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Advantages of TOGAF as a Common Frameworks for Higher Education Institution

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ABSTRACT

Implementation of Enterprise Architecture in Higher Education Institutions (HEI) has become an essential and priority concern due to competitiveness, process complexity, and stakeholder challenges. There are several EA frameworks that available and commonly used. For higher education institution choosing right frameworks are an essential step. TOGAF is one of EA frameworks widely used by HEI. We were trying to identify some advantages of TOGAF from different literature.

Key words: Enterprise Architecture, TOGAF, Higher Education Institution, Advantages.

1. INTRODUCTION

In the era of Industry 4.0, information technology (IT) and information system (IS) play a crucial role in making organizations more effective and efficient. Enterprise Architecture (EA) describes an organization from an integrated business and IT perspective [1]. EA adoption in higher education institution (HEI) has vital implications for the entities, especially to controls that apply the vision and strategy of the institution by making the necessary changes to align the business objectives and actions of the organization with the information technology (applications, data, technology infrastructure) used to achieve this vision [2].

Several EA frameworks are commonly used in different organizations: Zachman, TOGAF (The Open Group Architecture Framework), IAF (Integrated Architecture Framework), and FEAF (Federal Enterprise Architecture Framework. TOGAF & Zachman are frameworks that are common used in HEI EA. One research conducted by [3] showing date 89% of Higher Education Institutions (HEI) using TOGAF frameworks to some extent. This paper will explore some advantages of TOGAF framework implementation in higher education institutions.

2.3. TOGAF Overview

The Open Group Architecture Framework (TOGAF) originated as a generic framework and methodology for the development of technical architectures but evolved into an enterprise architecture framework and method. TOGAF has the following main components [6]:

1. An Architecture Capability Framework addresses the organization, processes, skills, roles, and responsibilities required to establish and operate an architecture function within an enterprise.
2. The Architecture Content Framework, which considers an overall enterprise architecture as composed of four closely interrelated architectures [7]: Business Architecture, Data Architecture, Application Architecture, and Technology (IT) Architecture.
3. The Enterprise Continuum comprises various reference models, such as the Technical Reference Model, The Open Group's Standards Information Base (SIB), and The Building Blocks Information Base (BBIB).
4. The Architecture Development Method (ADM), which is considered the core of TOGAF, cyclic approach for developing the overall enterprise architecture.

2. LITERATURE REVIEWS

To explore relevant advantages of TOGAF Frameworks for HEI Enterprise Architecture, we would like to explore in general what and how TOGAF Frameworks work.

2.1. Enterprise Architecture

Enterprise architecture is a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems, and infrastructure [4]. Enterprise Architecture is a management and technology practice that is devoted to improving the performance of enterprises by enabling them to see themselves in terms of a holistic and integrated view of their strategic direction, business practices, information flows, and technology resources [5].

2.2. Enterprise Architecture for Higher Education Institution

According to [2] there are three vital implications for the HEI: Firstly, EA provides a coherent platform to manage and operate fragmented organizational processes to improve overall efficiency. Secondly, EA leads to creating data and analysis of information that can be used to make strategic decisions for higher education institutions. Thirdly, EA provides higher education institutions (HEI) with reliable infrastructure and technology to sustain learning and meet diverse educational needs.

3. RESEARCH METHOD

To identify the advantages of TOGAF Frameworks for HEI, we explore and review some related papers that focus on using TOGAF Frameworks in planning, designing, and mapping

Enterprise Architecture related to Higher Education Institution.

3.1. TOGAF ADM

The TOGAF ADM refers to processes that can be divided into different sections and phases as listed and shown in the figure below [8]:

- Architecture Context Preliminary Phase
  - Phase A: Architecture Vision
- Architecture Development
  - Phase B: Business Architecture
  - Phase C: Information Systems Architecture
  - Phase D: Technology Architecture
- Transition Plan
  - Phase E: Opportunities and Solutions
  - Phase F: Migration Planning
- Architecture Governance
  - Phase G: Implementation Governance
  - Phase H: Architecture Change Management
- Requirements Management.

