A FRAMEWORK FOR KNOWLEDGE MANAGEMENT ARCHITECTURE

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Abstract: Many organizations began to reexamine and rearrange their business strategies, processes, information technologies, and organizational structures from a knowledge perspective. Adoption and assimilation of the knowledge management paradigm requires the design and establishment of structures, processes, and technologies along with organizational knowledge resources. The knowledge differs from the data and information by origin. Many experiences about preexisting methods for information system planning are still usable for knowledge management planning. One of the well known of them is enterprise architecture and specially Zachman framework. This paper is about customization of Zachman framework for defining knowledge management architecture in an enterprise.

1 INTRODUCTION

Many practices for knowledge management planning is still based on preexisting methods for information system planning, specially for identifying core knowledge and designing its management processes (Gold, Malhotra, & Segars, 2001). Knowledge is differing from data and information by origin (Kim, et al 2003) and because of this knowledge management planning methods is differing from information system planning methods. But many experiences around Information system planning could be useful for knowledge management planning practices and between them is enterprise architecture.

One of the most well known methods for information system planning is enterprise architecture that John Zachman introduced first time in 1987 in his paper entitled *Framework for Information Systems Architecture*. He presented the Zachman framework for enterprise architecture. The Zachman Framework provides a common context for understanding a complex structure. The Framework enables communication among the various participants involved in developing or changing the structure. Architecture is the glue that holds the structure together. The Framework defines sets of architectures that contain the development pieces of the structure. (Federal 1999).

This paper is trying to present an architecture framework for knowledge management. In next section some considerations about knowledge management planning will be discussed. After that there is a brief introduction to Zachman framework and the rules between columns, rows and cells. Then in part 4, based on knowledge management planning considerations and rules of Zachman framework, a framework has been developed for knowledge management planning. Finally there is conclusion about this paper.

2 KNOWLEDGE STRATEGIC PLANNING

While knowledge is recognized as a critical resource for sustained competitive advantages, implementation of knowledge management remains a main challenge to an organization (Davenport & Prusak, 1998; Demarest, 1997; Grant, 1997; Nonaka

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& Takeuchi, 1995; Teece, 1998; Wiig, 1997) requiring vast amounts of organizational resources, diverse techniques, and related tools calling for a solid and deliberate plan from the beginning (Davenport, DeLong, & Beers, 1998).

However many experiences in information system planning and implementation could be useful in knowledge management initiatives but knowledge is differing from data and information by origin (Kim et al 2003) and because of this, knowledge strategic planning, should be implemented by regarding these differences. Knowledge or knowledge management specific features that differentiate knowledge strategy planning from information strategy planning discussed below:

First, knowledge should be distinguished from information or data. Although some practitioners or scholars tend to be indifferent to this issue (Alavi & Leidner, 2001), lack of distinction between knowledge and information is one of the major reasons why knowledge strategy planning is confused with information systems planning.

Second, types of knowledge influence the design of knowledge management processes. In the case of information, similar techniques or processes can be applied to various types of information once their models are built up. On the other hand, different types of knowledge require different strategies, processes, or methods to manage them (Alavi & Leidner, 2001; Bohn, 1994).

Third, early knowledge management efforts should focus on a peculiar area of an organization where knowledge is more intensely created or utilized than in other areas (Davenport et al., 1996; Davenport & Prusak, 1998). A knowledge-intensive area such as an R&D division would be a good alternative for initiating knowledge management (Davenport et al., 1996). After launching a knowledge management initiative for such area, related results and experiences can be easily diffused throughout the organization. In case of prevailing information systems planning methods such as the business systems planning (IBM Corporation, 1975) and information engineering (Martin, 1989), their scopes of planning and implementation tend to be an entire organization, or, 'top-down'.

Finally, knowledge contains human cognitive and social activities. In knowledge management, the primary subject that takes charge of creating, storing, interpreting, and utilizing knowledge is a human being, not an information system. In carrying out these works, human beings perform various cognitive activities such as a metaphor, analogy, deduction, mental modeling, and so on (Hori, 2000; Nonaka & Takeuchi, 1995). For that reason, some knowledge is often processed in an unstructured form (Hori, 2000) and most of it cannot be represented explicitly.

