value for business architecture is 1.000, for information systems architecture is 0.728, for technology architecture is 0.756, and for university enterprise architecture is 0.978, the model fit of the university enterprise architecture is confirmed.

Figure 1

Path Coefficients, Factor Loadings, and R² for Main and Sub-Layers of University Enterprise Architecture

**Table 5**

Relationships Between Architectural Layers

Pathway	Estimate	Std. Estimate	Std. Error	t-value	p-value
Business Architecture -> Academic Enterprise Architecture	0.989	0.989	0.003	289.155	0.000
Strategic Layer -> Business Architecture	0.936	0.934	0.023	40.184	0.000
Strategic Layer -> Strategic Layer	1.000	1.000	1.000	-	-
Strategic Layer -> Strategy Layer	0.908	0.912	0.021	43.728	0.000
Strategic Layer -> Industry Relations	0.934	0.937	0.013	73.422	0.000
Business Architecture -> Operational Layer	0.992	0.991	0.004	269.563	0.000
Operational Layer -> Motivation	0.922	0.921	0.023	40.624	0.000
Operational Layer -> Core Layer	0.966	0.966	0.011	88.889	0.000
Core Layer -> Core Processes	0.948	0.949	0.014	68.946	0.000
Core Layer -> Structure	0.847	0.847	0.037	22.756	0.000
Core Layer -> Content	0.842	0.846	0.041	20.340	0.000
Core Layer -> Social Services	0.939	0.935	0.020	47.911	0.000
Core Layer -> Creativity	0.779	0.780	0.059	13.254	0.000
Core Layer -> Innovation	0.573	0.576	0.097	5.895	0.000
Core Layer -> Public Relations	0.698	0.694	0.075	9.329	0.000
Operational Layer -> Control	0.885	0.888	0.021	41.781	0.000
Operational Layer -> Support Layer	0.846	0.847	0.042	20.261	0.000
Academic Enterprise Architecture -> Information Systems Architecture	0.853	0.852	0.033	25.506	0.000
Information Systems Architecture -> Services	0.976	0.977	0.004	227.577	0.000
Information Systems Architecture -> Data Management	0.946	0.949	0.010	97.010	0.000
Academic Enterprise Architecture -> Technology Architecture	0.869	0.866	0.034	25.316	0.000
Technology Architecture -> Infrastructure	0.991	0.991	0.002	556.868	0.000
Technology Architecture -> Standards	0.996	0.996	0.001	947.251	0.000

The goodness-of-fit criterion for the structural equation model in Smart PLS is evaluated using SRMR, NFI, and VIF. Unlike version 2 of this software, version 3.2 emphasizes not using the GOF criterion because its calculation requires shared values, which are not accessible in version 3.2. An SRMR value of less than 0.08 indicates a good model fit. In this model, the SRMR value is 0.023, the VIF value is 1.000, and the NFI value is 0.171; the closer the NFI value is to 1, the better.

After assessing the fit of the measurement models, the university enterprise architecture model is evaluated by examining the significance of the t-values in each path and the standardized factor loadings associated with the paths. The research hypotheses are tested. If the significance coefficient of each path exceeds 1.96, the corresponding path is significant at a 95% confidence level, and the related hypothesis is confirmed.

Table 6

Results of University Enterprise Architecture Model Testing

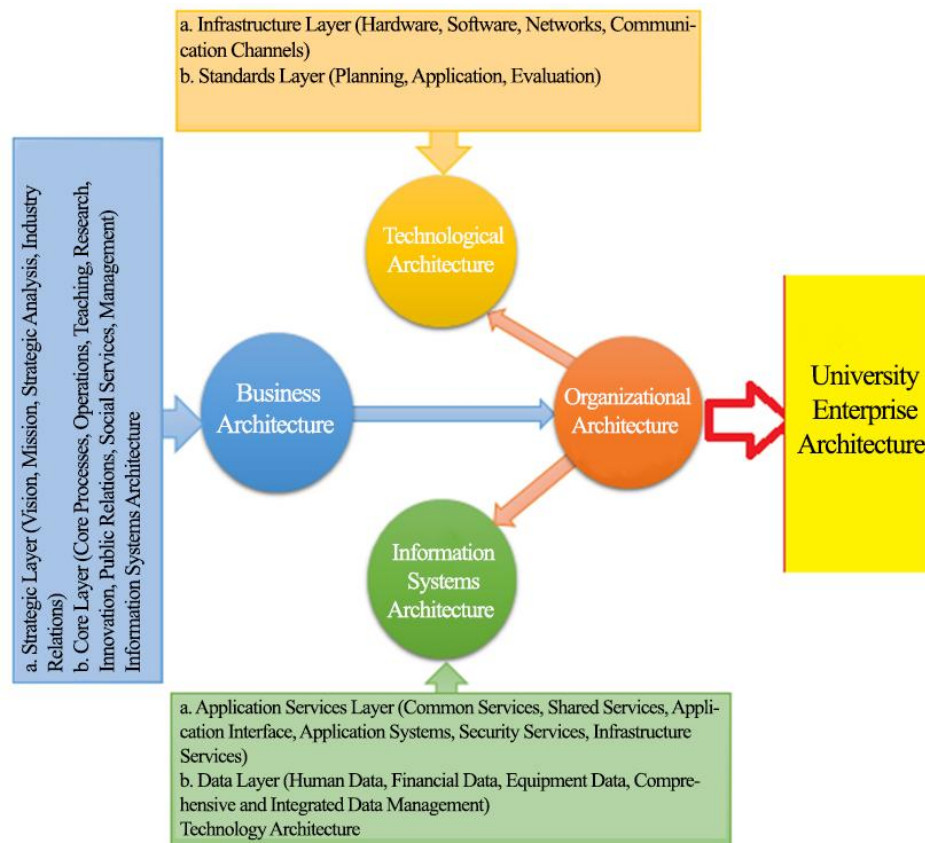
Path	Path Coefficient	T-Value	Correlation Coefficient	Hypothesis Result
University Enterprise Architecture -> Business Architecture	0.989	282.800	0.989	Confirmed
University Enterprise Architecture -> Information Systems Architecture	0.853	26.071	0.853	Confirmed
University Enterprise Architecture -> Technology Architecture	0.869	26.319	0.869	Confirmed

