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Towards a Framework for a Unified Enterprise Architecture

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***Abstract*—Researches in information systems on enterprise architecture framework have become increasingly intricate. Evolving strategies, new products, new processes and new technologies are what we experience continually. Therefore, the need to exhibit that an organization has a comprehensive governance plan in place has become a vital success factor. In this article, we substantiate on Zachman architecture framework which is considered to be ontology in information systems research. Our argument is base on reviews of enterprise architecture frameworks such as EAFIT, TOGAF, FEAF, and DoDAF. Each framework prescribes a specific methodology that addresses business requirements, information flow and technical infrastructure and in addition each framework also has developed in practice. This suggests the future potential to move towards a unified enterprise architecture framework.**

Index Terms— **Zachman Architecture Framework, Ontology, Unified Enterprise Architecture Framework, Business needs**.

I. INTRODUCTION

Globalization, competition, fear of survival coupled with advances in information systems has led organizations to adopt a more efficient and effective ways in their business operations. In order to achieve this feat and ultimately improve business processes, interoperability of information systems enterprise architecture (EA) framework can be relied on to achieve effectiveness and efficiency in the business environment at larger society. The phrase, enterprise architecture has its origin more than a decade an half ago. EA is the principle of management of information systems in organizations [31][10]. As [28] pointed out that enterprise architecture is the value that extensively influences the significance of the enterprise. He added that EA defines the structure of the enterprise in terms of its structure and form, which dictates the capabilities of the enterprise and its behavior.

[31] following Zachman framework for information systems architecture introduced in 1987, other enterprise architecture framework has since been introduced. Few of the enterprise architecture framework are: The Open Group Architecture Framework (TOGAF), the Department of Defense Architecture Framework (DoDAF), the Federal Enterprise Architecture Framework (FEAF), the CIM Open System Architecture (CIMOSA), Enterprise Architecture Framework for a Common IT (EAFIT) [12][18].

The shortcomings of the existing frameworks are as stated: (a) the existing inflexibility of the requirements of IT in relations to business change, (b) the incapability of multiple approach usage in the existing frameworks, and (c) existing boundary prevent future IT requirements from the business needs. [30] all the EA frameworks differ in content and target audience, TOGAF details the process of creating EA with less emphasis on actual modeling, DoDAF emphasizes models and metamodels. All of the existing EA compromise on the proper gaps and content of EA frameworks.

This paper proposes the Unified Enterprise Framework (UEF) based on the premise of the literatures and the shortcoming of the previous enterprise architecture framework such as TOGAF, DoDAF, FEAF and CIMOSA. The UEF can be functionally effective in the situations to be discussed. Foremost, UEF architecture considers implementation requirement beyond what is required at present. Secondly, UEF encompasses requirements and can accommodate any IT projects implementation requirements. Thirdly, for the purpose of academic environment, the contribution is a step towards an idea which can be a baseline towards achieving unified idea for a framework. When UEF architecture is fully adopted, enterprise tends to acquire many benefits, such as reduction of cycle time, faster response to customers, better financial management, skeleton for e-commerce, link organization function seamlessly, and making tacit knowledge explicit [32][1][27].

Section II of this paper describes related works on framework, while Section III presents the Unified Enterprise Architecture Framework, UEF and the conclusion is drawn in Section IV.

II. RELATED WORK

A. Enterprise Architecture Frameworks (EAFIT)

The prominent work that is related to identifying components of enterprise architecture frameworks is an enterprise architecture framework based on a common information technology domain (EAFIT) [18] for improving interoperability among heterogeneous information systems. EAFIT was created to resolve weakness on Zachman framework, C4ISR AF, FEAF and SBA [18]. However, the ability to unify and integrate the business processes across the Final Stage enterprise is lacking in EAFIT and also the adaptability and dynamic capability of this framework is of apprehension.

B. Zachman Architecture Framework

John Zachman presented an enterprise architecture framework in 1987 which consists of six columns, various views, and five rows. The Zachman enterprise architecture framework [31][2][5] is today recognized as ontology. The framework presents the perspectives

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of: planner, owner, designer, builder, and sub-contractor. The attributes of this framework is the 5W1H [18] which stand to question the 5w's and H, i.e what, where, who, when, why and how?

The framework advantage is that it provides clarity to a complex enterprise. It is in addition a model that describes enterprise business requirements in IT. The disadvantages come from the fact that there is no procedure in the application of the architectural framework. Also, the framework is too idealistic which makes it difficult to define a product base on this framework.

C. Federal Enterprise Architecture Framework (FEAF)

The Federal Enterprise Architecture Framework (FEAF) was introduced in 1998 by the Chief Information Office (CIO) consortium. FEAF provides guidance for enterprise integration (EI) information technology to the United States government. The architecture framework prioritize certain architectural segments while it also provides mechanism for identification, development, and documentation [31][18]. In addition, FEAF advantage is that it standardizes the organization's mission and vision, which makes it better to enhance effectiveness. The drawback of this framework is that it has no template or products for development.

