Cultivating excellence: a case study of enterprise architecture transformational journey in higher education

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ABSTRACT

An enterprise architecture (EA) is a critical framework that clarifies the complex elements of organizations, including business processes and technology. It coordinates the interaction of these elements to achieve predetermined business goals. Higher education institutions (HEIs) may become susceptible to rigidity, duplication, and intricate operations without a comprehensive EA. The primary aims of this study are to ascertain the necessary information for each EA domain: business, data, and application at Universiti Teknologi MARA (UiTM) and to design the landscape map viewpoint architecture for UiTM by utilizing the EA framework. This research uses qualitative methods, namely interviews and document analysis, to comprehensively comprehend the intricacies and prerequisites within every EA domain. Critical insights for each UiTM domain: business, data, application, and technology were uncovered through the discernments. From the thematic analysis, the frequency of issues according to the EA domain is business 13 issues, application eight issues, data seven issues, and technology seven issues. Following a thorough analysis, these findings led to the development of the landscape map viewpoint architecture diagram. In conclusion, the results of this research hold the potential to provide HEIs with invaluable knowledge for enhancing their organizational transformation via EA, thereby propelling the overall quality and efficacy of higher education systems forward.

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1. INTRODUCTION

Universiti Teknologi MARA (UiTM), Malaysia's largest comprehensive university, has 34 campuses, 4 colleges of study, 14 faculties, and 9 academic centers nationwide. UiTM provides nearly 500 educational programs at various levels, from Foundation to PhD, including Professional Programs, displaying a commitment to improving higher education accessibility and contributing to national growth.

Enterprise architecture (EA) defines the critical organizational parts, their information systems, how these elements work together to achieve specified business goals, and how the information systems support administrative business activities. People, business processes, technology, information, finances, and other

resources are all included [1], [2]. Organizational architecture assembles the methodologies, tools, and frameworks required to develop a unified, standardized IT architecture that supports the enterprise's business activities while taking a holistic view of the enterprise's IT resources [1], [3].

EA has acquired importance in Malaysia over the last two decades as a main endeavor that has enabled organizations to resist business disruptions. EA acts as a link between business and IT initiatives, facilitating their mutual drive. It is concerned with the enterprise's current capabilities (baseline capabilities) as well as its desired future capabilities (target capabilities) [4]. EA fully portrays the firm, including its processes and information technology, resulting in a more organized and successful alignment of business and IT. EA unifies an organization's commercial, strategic, and technological components [4].

Higher Education Institutions (HEI) currently lack a standard landscape map viewpoint architecture, necessitating expertise and knowledge in top management within the HEI sector [3]. Convincing top management at HEI of the value of an EA program will be challenging due to the absence of an immediate need [5]. The consequences of not implementing EA at HEI could be challenging due to the rigidity, redundancy, and complexity of their business and IT systems [6]-[8]. Therefore, these institutions should embrace EA as it enables more effective utilization of existing resources, skills, and competencies to attain institutional goals and navigate through changes. Thus, HEI must establish a standardized design for the landscape map viewpoint for reference [9], [10].

Using a landscape map viewpoint in EA has various advantages. For starters, it provides non-technical stakeholders, like managers, a high-level overview of the design without becoming bogged down in technical specifics [11]. Second, it aids in developing and deploying information technology and information systems consistent with the enterprise's vision and purpose [12]. Furthermore, it facilitates examining EA information from many angles, providing new use cases and analysis capabilities [13]. Finally, it enables visualizing and comprehending the IT landscape's intricate linkages and dependencies, from applications to domains [14]. Landscape maps viewpoint are key tools for understanding and managing complex systems, processes, and information within an organization in the context of EA. In essence, landscape maps with perspectives serve an important role in institutions by offering a structured and visual representation that helps strategic decision-making, collaboration, risk management, and continual architectural improvement.

EA has grown in importance in the context of higher education, providing solutions for business, data, application, and technological architecture to improve information systems and services. EA, for example, has been demonstrated to help teaching and learning in Colombian higher education, adding value to the educational process. UiTM's situation highlights the challenges in EA domains. Financial constraints and limited facility management expertise hinder ICT security in the business domain. The data domain faces system traffic and integration issues, affecting database performance. The application domain sees user satisfaction impacted by interface problems and security awareness gaps. The technology domain confronts infrastructure readiness and outdated equipment, hindering effective teaching. These challenges reveal a misalignment between UiTM's EA and operational needs, hampering digital technology utilization. To address this, a comprehensive examination and strategic realignment of UiTM's EA are crucial for achieving educational goals, thriving in the digital era, and fostering innovation and research excellence.

