Knowledge Management Framework using Enterprise Architecture and Business Intelligence

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Abstract: Knowledge Management (KM) has emerged as a tool which enables the efficient creation, use, distribution and transfer of knowledge in organizations. In the core of KM there are three dimensions of analysis: people, processes and technology. KM Frameworks presented in the past have had a strong theoretical background, but they have not been well explained in terms of how to implement them in practice to cover all KM dimensions. In this paper, a novel KM framework is presented. This framework was designed as a practical guide to implement KM endeavours in organizations. To accomplish our research objective, two management practices are incorporated in the framework: Enterprise Architecture and Business Intelligence. Enterprise Architecture allows companies to visualize organizational objects in different areas (business, applications and technology) through the use of models. Moreover, Business Intelligence technologies as data warehouses, data mining and visualization can enable the capture, transfer and the creation of new and purposeful knowledge. This work is intended to be a good resource for companies or individuals that want to implement a KM initiative.

1 INTRODUCTION

Knowledge Management (KM) has emerged as a discipline which enables the efficient creation, use, distribution and transfer of knowledge in organizations (Campbell, 2006). Innovations in science and technology have led to the emergence of intensively information-based organizations. These organizations need to transform this information into knowledge to secure competitiveness and improve decision making.

The core dimensions that need to be examined in a KM project are: people, processes and technology (Edwards, 2011). Knowledge derived from these dimensions should be analyzed and stored using different information repositories. A Knowledge Management Framework (KMF) enables organizations to conduct and implement KM initiatives. KMFs are the foundation for developing information infrastructure and information systems to manage knowledge properly. Karemente, Aduwo, Mugejjera, and Lubega (2009), describes different KMFs; however, none of these integrates and analyzes the three knowledge dimensions as a whole and are difficult to use in practice.

As a result of a university research project, a KMF was developed. This framework details how a KM implementation should be done in order to capture explicit and implicit knowledge derived from the three knowledge dimensions previously mentioned. Moreover, two management practices are included in the framework to accomplish our objective: Enterprise Architecture (EA) and Business Intelligence (BI).

EA is defined as "a coherent set of principles, methods and models that are used in the design, realization and maintenance of an enterprise's business architecture, organizational structure, information architecture and technology architecture with respect to the corporate strategy" (Lankhorst, 2009). The purpose of EA is to optimize the processes of an organization into a cohesive environment that is open to change and supportive to the business strategy (The Open Group, 2011).

On the other hand, BI is "the conversion of organizations resources to knowledge. It is the data mining and the integration of information from corporate data warehouses to produce large amounts

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of information needed for effective decision making process and for planning strategically to achieve a competitive advantage in its industry" (Barakat, Al-Zu'bi, and Al-Zegaier, 2013). In this paper, a KMF supported by EA and BI is presented. The framework was designed as a practical guide to implement KM in organizations.

The rest of the paper is structured as follows: Section 2 presents the theoretical background; Section 3 explains how the KM framework was developed; and Section 4 provides conclusions of the work.

2 BACKGROUND

The research objective of this work is to present a KM framework which can be used in practice to capture, use and transfer knowledge. In this section, the literature research made for this work is presented.

2.1 Knowledge Management

Knowledge is one of the key resources that can strengthen the positioning of an organization (Curado, 2006). In order to sustain a competitive advantage, a resource should be valuable, rare and imperfectly imitable (Wernerfelt, 1984). Organizational knowledge meets these characteristics; therefore, it must be captured and managed appropriately. Knowledge can be defined as experience, facts, know-how, processes, beliefs, that increase an organizational or individual's capability (Karemente et al., 2009).

KM is "a process of identifying, capturing and leveraging the collective knowledge in an organization to help the organization compete" (Alavi and Leidner, 2001). Moreover, KM is "concerned with the exploitation and development of the knowledge assets of an organization with a view to furthering the organization's objectives" (Rowley, 2000). The reasons for KM include staff turnover, information overload, increasing need of expert staff, improved decision making and digitalization of organizational knowledge.

From the definitions, two important tasks are necessary to implement KM. Firstly, it is necessary to develop the technological infrastructure for facilitating knowledge capturing and sharing; and secondly, to establish mechanisms and procedures for retaining knowledge from people and processes. In order to accomplish these objectives, researchers have developed KMFs with different approaches. Nevertheless, a generally accepted framework has not been established (Heisig, 2009).

