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Knowledge Architecture Framework based on Zachman's Enterprise Architecture Framework

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***Abstract*—** during the last fifteen years, knowledge management has changed through new perspectives and enhancements from generation to generation. Numerous researchers have presented research methodologies, frameworks and technologies and have discussed various theoretical and practical knowledge management issues. However, knowledge management is still in need of improvement and has not yet reached its maturity. This paper assesses the common research grounds between knowledge management and Zachman's enterprise architecture framework. Applied research is carried out using descriptive surveys. Information was gathered by using questionnaires filled out by knowledge management and enterprise architecture experts. Finally, a knowledge architecture framework was designed according to Zachman's framework.

Keywords- *Zachman's framework, knowledge management*

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I. INTRODUCTION

A framework is mainly holistic and summarizes a description of key elements, concepts and principles of a particular domain. The main objective of this framework is to describe the scope and definition of the core content's standard model as a reference for future projects. A knowledge management framework consists of knowledge management key elements, their relationships and principles of how they interact. Therefore, a reference for making decisions about the implementation and use of a knowledge management system/project within an organization or business institute is created. [1]

A. Knowledge Management

Knowledge management is a process which aids organizations in defining, selecting, organizing, disseminating and transferring vital information that is part of the organizations reputation especially within the realm of being deployed in a structured manner. Knowledge management is increasingly becoming an inseparable trade for most organizations. Manager's awareness of intellectual capital value has drawn their attention to understand methods of utilizing these capacities and abilities. Organizational knowledge is the main source of gaining sustainable competitive advantage. [2], [4]

Studies and assessments on knowledge management's evolution reflect the changes in the type and manner of human thinking. There were times when money and material wealth was considered a kind of power but presently philosophical thinking, new ideas and methods of their application in the right directions are considered great value. Educational organizations which deal with human evolution are considered the most dynamic organizations. Transformational change is one of the current age's most prominent features. In order for organizations to adapt to global changes and survive, it is essential to teach employees relevant skills and knowledge. Achieving this will not be possible without managers with conscious minds and philosophical thinking skills. [5]

B. Enterprise Architecture

Enterprise architecture links objectives, strategies, and organizational strategic plans with organizational information systems. Architectural significance is due to the existence of various views or perspectives about the organization. The framework for presenting these perspectives is called architecture.

In an organization individuals working in different departments view the organization from different perspectives. Some individuals working in management prescribe competitive strategies for the organization. Some employees define business strategies while others design software to mechanize processes. Enterprise architecture presents all these activities in one framework and shows how these components interact with each other. Organizational architecture is a logical structure to classify and organize various aspects of an organization. [6]

In the age of information technology, enterprise architecture must present a framework for organizational architecture which is based on information technology. Zachman's framework has become a framework for enterprise architecture by developing the concept of enterprise architecture and is currently the most prominent methodology for designing enterprise architecture.

II. KNOWLEDGE ARCHITECTURE FRAMEWORK

Architecture provides a technical description of a system that represents its components, the relationship between them and the principles governing their design and evolution over time. Architecture frameworks provide methods for organized thinking about large and complex systems.

A. Knowledge architecture framework necessity

Nowadays large sums of money are invested for knowledge management and large percentages of these investments turn into costs within organizations. Due to the increasing applications of knowledge management concepts and its influence in organizations on one hand and the existence of

innovative approaches on the other, presenting an appropriate knowledge architecture framework will aid in increased productivity in this field by providing the following:

- Necessary flexibility when faced with environmental changes
- Implementation of mission requirements based on information technology and communications
- Reduction in knowledge management projects risks
- Effective control and guidance over knowledge management in the organization
- Reduce costs and time to develop knowledge management systems
- Ability to use common systematic components at organizational level

These issues are considered advantages of utilizing enterprise architecture which has been localized for knowledge architecture. As John Zachman, enterprise architecture theorist stated: "the need to be updated, quality oriented and the speed of changing conditions force us to turn to enterprise architecture. In the 21st century, architecture is the determining factor in the success or failure of organizations". [3]

Specifically, benefits of enterprise architecture approach can be classified into two main groups.