Therefore, this research will focus on acquiring the necessary data for each HEI domain (business, data, application, and technology, and constructing the landscape (as-is) and change (to-be) to promote knowledge, highlight the need for digital transformation in HEI, and assist HEI in minimizing overlapping change requests. A standard landscape map viewpoint will assist the organization in visualizing the operational landscape and the project impact to reduce overlapping change requests [7], [15].

2. RESEARCH METHOD

The use of qualitative research for this study was deliberate, given its ability to thoroughly scrutinize and collect reliable information from various sources. This is consistent with the landscape mapping ideas offered by Emiliussen *et al.* [16]. Furthermore, this strategy helps to alleviate ethical difficulties associated with qualitative approaches. For example, as Morgan emphasized in 2022 [17], researchers do not need to manage participant data or privacy records unless voluntarily provided for study. Consequently, employing qualitative research techniques is optimal for exploring a contemporary, unexplored phenomenon within its intricate, natural context.

This scholarly effort gathered primary data through interviews, supplemented by thorough literature study and document analysis. Employing a case study methodology, the focus is on UiTM in Shah Alam, Malaysia. As one of the country's largest universities, UiTM emphasizes technical and vocational education, standing out in Malaysia's higher education landscape. UiTM Shah Alam, the most comprehensive university in Malaysia, offers diverse academic programs across 34 campuses, four colleges, 14 faculties, and nine academic centers, from Foundation to PhD levels.

UiTM, Shah Alam is chosen as a single case study to give a concentrated and in-depth investigation of the institution's distinctive circumstances and issues. Researchers can acquire thorough information regarding digital implementation within a specific higher learning institution, in this case, UiTM, by selecting one organization [18]. This enables a complete understanding of the organization's unique features and dynamics, which can subsequently be utilized to inspire recommendations and changes tailored to that environment. Furthermore, concentrating on a single organization allows for a more manageable and viable research scope, guaranteeing that the study may be carried out effectively within the given resources and time restrictions.

This choice is based on the methodology's ability to investigate a real-world event while focusing on comprehending many stakeholders, such as students, administration, and the higher education institution itself [19]-[26]. A single case study is favored because it develops high-quality theories, provides in-depth insights into the subject, and allows for evaluating established and emergent theoretical linkages in UiTM's specific circumstances [20]. The participant profile for this study is shown in Table 1. The researchers conducted interviews with three distinct participants in this study. With over 20 years of professional experience, the first participant leads as the Head of Statistics and Analytic Data at UiTM. The second participant, a Head in the Information Systems Division, boasts nearly two decades of UiTM experience, with a dedicated 5-year focus on the division. Lastly, the third participant, an Information Technology Officer, contributes a decade of overall experience at UiTM, complemented by a concentrated 5-year commitment to their specific role.

A non-probability sampling strategy was used for this case study, with a purposive sample adopted from Hinkelmann *et al.* in 2013 [21]. These interviews explored their EA practice involvement, document usage, perceived document utility, relationships with other EA practitioners, and relevant issues. The interview questions are based on earlier research [22]-[24]. Thematic analysis was used to examine each participant's response qualitatively. The SWOT analysis was used to identify critical conclusions from the document review.

Table 1. Participant profile

Participants	P1	P2	P3
Designation	Head of statistics and analytic data	Head of information systems division	Information technology officer
Years of working	>20 years	>20 years	>10 years
Years of experience in designation	>5 years	>5 years	>5 years

3. RESULTS AND DISCUSSION

A landscape map viewpoint architecture uses four primary domains: data, business, technology, and applications. The data domain focuses on standardizing how UiTM acquires, stores, processes, and uses data. The business domain includes all UiTM activities, such as organizational units, actors, roles, processes, functions, and business services. UiTM's technological domain includes a variety of technologies, including service platforms and technology components. Finally, the applications domain includes all UiTM components, including planning, development, and maintenance procedures. A landscape map viewpoint is created through two major stages: document analysis and interviews, both of which contribute to the overall design. Table 2 summarizes the findings analyzed.