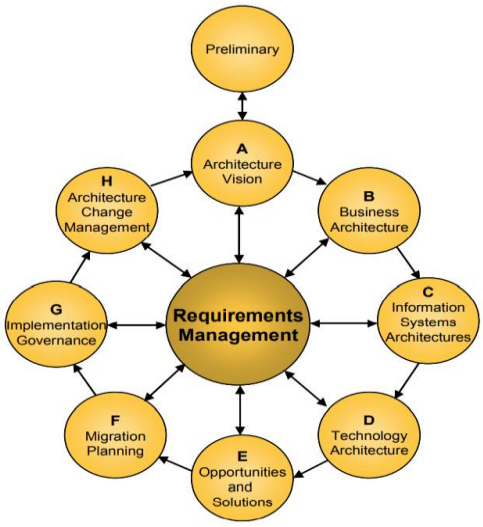

Figure 1. Here are the sections and phases in TOGAF ADM.

3.2. Applying TOGAF ADM.

TOGAF provides a very detailed method of how to manage enterprise architecture and information systems called the architecture development method (ADM). ADM or TOGAF architecture development method that provides a test process and can be repeated to develop architecture.

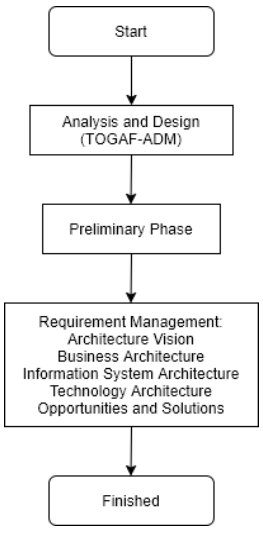

Figure 2. TOGAF Flow Chart.

Figure 2 shows the steps in applying TOGAF framework as follow:

- Analysis and design (TOGAF-ADM), comprises of preparing required documentation. It can be done examining existing problems.
- Preliminary phase, addresses preparing all required resources. Preliminary phase ensures all parties within organization are ready to apply TOGAF steps.
- Phase to elaborate in the article such as: requirement management, architecture vision, business architecture, information system architecture and technology architecture, and exploring more solution and opportunity for improvement. The article examines these urgent problems to be highlighted.
- The migration planning, implementation governance and architecture change management are not discussed in here. They will be used for further step execution.

3.3. TOGAF in Higher Education Institution (EA)

TOGAF is one of the common EA Frameworks used in Higher Education Institution [9]. According to the research conducted by TOGAF is an appropriate EA framework for implementation in higher education institutions [8].

3.4. Industry 4.0 Elements in Higher Education Institution

For HEI, industrial elements 4.0 has a crucial role, especially in responding to the development of the current needs for learning methods. Future learning is possible to utilize Industry 4.0 elements, or we can call education 4.0. E-learning refers to a teaching method using electronic media, especially a web system, which enables interactive long-distance learning without any time and place limitation [5]. One of the Industry 4.0 elements applicable to combine with E-Learning is IoT, as illustrated by [10] in the figure below.

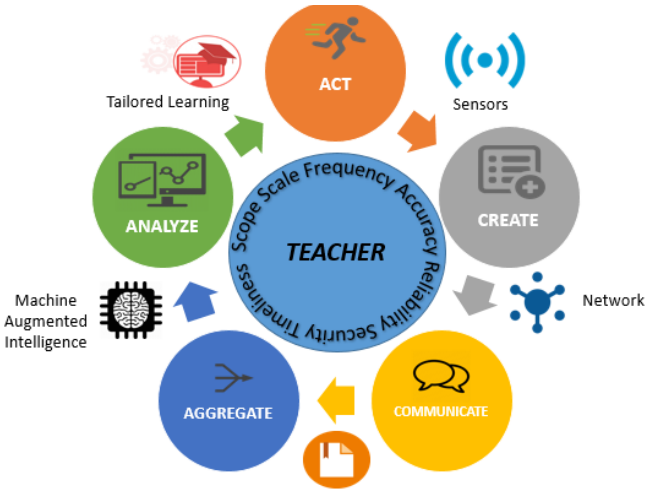

Figure 3. Learning Life Cycle in IoT Enabled Classroom.

The Figure 3 shows the learning life cycle in applying IoT enabled classroom that comprises of:

- Teacher. Teacher plays essential roles to manage entire learning process starting creating materials, disseminating materials through computer networks, establish interactive communication, gathering all inputs, analyse the process and summarise the

findings. These findings will be later to be used for further materials and learning process improvement.

- Aggregate. Aggregate is the process to collect information from all sensor devices (IoT), such as: camera and other recording devices.
- Machine augmented intelligence applications, helps teacher and students to explore more on the materials. The output of augmented application is recorded and to be used for further analysis.