3 KNOWLEDGE MANAGEMENT AND ENTERPRISE ARCHITECTURE

In 1987, John Zachman published a paper in the IBM systems Journal identifying what he called *"A Framework for Information System Architecture"*. In his paper, Zachman said " In any event, it is likely will be necessary to develop some kind of framework for rationalizing the various architectural concepts and specifications in order to provide for clarity of professional communication, to allow for improving and integrating development methodologies and tools, and to establish credibility and confidence in the investment of system resources." And also he introduced his architectural framework as linkage between business strategy and information system strategy.

Zachman discussed about two ideas in his framework. First, There is a set of architectural representations produced over the process of building a complex engineering product representing the different prospective of different participants and second, the same product can be described, for different purposes, in different ways, resulting in different types of descriptions.

Regarding this two ideas, Zachman introduced his framework with rows that represent the different perspectives about the organization and its systems that are "planner", "owner", "designer", "builder" and "subcontractor" perspective. Also each column represents the different aspects of an organization and its systems.

By take a glance on Zachman framework; there are six architectures that may be considered in enterprise architecture: data (entity) architecture, application (process) architecture, technology (location) architecture, organization (people) architecture, schedule (time sequence) architecture, and motivation architecture.

Also Kim et al. (2003) talks about four main architectures in knowledge strategic planning. These architectures are: (1) Knowledge architecture, which incorporates both of knowledge and expert maps; (2) Knowledge management process architecture, which defines knowledge management activities and their relationships; (3) Organization architecture, which

designs an organization structure for seamlessly carrying out knowledge management processes; and (4) Information technology architecture, which integrates information technologies or tools for supporting knowledge management.

Comparing these four architectures with Zachman framework, in the next section a framework for knowledge management architecture has been introduced.

4 THE PROPOSED FRAMEWORK

As said in previous section, there are four main focuses in knowledge management architecture planning that are knowledge architecture, knowledge management process architecture, organization architecture and information technology architecture. Comparing theses four architectures with Zachman framework, it is obvious that process, organization and technology architecture is same in both. But data has replaced with knowledge. Data and knowledge both are entity kind objects and are replaceable with each other. Based on these issues a framework like table 1 has been developed for knowledge management architecture planning. In the rest of this section different perspectives about different focuses will be discussed specially about knowledge column in the proposed framework.

Table 1: Proposed framework for knowledge management Architecture.

	Knowledge	Knowledge Management Processes	Information Technology	People (organization architecture)
Planner	List of knowledge types in organization	List of Knowledge Management Processes	List of Business Locations	List of Organizations Important to the Business
Owner	Knowledge Map	Process Model	Business logistics System	Work Flow Model
Designer	Knowledge Repositories	KBS Architecture	System Geographic Deployment Architecture	Human Interface Architecture
Builder	Codified Knowledge Documents	KBS Design	Technology Architecture	Presentation Architecture

4.1 Knowledge Architecture

The knowledge architecture is a result of classifying organizational knowledge by one or more dimensions. It represents the whole structure of an organizational knowledge and related information. Glazer (1998) referred to knowledge architecture as 'meta-knowledge', namely, knowledge about knowledge. Meta-knowledge is 'the information on the configuration of organizational knowledge and the structure of its storage, which makes knowledge assets intelligently accessible to people' (Glazer, 1998). In this section, different architectural views about knowledge architecture have been reviewed.

4.1.1 Planner Perspective about Knowledge Architecture

Planner view is an overview or estimate of the scope of the system, what it would cost, and how it would relate to the general environment in which it will operate (federal 1999). Therefore in planners view about knowledge architecture, at first it is useful to recognize required knowledge to satisfy knowledge management objectives and goals in the organization. In fact in planner perspective the scope of knowledge that should be regarded in planning will be defined. To recognize the required knowledge, it is useful to classify organizational knowledge according to different dimensions.