- General benefits associated with organization's business
  - Adherence to strategy: Organizational design will be based on strategic objectives, organizational changes guidelines and organizational system development. Instead of focusing solely on carrying out tasks correctly, carrying out correct tasks will also be considered.
  - Reduction of redundant activities: Redundant and wasteful activities are one of the IT sector's main concerns but by utilizing enterprise architectural approach, these activities are identified and eliminated.
  - The nature of enterprise architecture processes: All organizational levels are taken into account which itself entails major advantages such as increasing personnel awareness throughout the organization especially the IT sector and enabling knowledge sharing.

- Benefits associated with the IT sector, information systems and business resource:
  - Reduction of excesses: Decreasing excess data and processes which the former enables increased accuracy and the latter enables easier maintenance and altogether cause decreases in costs related to the information systems.
  - Effective systems: Through the integration of business and IT, developed organizational systems will be more objective oriented and in line with the core of the organizations business objectives.
  - Increased systems quality: Inter-departmental analysis in enterprise architecture causes target-driven systems development based on a holistic approach and therefore of higher quality.
  - System integration: Enterprise architecture's holistic approach pays special attention to the integration and governance of system standards. This will also prevent dispersed information throughout the organization.

III. RESEARCH METHOD AND FRAMEWORK

In this study, the primary means of data collection was interviews and questionnaires. The Zachman framework was first described and localized models were illustrated using colored rows in tables. The Zachman framework consists of a number of cells where each one is formed when a row and column intersect. Each cell contains an indicative model which shows architecture from the perspective of various organization stakeholders. Each route in the Zachman framework illustrates a methodology. In other words, architecture frameworks aren't considered methods, but rather a type of metadata. Architecture frameworks can be used for creating or assessing methodologies. Methodologies indicate certain movements on the framework

Based on figure 1, two main ideas are involved in this formation:

- Rows which illustrate various shareholders views towards organization architecture.
- Columns which represent various descriptions of the same products from different perspectives.

Each of framework's rows is explained below:

Scope: A concise view of the physical formation and main mission of the organization. This row shows the architect or investor's perspective who estimate organization business costs and future performance. Board members and stakeholders are examples of perspectives shown in this row. Almost all information shown in this row is presented as text.

Organization model: Business owners perspective is shown here. Personnel (top and middle level managers and executives) views are stated here. What is shown here is generally known as the business model.

Systematic model: The results of analyzers who assess the organization and its businesses are shown here. High level analyzers and organization architects perspectives are presented.

Technology model: The architecture obtained from the previous rows need to be maintained using technology. Implementation standards are presented here. Technology standards for designing information systems are presented and then put out to tender by the organization. In analogy to software engineering, this row contains the detailed design of the system.

Components: Here, information systems architecture relevant to technologies used is divided into smaller components. This row is related to software engineering in that personnel used are typically software programmers. Subcontractors usually take this role and provide a working team of analyzers, designers, architects, programmers etc.

Working organization: This is not a model since it is not seen in most architecture implementation methods because it cannot be presented through charts. This row presents the real organization and organization users.