D. The Open Group Framework (TOGAF)

The Open Group Framework (TOGAF), developed by the Architecture Forum in the mid-1990 and its first version was presented in 1995 based on the Technical Architecture Framework for Information Management (TAFIM). TOGAF provides a comprehensive approach for designing, planning, implementing and governing enterprise information architecture [21][22]. It has a holistic approach to design, modeled at business, application, data, and technology; however, it depends on modularization, standardization and already existing technologies.

E. Department Of Defence Architecture Framework (DoDAF)

The Department of Defence Architecture Framework (DoDAF) first version was developed in the 1990s as C4ISR (Command, Control, Communications, Computers, and Intelligence, Surveillance, and Reconnaissance) architecture framework. This framework can be classified as descriptive framework [25] that act as mechanisms for visualizing, understanding, and assimilating the scope and complexities of an architecture. On the other hand, it is only suitable for large scale systems. It specifically detail external operating domain for customers to operate.

III. UNIFIED ENTERPRISE ARCHITECTURE FRAMEWORK (UEF)

Adopting Zachman's framework [17][14] provides taxonomy for relating the concepts that describe the real world system and its implementation.

This section introduces the unified enterprise architecture framework. The framework resolves the weaknesses in the prevailing architecture framework. The framework relies on the Zachman framework, based on the fact that it is now ontology for enterprise architecture framework modeling [24][19].

The understanding and use of Zachman framework [25] is essential in an increasingly dynamic and uncertain business environment for the following reasons: (1) The process of modeling social-technical systems or an ontology such as an unified architecture framework helps in identifying and understanding the relevant elements in a specific domain and the relationships between them [24][19]. (2) The use of formalized Zachman enterprise architecture framework (i.e. ontology) helps managers to communicate easily and share their understanding of an e-business among other stakeholders [6]. (3) Mapping and using enterprise architecture as a foundation for discussion that facilitates change. Business enterprise architect can easily modify certain elements of this enterprise architecture framework. (4) Unified enterprise architecture can help in identifying the relevant measures to follow in the business change process [8]. (5) Enterprise architecture framework can help managers simulate business rule, change management and capability to learn about them. This is a way to execute risk free experiments without endangering an organization [16].

The unified enterprise architecture framework is matrix modeled architecture; *n*-by-*m* matrix is composed of *n* rows which represent perspectives and *m* columns which represents views. The perspective in this context comprise of the enterprise, system, implementer and the hardware [17][14] and the views are data, function, organization, and infrastructure. The requirement entries in the row are represented by *x* rows, and the entries for the column are represented by *y* columns which is denoted by *aij*. The relationship between figure 1 and the matrix shown below are *a11, a12, . . . , a1m* represents the horizontal integration and *a11, a21 . . . an1* represents the vertical integration of enterprise requirements [18]. The matrix shows the extent which enterprise requirements can be constructed to achieve the goal of UEF and the business.

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nm} \end{pmatrix}_{n \times m} = \left(a_{ij}\right)_{n \times m} \quad (1)$$

The Unified Enterprise Architecture (UEF) enables various enterprise elements to understand detailed structure and components of the enterprise and how they work together. [30] asserts six common values of the Enterprise Architecture as follows: (1) readily available documentation of the enterprise, (2) ability to unify and integrate the business processes across the enterprise, (3) ability to unify and integrate data across the enterprise and to link with external partners, (4) increased agility by lowering the complexity barrier, (5) reduced solution delivery time and development costs by maximizing reuse of enterprise model, (6) ability to create and maintain a common vision of the future shared by both the business and IT communities, driving continuous business/IT alignment.

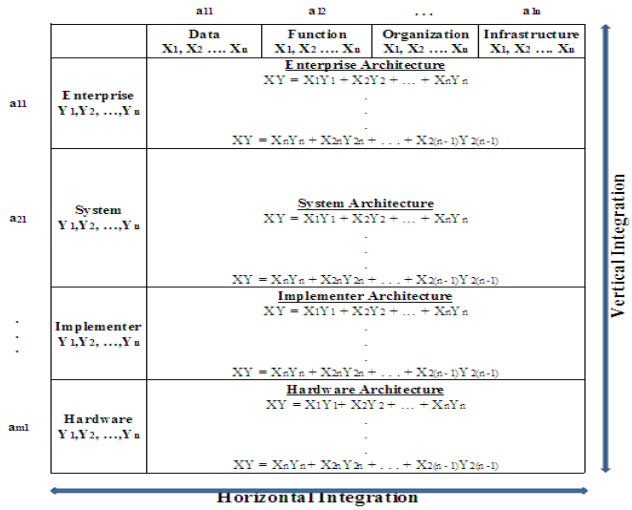

Fig. 1. Unified enterprise architecture framework

The UEF accommodates for the present requirement and future requirement for the enterprise; the architecture examines requirements based on the enterprise, system, implementer, and hardware requirements. This is similar to the EAFIT architecture [18], but differs in the accommodation for on-going enterprise requirements to develop the information system. The desired integration of people, strategies, processes, methods, models, and tools could be accomplished according to [23], through a central system model that define capturing all system requirements and decisions that fulfill them at different levels of abstraction.