Recognizing the knowledge type in organization is essential because different types of knowledge require different strategies, processes, or methods to manage them (Alavi & Leidner, 2001; Bohn, 1994; Junnarkar, 1997). On the other hand, using multiple dimensions in classifying the organizational knowledge makes it possible to identify an exhaustive set of organizational knowledge in knowledge strategy planning. If knowledge is classified only by its creation mode (experiential vs. analytical), for example, it is difficult to deal with its tacit, implicit, or explicit aspects properly. Therefore, it is recommendable to combine several dimensions in classifying knowledge. (Kim 2003)

According to literature, there are several dimensions for classifying the knowledge in organization such as explicit knowledge vs. implicit and tacit, experiential knowledge vs. analytical knowledge (Kim 2003), personal knowledge vs. group, organizational and external knowledge (Dutta 1997). Dimensions for classifying organizational knowledge would be selected based on the planners' idea and the nature of organizational working model and the knowledge embedded.

4.1.2 Owner Perspective about Knowledge Architecture (Knowledge Map)

In enterprise architecture the owners perspective refers to enterprise (business) models, which constitute the designs of the business and show the business entities and processes and how they relate (Federal 1999). Correspondingly, it seems that the knowledge map is suitable alternative for

representation of knowledge existence as an entity and its relationships all over the organization.

Developing a knowledge map of an organization is a critical component of knowledge management. This is typically part of the knowledge audit step that attempts to identify stories, sinks, and constraints dealing with knowledge in a targeted business area, and then identifies what knowledge is missing and available, who has the knowledge, and how that knowledge is used. A knowledge map will then be drawn to depict those relationships in that organization. (Liebowitz 2001)

Knowledge maps and knowledge mapping has been said to be about facilitating efficient knowledge sharing between organizational members, and sometimes also with the outside world (Hellström 2004). Wexler (2001) has further suggested that knowledge maps must be problem-oriented; they have to address and attempt to solve a specific problem, and that problem orientation must be a central concern already early in the process of constructing a knowledge map. Problem orientation can take place in several different domains, for instance knowledge maps may be oriented toward identifying intellectual resources, socializing new members of an organizations, anticipating new opportunities, and stimulating learning and change (Wexler, 2001).

Duffy (2000) refers to knowledge maps as "navigational systems that enable users to find the answers they seek". As such the knowledge map is a key tool for representing the whole range of "knowledge objects", across categories and locations, as well as the links between these objects. In other words a knowledge map is a constructed architecture of a knowledge domain. In this regard knowledge maps address at least two organizational needs with respect to knowledge:

(1) Increased transparency as to the location of valuable knowledge in the organization, thereby making knowledge more accessible; and

(2) Stronger support for development of a common context on which employees can draw in the search for knowledge, as well as in creating new knowledge.

There are no standard or uniformity of how to create knowledge map (Liebowitz 2001) and usually a graphical method is used to create the knowledge map of an organization. Selection of suitable knowledge mapping method depends on the types of knowledge embedded in organization and knowledge relation structure in organization.

4.1.3 Logical and Physical Knowledge Repository

Corresponding to logical and physical data models, in data column of Zachman framework, in the proposed framework for knowledge management there are logical and physical knowledge models that also can be called as logical and physical knowledge repositories.

According to Turban (2001) knowledge repository is a collection of both external and internal knowledge and the structure of the repository is highly dependent on the kind of knowledge stored. The repository can range from simply a list of frequently asked questions and solutions to a listing of individuals with there expertise and contact information to detailed best practices for a large organization (Turban, 2001). Knowledge repositories capture explicit, codified information wrapped in varying levels of context. They are used to store and make accessible "what we know" as an organization. (Ruggles,1998). Knowledge repository is the place to store knowledge both implicit and explicit.

In fact Knowledge repository may be a FAQ (Turban, 2001) or may be a data warehouse (Ruggles, 1998) or any other structures. The structure of a knowledge repository should be in adoption with the type of knowledge that it wants to store. It is against the common methods for information systems and data storing in which there is several standard structures for storing and retrieving data stored.