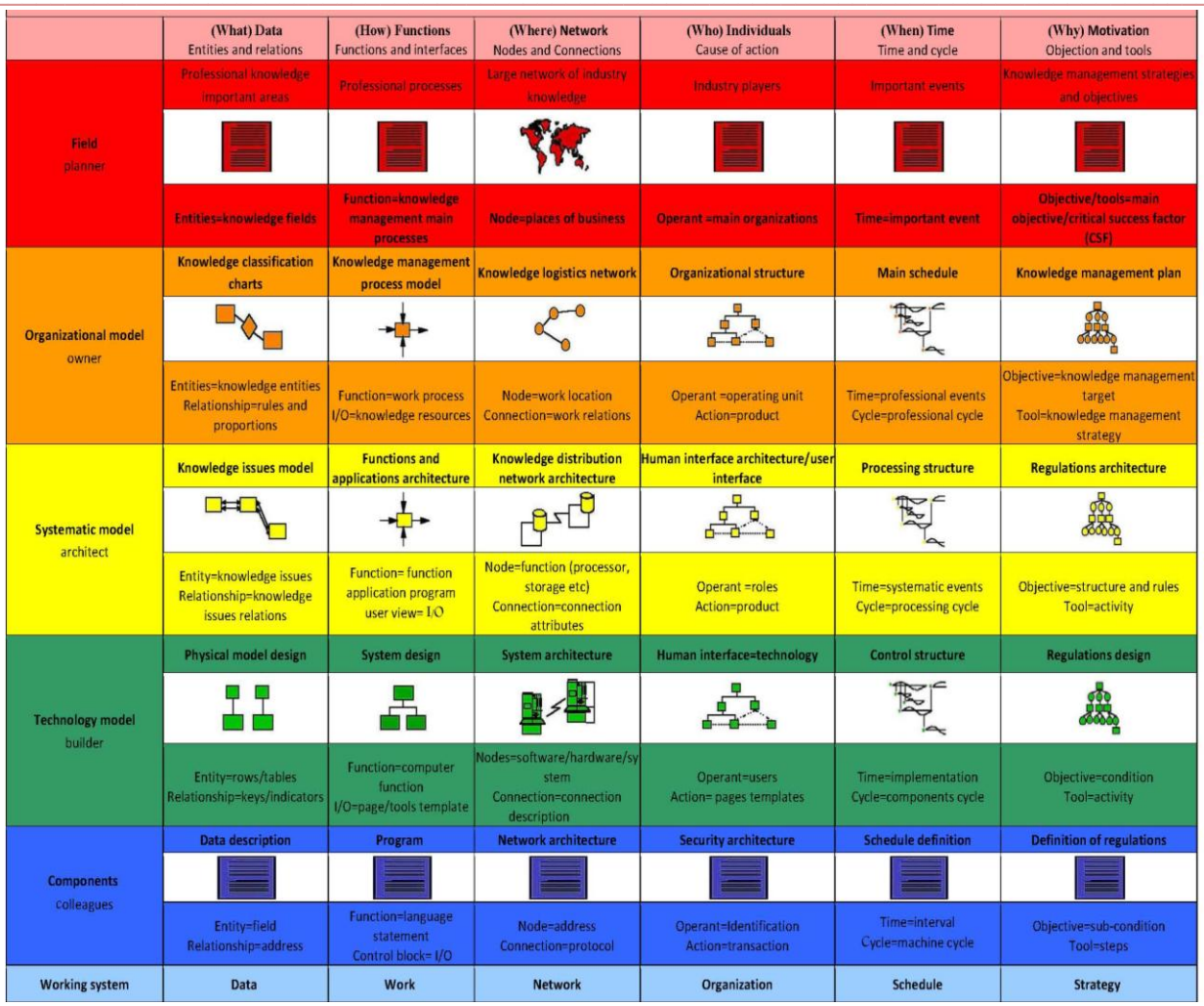

Figure 1. Zachman's Framework

Once vertical examination is complete, attention is turned to the horizontal part of this framework.

The columns are now assessed

Data: Each row of this column processes organizational data. In an additive way, modeling details of different rows vary. Details may include a simple list of objects, business model entities, conceptual model, logical model, physical model, databases and data storage.

Function: This column explains how the organization objectives are broken down into more detailed operations. The first row presents a list of objectives and the organization's main mission. This list is then divided into the business model process, sub-systems, components and finally actual workflow. This column also focuses on organizational activities geographical distribution. Lists of departments in terms of geographical location, logistics, deployment model, network architecture, network address and details of actual network are included.

Personnel: This column shows personnel duties and is of vital importance in terms of security. A list of organization departments, personnel interaction with main information systems, user interfaces, and user interface interactions is included here.

Time: The effect of time on the organization is presented on this column. A list of important events and times, business scheduling, operational sequence diagrams, components and actual timing of work order is also included.

Motivation: Focus is made on how results are obtained using aims and strategies along with potential restrictions. A list of aims and strategies, work rules model, professional constraints, sub-system regulations, and how these regulations affect work flow is presented.

IV. *RECOMMENDED* KNOWLEDGE *ARCHITECTURE FRAMEWORK*

In this section the knowledge architecture framework is explained from different perspectives. Table 1 explains the macro view of planning. Table 2 is about the enterprise model from the owner's perspective. Table 3 illustrates the system model from the architect's perspective. Tables 4 and 5 explain the technology model and detailed representations respectively.