4. ANALYSIS

4.1. TOGAF ADM Design in HEI.

Initial research conducted by [6] found that TOGAF characteristics are 'reasoned', neutral, have a scalable approach, and can integrate with different systems (adapt-able). Based on the System Development Cycle comparison conducted by [11], TOGAF only covers phase Analysis, Design & Implementation when TOGAF has principles that support decision-making across the enterprise; provide guidance of IT resources; support architecture principles for design and implementation.

Moreover, research conducted by [2] explains that TOGAF ADM is the correct basis for defining HEI Methodology that more relevant to achieve HEI EA goals:

1. The first goal is the definition of the scope and requirements of the university programs, whereby it will ensure that all the stakeholders involved in the implementation of the system are well versed in what the systems aim at doing as well as the regulatory and requirements.
2. The second goal is to help the institution to have a smooth and effective EA implementation in which they will be able to align their organizational mission, goals, and objectives towards the framework. This ensures that they are well within the set future plans as well as giving them a competitive advantage over their competitors.
3. The final goal is to help in the efficient utilization of the enterprise architecture that will promote and build the capability rate of the institutions.

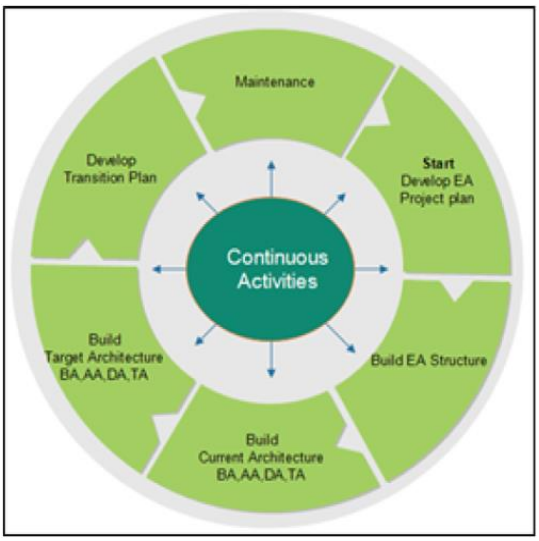

Figure 4. HEI Methodology.

This methodology consist of 7 stages:

1. **Develop EA Project Plan**: This stage is tailored in a manner through which the critical activities in the enterprise architecture are described effectively while obtaining the required permission for resources needed to develop the project.
2. **Build EA Structure**: This stage involves the construction of vital pillars from the HEI methodology, such as the principles, goals, mission, and vision which are needed in the project.
3. **Build Current Architectures**: The approval and establishment of the EA structure are followed by capturing the existent institution architectures in a bid to ensure that they are well-versed in both the informational and business landscapes.
4. **Building Target Archives**: The analysis of the current existent architectures of the institution is followed by the development of the target architectures needed in order to improve the business and information technology facets.
5. **Develop Transition Plan**: The transition plan is used to offer the definition and prioritization of any transitional projects, systems, and activities that will help implement the future state of the required architectures.
6. **Maintenance:** The final stage involves the organization executing and maintaining its enterprise architecture.
7. **Continuous Activities** (applicable during all stages): Owing to the fact that the systems are normally set to run in the long-term, they are bound to be faced by a number of issues.

TOGAF also become a major platform of Education Enterprise Architecture (EEA) by the US Department of Education. EEA has some benefits [12]:

- More effective change management
- More planning for sustainability
- More efficient IT operations
- Better return on investment
- Faster, simpler, and cheaper procurement

TOGAF also applicable with European Interoperability Frameworks (EIF) when the use of TOGAF was largely encouraged among the institutions because of its alignment with sector needs for open-sourced interoperability models and frameworks [13]. TOGAF ADM is an agile solution in developing this type of complex architecture[14].

In general, there are direct and indirect advantages of TOGAF. Direct advantages are:

- Good understanding of how to integrate architecture development with (IT) strategic planning, business strategies, solution design, IT development, implementation, and program/ project management through the use of the ADM
- Good understanding of how to integrate architecture governance with IT governance (government framework in TOGAF)
- The two reference models provide a reasonable contextual basis for structuring and populating an enterprise-specific model

- It offers numerous checklists which support IT governance in general and architecture governance in particular. Techniques and artifacts that can be adapted to meet IT and architecture needs

Indirect Advantages Enabled by Applying EA or TOGAF:

- Reduced IT operating costs
- More efficient IT operation
- Increased portability of applications
- Improved interoperability

The TOGAF Architecture Development Method (ADM) provides a tested and repeatable process for developing architectures. The ADM includes establishing an architecture framework, developing architecture content, transitioning, and governing the realization of architectures.