A. Adaptability of UEF

[13] on adaptability examines the developers and user's views that systems hold high hopes for their potential to change traditional organizational design, intelligence, and decision-making for the better, but they raise the following questions on what these systems actually bring to the workplace? What technology impacts should we anticipate? and how can we interpret the changes that we observe? The nature of adaptability of UEF for studying variations in enterprise change that occur as advanced technologies are used [13].
When we have *X1, X2, ... Xn and Y1, Y2, ..., Yn* for *m* rows and *n* column.

Then we have $XY = X1Y1 + X2Y2 + \ldots + XnYn$

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$$XY = XnYn + X2nY2n + \ldots X2(n-1)Y2(n-1) \quad (2)$$

For data, function, organization and infrastructure based on the enterprise, system, implementer and hardware requirement that can accommodate for change both for present and long term requirements.

B. The Dynamic Capability of UEF on Enterprise

[31] define dynamic capability as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Dynamic connotes change [29] contrast with ordinary capabilities concerned with change Dynamic capabilities govern the rate of change of ordinary capabilities. [29] added from a logical point of view, the "existence" of higher order rates of change is in question only in the mathematical sense that some derivatives might not exist; and from a computational point of view, a time sequence of n+1and m+1 values of a variable suffices to compute one value of the nth and mth order rate of change.

There really is not a whole lot to this other than to just make sure that we can deal with calculus of the matrices. For the purpose of this study only matrix with numbers as entries have been considered, but the entries in a matrix can be functions as well. So we can consider matrices in the following form,

$$A(t) = \begin{pmatrix} a_{11}(t) & a_{12}(t) & \cdots & a_{1n}(t) \\ a_{21}(t) & a_{22}(t) & \cdots & a_{2n}(t) \\ \vdots & \vdots & & \vdots \\ a_{m1}(t) & a_{m2}(t) & \cdots & a_{mn}(t) \end{pmatrix} \quad (3)$$

This should be organized for integration of IT management based on the vertical and horizontal integration and interoperability between information technology systems. The relationship between figure 1 and the matrix shown below are *a11(t), a12(t), . . . , a1n(t)* represents the horizontal integration and *a11(t), a21(t) . . . am1(t)* represents the vertical integration of enterprise requirements change with time [18].

C. Change in Technology And Absorptive Capacity Of UEF

Changes in technology bring about new possibilities in the business environments. Since information technology technical solutions are not static; organizations are faced with continual change hardware, software, and networking standards. As new software becomes available, hardware must be replaced to meet the minimum requirement of the software [16]. As this phase of change occurs in technology, firm's innovation performance, aspiration level, and organizational learning according to [4] that in order to be innovative an organization should develop its absorptive capacity. The change in technology forces shift in the scope of technology implementation, the unified enterprise architecture should create an avenue for this change to be accommodated [11].

I. CONCLUSION

This paper explored enterprise architecture framework with the view to propose unified enterprise architecture whose significance is to address the requirements of IT resources in the rapid changing business and IT environments. Changes in technology bring about new possibilities in the business environments. Since information technology technical solutions are not static [16]; organizations are faced with continual change hardware, software, and networking standards. As new software becomes available, hardware must be replaced to meet the minimum requirement of the software.

The future of technology development may be unknown though, but suffice it to say that technology will continue to evolve at a fast pace. Therefore, organizations should anticipate the future demands which will result from technology change. In this aspect, enterprise architecture to be relied on should have the capability to meet current demands while also maintaining the capability to meet anticipated future demands.

Furthermore, organizations have to realize the importance of enterprise architecture before considering IT solution to serve their business needs. In the light of the above, this paper examines existing enterprise architecture paying attention to the strength of the architecture considered. Through reviewing related work, the paper presented an alternative in the unified enterprise architecture framework (UEF) which emerged based on the shortcomings and weaknesses of the existing enterprise architecture.

However, it is too early for UEF to be used as a basis for enterprise architecture framework but this research will continue and in future work data may be used to validate the outcome of the study. The analysis used in this paper is merely descriptive, and full statistical data analysis remains to be examined.

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