When organizational knowledge map is determined, and there is complete awareness about knowledge types and their relationship in organization, it is time to determine the logical and physical structure of knowledge repositories in organization. Knowledge map specifies the places and relationships of knowledge, but knowledge repository specifies the internal structure for storing and using each type of knowledge in the organization. Therefore there is just one knowledge map for the organization, but there may be several knowledge repositories, up to the diversity of knowledge types in organization. Also based on organizational knowledge map, the knowledge repositories should be in relation with each other.

4.2 Knowledge Process Architecture

In the second column the knowledge management process architecture is regarded. As said before the process architecture in proposed framework is like

process architecture in Zachman framework, because the nature of process is same for both of them. Therefore in this section different knowledge intensive processes have been discussed.

According to (Kim 2003) the knowledge management process architecture defines a variety of processes involved in a life cycle of knowledge, from its creation to termination. Ruggles (1998) introduce 8 knowledge processes that are: generating new knowledge, accessing valuable knowledge from outside sources, using accessible knowledge in decision making, embedding knowledge in processes, products, and/or services, representing knowledge in documents, databases, and software, facilitating knowledge growth through culture and incentives, transferring existing knowledge into other parts of organization and finally measuring the value of knowledge assets and/or impact of knowledge management.

Selection of knowledge intensive process is impacted by the nature of knowledge types in organization and also the rules, policies and strategies of organization (Kim, 2003). It is against the information systems planning in which processes just are determined by organizational rules and policies.

In the first row of process column, there is a list of knowledge intensive processes, which are needed in the organization. As said before regarding the nature of knowledge types in organization and organizational rules and policies this processes are determined. In the second row of this column there is a knowledge intensive process model of organization. This process model shows all the knowledge intensive processes and their relationships. In the third row a set of processes are constructed and reviewed by detail to be embedded in a knowledge base system (KBS). Thus in this cell, the architecture of a knowledge base system will be determined to facilitate the selected processes. To do so, there should be a detailed description about each selected process. And finally in the next row there is the design of specified knowledge base system and specifying instructions that are understandable by machine.

4.3 Information Technology Architecture

The information technology architecture is a blueprint of a knowledge management system, namely, a technical infrastructure for knowledge management. A knowledge management system can be either a stand-alone information system or the combination of various information-technologies (Alavi & Leidner, 2001; Wiig et al., 1997). It defines various components of a knowledge management system and their relationships. To design the architecture, functional requirements of a knowledge management system should be identified in advance by considering the other three architectures. Then, information technologies applicable to realize those functions are searched, and their interfaces are designed.

Other descriptions about information technology architecture are like Zachman framework. Thus here it's not essential to discuss about it any more. For more information about technology architecture, readers can refer to Zachman paper or other documents about enterprise architecture such as Federal Enterprise Architecture Framework document.

4.4 Organization Architecture

Organization architecture refers to the structure of human resources in an organization. This column in the proposed framework is similar to "Who" column in Zachman framework and refers to organizational structure.

According to (Kim 2003), the organization architecture designs organizational structure and programs for managing human resources. Organizational structure defines the role of each knowledge management team responsible for performing or supporting knowledge management processes. Various knowledge management teams and their roles can be organized as necessary, for example, chief knowledge officer (CKO) (Earl & Scott, 1999), steering committees, councils, expert groups, communities of practice (Brown & Duguid, 2001), etc. A program for managing human resources contains plans for bringing up knowledge workers through devices such as a reward system, training programs, or communities for networking with internal and external experts (Kim, 2003). At this point the access rules for each member should be defined, regarding their role in organization.

5 CONCLUSIONS

In this paper we examined and customized the Zachman framework for knowledge management objectives. The proposed framework is based on the characteristics of knowledge as an organizational entity. Regarding the knowledge as an organizational entity and using the proposed framework, makes it easier to manage and handle the organizational knowledge and aligning the

knowledge management policies with the related knowledge processes. Also as an advantage for enterprise architecture method, using proposed framework results in comperhensive perspective about the organizational knowledge.

For later researches in this area there could be studies about efficient methods for knowledge mapping in an enterprise. Also the studies about the other columns of Zachman framework and there relation with the proposed framework may be the topics of later studies.

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