4.2. TOGAF and IoT

According to [15], considering the form of development of the TOGAF architectures with the general standard of the IoT architectures, it is possible to emphasize that the IoT can be developed within the TOGAF structure mainly in the application phase of the technologies since it represents the implementation stages of technology. However, the complexity of the TOGAF architectures and the different line of action of its layers differs from the very objective process. The TOGAF context guides and creates an order but does not highlight essential points of development. The implementation of IoT solutions could benefit from the structural rigor of the TOGAF standard, as they would allow the development of solutions that look at the company as a whole and align with business objectives and enable data exchange and interoperability with other systems.

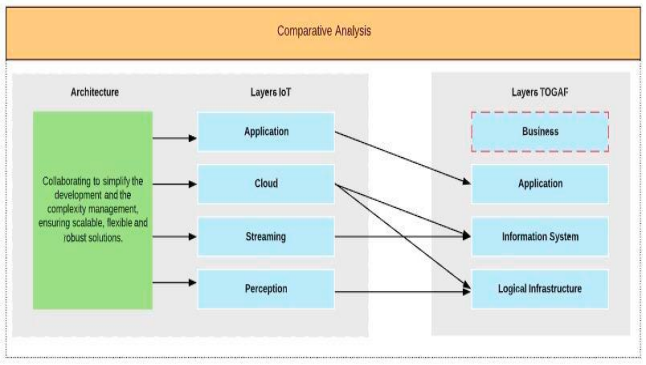

Figure 5. Correlation of IoT and TOGAF layers.

Figure 5 maps the architecture and IoT layers into TOGAF layers. According to [16] IoT Layer consists of the following:

1. IoT Operations: A collection of capabilities and systems for provisioning, management, and monitoring
2. Platform Layer: A collection of information management/analytics and enterprise integration capabilities that can capture and process events and generate insights
3. Network Layer: Connects sensors, actuators, controllers, and gateways with Platform Layer capabilities
4. Control and Sensing Layer: A collection of capabilities to read sensor data, apply necessary rules/logic, and deliver data and control signals to actuators
5. Physical Devices Layer: A collection of physical systems such as smart sensors, devices, and machines.

The following diagram illustrates where IoT fits in an enterprise ecosystem.

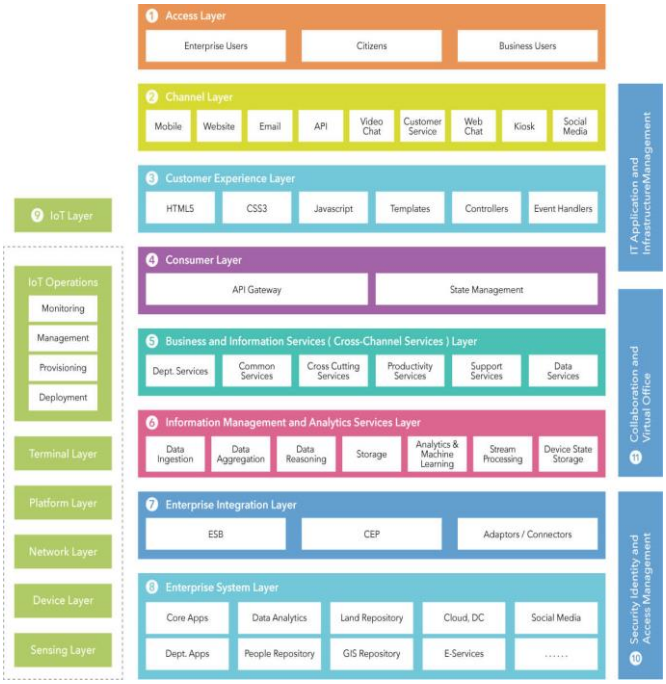

Figure 6. IoT in EA layer.

Figure 6 shows the mapping of IoT in EA layer will address the following layer such as:

- Access layer, serves end user.
- Channel layer, refers to medium for access layer.
- Customer experience layer.
- Consumer layer, refers to connectivity and process handling.
- Business and information services layer, serves business units.
- Information management and analytics service layer.
- Enterprise integration layer.
- Enterprise system layer, comprises essential applications.

5. CONCLUSION

According to some literature reviews, TOGAF has some advantages and relevant benefits for Higher Education Institution Enterprise Architecture. In the context of Industry 4.0, TOGAF also has the flexibility to integrated with Industry 4.0 elements since TOGAF Framework also expanded to accommodate IoT adoption. Further research to identify systematically and structured are required.

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