Based on the results in Table 6, all variables at the 95% confidence level are significant in the predicted paths between business architecture factors and university enterprise architecture, between university enterprise

architecture factors and information systems architecture, and between university enterprise architecture factors and technology architecture. Figure 2 presents the final model of the university enterprise architecture.

Figure 2

Final Model of University Enterprise Architecture



4 Discussion and Conclusion

The aim of the present study was to propose an enterprise architecture model for the Islamic Azad University, East Azerbaijan Province. The findings revealed that the primary components of the university enterprise architecture model include three main components: business architecture, information systems architecture, and technology architecture. These were identified and examined through confirmatory factor analysis. The findings of this research align with prior studies (Ahmadian et al., 2014; Appiah et al., 2020; Cunningham et al., 2022; Curaj et al., 2018; Mathews et al., 2020; Parsa et al., 2012; Ross, 2014; Verma et al., 2023; Wahju et al., 2019).

The results of the confirmatory factor analysis indicate that the university enterprise architecture consists of three main components: business architecture, information systems architecture, and technology architecture. As mentioned, each of these components has its sub-components, and the factor loadings associated with these constructs were all significantly high at a 0.5% error level. Additionally, the calculated t-values for each of the factor loadings for each indicator with its corresponding latent variable exceeded 1.96, indicating that the questionnaire items are aligned with their respective factors. The main model fit indices also demonstrated that the RMSEA and the chi-square to degrees of freedom ratio, both less than 0.08, are the most important indicators confirming the model.

According to the results, among the key components of university architecture, business architecture ranks first in priority, followed by technology architecture in second place, and information systems architecture in third place. The university enterprise architecture comprises these three main components. The results of the evaluation of the Islamic Azad University, East Azerbaijan Province, based on the proposed university enterprise architecture model, indicate that the university is in a good position in terms of technology architecture, with an average score of 3.15. In terms of business architecture, it has an average score of 2.72, and for information systems architecture, an average score of 2.85, placing it in the above-average range. It can be said that the university performs better in the technology architecture layer compared to the business architecture and information systems layers.

The limitations of the present study include the novelty of the research topic in the field of educational management and the lack of sufficient information in this area for the respondents who were graduates of this field, despite the fact

that research in management or technology fields in Iran has a history of more than two decades. Another limitation was the inability to provide adequate justification to some of the statistical samples regarding the research topic, which would have improved their responses to the distributed questionnaires, compounded by the limitations of access to all members of the research community during data collection due to the simultaneous outbreak of COVID-19.

Based on the results obtained for designing and articulating the university enterprise architecture model, the following suggestions are made: It can be said that in any business, strategy takes precedence. To implement any strategy, it is necessary to establish minimum standards, and as the work progresses, attention to application services becomes essential.

Given the significance of the three key components in the university enterprise architecture model in this study and their impact on the formation of university enterprise architecture, it is crucial for university management to consider the following aspects before designing and developing the university enterprise architecture: initially focusing on business architecture, then establishing technology architecture as the foundation, and finally achieving the desired outcome with the help of information systems architecture. In this regard, based on the results obtained, the mentioned indicators should be prioritized in management's evaluations.

Among the components, business architecture, which plays a role in shaping the university enterprise architecture model, was shown to have the highest priority in the strategic and operational layers. Therefore, it is recommended that in designing the university enterprise architecture, university management should place the business architecture of the university at the forefront of its feasibility studies and program planning to establish such a comprehensive approach.

Among the dimensions of technology architecture that play a role in shaping the university enterprise architecture model, the results indicated that the standards variable has the highest priority. Therefore, it is suggested that university management closely monitor the standards within the university. Based on the results obtained in this study, this issue has the highest priority among the two variables of the technology architecture component, namely infrastructure.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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