3.1. Results: to identify the required information for each EA domain in business, data, application and technology in HEI

The primary purpose of this study is to identify the information required for each EA domain in UiTM, which are business, data, application, and technology. This goal was attained by utilizing information obtained from a related paper from UiTM. Three UiTM officers were interviewed to gather additional insights supporting the document's conclusions and to understand the perspectives of upper management regarding the future of digital initiatives. Based on the TOGAF paradigm, the information is classified into four domains: business, data, application, and technology.

3.1.1. Business domain

The researchers examined the business domain in the publication *"Pelan Strategik Pendigitalan UiTM 2022-2025"* [25] and identified two important difficulties. Initially, it was identified that UiTM is grappling with financial challenges due to outsourcing, leading to elevated costs and impediments in implementing ICT initiatives. Additionally, there is a lack of expertise in EA implementation to assist in ICT

projects. Thus, it is suggested that UiTM enlist knowledgeable practitioners in the EA domain to ensure sustained effectiveness and avoid losses in ICT project implementation.

The fundamental business difficulty at UiTM is a lack of awareness among top management about the necessity and operation of EA. Some top-level executives are confused by how EA works and its benefits towards UiTM. Furthermore, the *Pejabat Pembangunan Infrastruktur dan Infostruktur (PPII)* and the *Bahagian Transformasi Universiti UiTM (BTU)* confront issues due to the complexity of administering several components involving multiple departments. Even though UiTM's primary focus is on learning and teaching, a variety of supporting business activities complicate organizational operations. Furthermore, UiTM's various systems require modifications, but there is a lack of a holistic overview to manage these changes efficiently. As modifications are frequently handled manually, recognizing the possible implications of process changes within the interrelated systems becomes difficult. PPII is associated with the primary stakeholders responsible for UiTM's applications and data, with eight separate domains including HEA, HEP, *Bendahari, Pendaftar*, ICAN, *Penyelidikan dan Inovasi* (PI), Library, and *Jabatan Korporat* (JK). Each of these fields has its own set of applications and data, which are monitored by PPII. Furthermore, BTU oversees managing the development of EA and is critical in supplying data to UiTM. Currently, BTU thoroughly evaluates data before its exposure to the external environment.

Five keywords appeared with varied degrees of frequency. During interviews, "lack of understanding" was noted once, while "not having a big picture," "too many components," "stakeholder request," and "financial constraints" each emerged three times. These terms were mentioned 13 times in total, demonstrating the predominance of business-related difficulties in comparison to other architectural disciplines.

Table 2. Findings to develop the landscape map viewpoint

Themes	Issues	Source		Frequency	Total
		Interview	Document		
Business	Lack of understanding	1	0	1	13
	Do not have the big picture	2	1	3	
	To many components	3	0	3	
	Stakeholder request	2	1	3	
	Financial Constraint	0	3	3	
Data	Integration of data	2	1	3	7
	Feels ownership towards data	3	0	3	
	High traffic	0	1	1	
Application	The interface is not user-friendly	0	1	1	8
	Low awareness	0	1	1	
	Core application	3	0	3	
	Support Application	3	0	3	
Technology	Lack of expertise	0	2	2	7
	Systems work in silos	1	0	1	
	Framework being used	1	0	1	
	Infrastructure readiness	0	1	1	
	Limited Wi-Fi coverage	0	1	1	
	Outdated equipment	0	1	1	

3.1.2. Data domain

Based on a review of a document yielded two significant keywords. First, there is an issue with heavy traffic within UiTM's systems, especially during the course registration process, when a large number of students access the same websites at the same time. The high volume of traffic has a negative influence on database performance and overall system responsiveness. Second is the data integration issues. With so many systems in place, the ICT department is having difficulty properly integrating data across them. Because precise mapping of data is necessary during the process, this integration problem leads to erroneous data consolidation.