TABLE I. ROW1: SCOPE; MACRO VIEW OF PLANNING

Title	Explanation
Data (What)	The overall vision and strategy of the organization knowledge areas are determined here. The industry knowledge portfolio is specified.
Function (How)	A list of knowledge functions and classes are determined along with the knowledge portfolio at macro level.
Network (Where)	A list is obtained from areas where the industry has flourished to design an overall network of industry activity fields.
People (Who)	In this cell a list of the industry's knowledge main players is created and studied.

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Title	Explanation
Time (When)	Important events relevant to the industry and business are listed. These events may be repeated periodically or may occur unexpectedly.
Motivation (Why)	Business objectives are determined including issues such as overall missions and business critical success factors.

TABLE II. ROW2: ENTERPRISE MODEL; OWNER'S PERSPECTIVE

Title	Explanation
Data (What)	The organization's knowledge entities are determined from the perspective of senior managers and key personnel. Knowledge entities classification and their relevance to business are shown here.
Function (How)	Organizational knowledge management processes model, knowledge resources and their processes are determined.
Network (Where)	Organizational opportunities in determining knowledge logistics network are listed by determining organizational knowledge management system locations and relations.
People (Who)	Knowledge workers are identified and knowledge based organizational positions are studied.
Time (When)	Knowledge management cycle times and important events are identified for the knowledge management system and a comprehensive schedule is drawn up. The mentioned events may be periodically repeated or occur unexpectedly.
Motivation (Why)	Motivational factors are listed using organizational objectives and strategies to advance knowledge management goals.

TABLE III. ROW3: SYSTEM MODEL; ARCHITECT'S PERSPECTIVE

Title	Explanation
Data (What)	Knowledge issues are attended to with the aid of managers and personnel. A list is then created for each knowledge field and classifications are made based on previous knowledge entities classification. Finally, the knowledge issues logical model is derived.
Function (How)	Knowledge management system applications architecture is designed here. This process is completed by determining system functions which are identified using users' reviews.
Network (Where)	Knowledge distribution network design takes place here by utilizing industry/business knowledge network along with their functions.
People (Who)	System users' interface, system's various individual roles, access levels, and results reports are determined here.
Time (When)	At this point the timing and sequence of events is specified. The sequences of interest relevant to system functions must correspond to the business logic. These events may be accidental or occur periodically.
Motivation (Why)	Business rules are determined by senior managers and knowledge management performance criteria are specified.

TABLE IV. ROW4: TECHNOLOGY MODEL; CONSTRUCTIVE VIEWPOINTS

Title	Explanation
Data (What)	Knowledge issues physical model is created and by using key points and indicators, a database is designed.
Function (How)	Computer functions and technology templates are specified here.
Network (Where)	At this point, required software and hardware for creating the communications network are identified.
People (Who)	Knowledge management system key players, screen formats, and technology system access methods are studied.
Time (When)	The control structure and system components cycle are assessed and developed here.
Motivation (Why)	A rules system is designed to explore different conditions using technologic functions.

TABLE V. ROW5: DETAILED REPRESENTATIONS; CONTRACTOR'S VIEW

Title	Explanation
Data (What)	Knowledge issues and data are defined in detail at this level.
Function (How)	System functions along with relevant programming languages and control blocks are determined.
Network (Where)	Network architecture is designed by preparing communications protocols.
People (Who)	System security architecture is attended to and by specifying system users, detailed access methods and user roles are defined.
Time (When)	A schedule is drawn up for the knowledge management system effectiveness.
Motivation (Why)	System regulations and sub-conditions along with relevant steps are explained.

V. CONCLUSION

To utilize any type of technology, tools, approaches and management methods, the organization requirements and objectives must first be identified. Then with a good understanding of the tools and approaches, decisions are made on how and to what extent these tools should aid the organization in achieving its goals.

In this paper a framework and tools to analyze organizations, knowledge management and effective knowledge management necessary for organizations are presented. In other words an applicable framework to implement knowledge management projects in organizations is presented with a completely operational approach.

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