Participants highlight the difficulties of integrating data mapping due to the interconnectedness of systems across multiple departments. Ownership disputes arise when many domains assert ownership over data that rightfully belongs to UiTM. These challenges hinder the PPII department's efforts to achieve data architecture. Individuals are more comfortable with existing systems, making the data mapping process more complex. Three keywords were discovered in this domain. "Integration of data" was referenced three times during interviews, "feels ownership towards data" was mentioned three times, and "high traffic in UiTM" was discovered once during document analysis. The total frequency of all data-related keywords was seven, which was comparable to the frequency in the technological domain architecture.

3.1.3. Application domain

Based on the review of the *'Pelan Strategik Pendigitalan UiTM 2022-2025"* document, researchers found numerous keywords relevant to the application domain. The first keyword refers to the lack of user-friendliness in the system's interface, which leads to user discontent and aversion to using the system extensively. Second, the complexity of the application components in UiTM presents difficulties for the IT department when making changes to the existing system. Finally, the document analysis demonstrated that UiTM users had a low degree of understanding of ICT security, resulting in ignorance of ICT security issues. These keywords emphasize major issues in the application domain at UiTM.

Participants describe the numerous applications used inside the UiTM. UiTM is divided into eight major sections, each with its own set of applications and data. SIMS and NILAMS are used by HEA and HEP, respectively, for student profiles and details. *Bendahari* uses FAIS for financial and auditing purposes, but *Pendaftar* uses STARS and HR2U for staff and human resource data. To manage research and innovation data, PI uses PRIME and IRES, whereas the library domain uses three primary applications: Executive System, Inventory System, and UiTM Institutional Portal. JK also employs SMART to manage general data acquired from social media and newspapers.

Participants also differentiate between core and support applications within UiTM, with core applications directly related to the institution's primary functions, such as teaching, research, commercialization, leadership, entrepreneurship, and industry networks, and support applications handling university governance, financial management, human resources, and infrastructure and infostructure management, all of which serve as critical support functions for UiTM's operations. The application domain has a total of eight keywords with a frequency of occurrence. Each of the phrases "interface is not user-friendly" and "low awareness" appeared once. The terms "core application" and "support application" were mentioned three times in interview sessions. In document analysis, the terms "user-friendly" and "low awareness" were discovered.

3.1.4. Technology domain

In the document, the researcher identified critical infrastructure readiness challenges. The first keyword emphasizes the need for infrastructural preparation for effective teaching and learning at UiTM. According to the statement, UiTM is actively trying to improve infrastructure readiness across its campuses. The second keyword refers to UiTM's limited Wi-Fi coverage, which is essential for facilitating the teaching and learning process. These terms emphasize the significance of UiTM's infrastructure improvement and modernization efforts in efficiently supporting its educational activities.

Participants address problems related to the technical components in the interview excerpts pertaining to the Technology Domain at UiTM. While establishing infrastructure is a vital activity, not all technical personnel are competent in managing infrastructure based on EA. Another issue raised is regarding systems operating in isolation (silos), which complicates data and information gathering for the PPII department, particularly regarding the four main components: business, data, application, and technology. Participants also discuss the use of technology in UiTM for database management. The majority of UiTM's technology is open-source, and in-house development is common, with system construction dependent on the knowledge of the responsible teams, owing in part to a lack of standardization within the IT Department.

This domain contained six recognized keywords, each with a different frequency. During document analysis, the phrase "lack of expertise" was discovered twice. "System work in silos" and "framework" were both mentioned once. Like the frequency in the data domain architecture, the total frequency for all technology-related keywords was seven.

From the above findings, the researcher used the open group architecture framework (TOGAF framework) and three fundamental phases to create the landscape map viewpoint: Business Architecture, Information Systems Architecture, and Technology Architecture. These phases were used to address the highlighted concerns fully within the relevant architectural domains and to provide a holistic perspective for further analysis and strategic planning.

3.2. Results: To develop the landscape map viewpoint architecture using the EA approach for HEI

The information gleaned from document analysis and interviews is transcribed. From phase B to phase D, the researchers performed a gap analysis for each domain to develop the landscape map perspective architecture for UiTM, driven by the TOGAF framework depicted in Figure 1.

3.3. Development of landscape map viewpoint architecture

This design was meticulously developed using the TOGAF methodology and encompasses four major domains: business, application, data, and technology. Based on extensive interviews and document analysis, the service platform considers mobile applications, email, social media, and web-based platforms as

critical tools. Staff, management, students, and lecturers are among the service users who are divided into stakeholders (entities that control and use the systems) and users (individuals who input data into the systems). Internal and external users are the two types of stakeholders. Figure 2 illustrates the comprehensive organizational landscape map viewpoint architecture for UiTM.
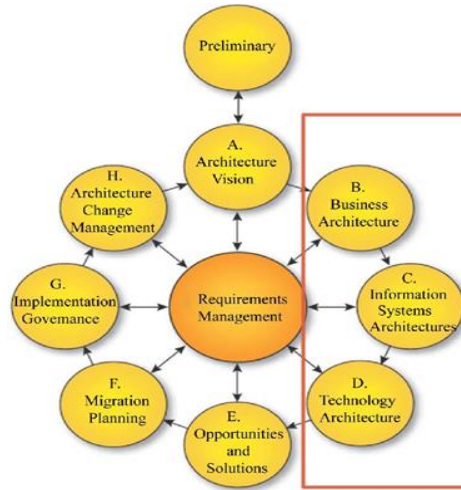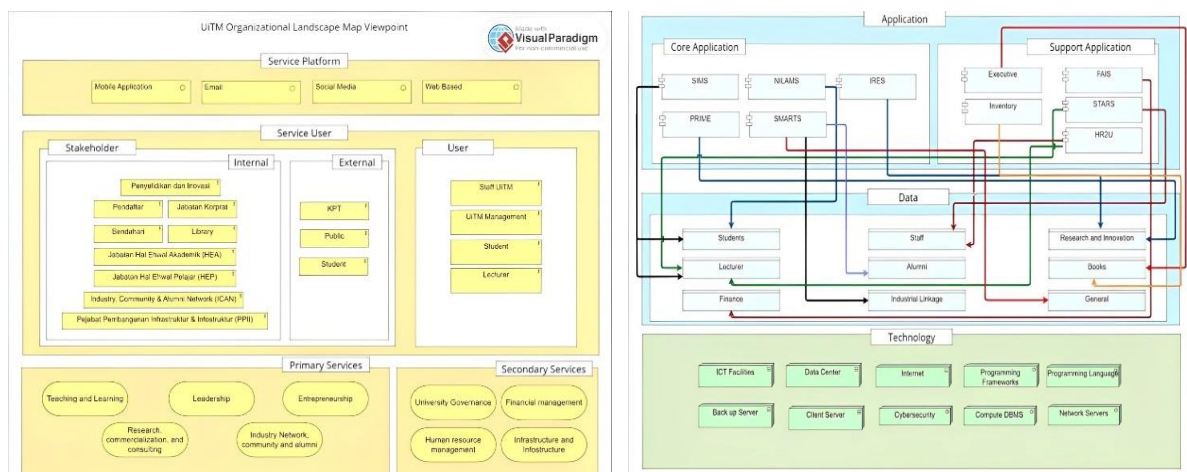

Figure 1. TOGAF Framework

Figure 2. Landscape map viewpoint architecture

The business domain is divided into two parts: primary services (core services like teaching and learning, leadership, and so on) and secondary services (support services). The application domain differentiates between core and support applications, with a set of applications corresponding to specific databases in the data domain. Backup servers, data centers, and cybersecurity procedures are all part of the technology domain. The color-coded framework provides a thorough overview of the organizational landscape at UiTM, providing useful insights for future study and development.

4. CONCLUSION

The research successfully achieved its objectives of identifying essential information for each EA domain: business, data, application, and technology at UiTM through a thorough process of document analysis and interviews, which was supported using the TOGAF framework. The study included a comprehensive assessment of papers as well as interviews with three officers from UiTM, acquiring a deeper understanding and insights into upper management's viewpoints on digital efforts. The acquired data was rigorously classified into the four EA domains, and a thematic analysis was performed to identify gaps within each area.

Despite its extensive approach, the study had some drawbacks. Time limits were a considerable challenge, impeding complete data analysis. The gap analysis approach, guided by the TOGAF paradigm, resulted in the construction of UiTM's landscape map viewpoint architecture. In the future, the authors propose that future studies should include UiTM experts to verify the landscape map viewpoint. Furthermore, it is suggested that the landscape map be aligned with the EA framework when it has been developed. The architecture's continuous improvement will ensure its continued relevance and utility, leading to future advantages.

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