2.2 Enterprise Architecture

Enterprise Architecture (EA) supports in describing the current state (as-is situation) of an organization and proposes the best alternative solutions for the desired outcome (to-be situation). EA can be seen as a map that incorporates methods and techniques to create architectures in different layers of an organization. US Federal Enterprise Architecture Management Office defines EA as "a management practice to maximize the contribution of an agency's resources, IT investments, and system development activities to achieve its performance goals" (FEA Program Management Office, 2007).

EA addresses the need to manage increasing complexity and deal with continuous change by providing a holistic view of the organization, including their organizational components and their relations. EA is often viewed as a management practice that supports digitalization of knowledge to improve the performance of organizations (de Vries and van Rensburg, 2008).

Figure 1 shows a pyramid with the organizational architecture layers as: people, business, applications and technology. The circular arrows sequentially depict the process for implementing EA in an organization: getting the stakeholders involved, establishing management and control, defining the architecture process, the creation of the as-is and to-be scenario, development of a sequencing plan, using and maintaining the EA.

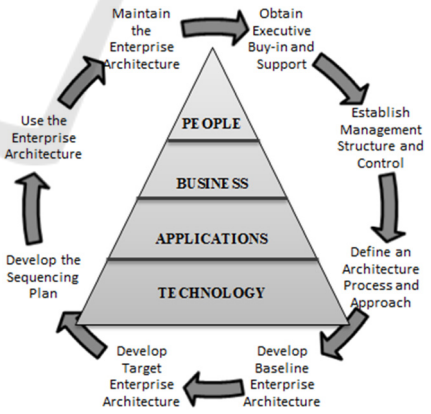

Figure 1: Enterprise Architecture Based on: (Tucker and Debrosse, 2003).

2.3 Business Intelligence

The term Business Intelligence (BI) was coined and became popular in the 1990s (Chen, Chiang, and Storey, 2012). According to (Gartner Inc., 2013), BI builds upon a set of tools and applications that

enable the analysis of vast amounts of information (Big Data) to improve decision making and performance of organizations. To accomplish this objective, decision makers require having access to all organization´s data, to analyze the business, its requirements and its trends.

The main technology in a BI project is a data warehouse. The data warehouse is a data repository which is populated from the integration of different operational data sources maintained in different units of the organization. An efficient analysis of data requires powerful analysis tools. Two main types of analysis tools exist: Online Analytical Processing (OLAP) and Data mining tools. OLAP tools use multidimensional views of aggregate data to provide access to corporate information for the purpose of improving decision making. Data mining uses software techniques for finding hidden patterns and trends in large databases to support strategic decisions (Connolly and Begg, 2005).

3 PROPOSAL OF KNOWLEDGE MANAGEMENT FRAMEWORK

As mentioned previously, in the core of KM there are three dimensions of analysis: technology, people and processes. Hence, a successful implementation of a KM initiative in organizations must take into account mechanisms to effective capture, use and transfer knowledge acquired from the three stated dimensions. The design of the framework is intended to put order in the KM process. Moreover, a practical framework can support managers in the creation, capture, digitalization of knowledge and decision making.

3.1 Technology

The first dimension of analysis in a KM process is technology. Technology is defined by (BusinessDictionary, 2015) as "The purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities". In this paper, technology is referred to as objects used by humans (tools, software, hardware, machines) for KM. Information repositories for EA and databases are the core technologies that support KM.

EA repositories store the objects and processes modeled from the different architectural layers in an organization. On the other hand, databases store data generated from different applications. There are two main sources in which information can be found Online Transaction Processing (OLTP) and Online Analytical Processing (OLAP). The source of data for OLTP databases is operational data. The main purpose of OLTP databases is to run and to control fundamental business data with a highly normalized design. Data for OLAP databases is integrated and loaded from different operational sources into a multidimensional database namely a data warehouse. The purpose of OLAP databases is to improve business analysis and decision making. In a KM implementation, information can be extracted and processed from these two repositories. Many methods and techniques can be used to extract useful knowledge from databases. Some of the most used techniques in a knowledge discovery process are data mining and machine learning.

3.2 People

People dimension is one of the pillars for the exploration and exploitation of knowledge in organizations. According to Churchman (1975) "knowledge resides in the user and not in the collection of data". Thus, a mechanism should be designed within the proposed framework in order to capture and to transfer knowledge from people in organizations. It is important to note that the staff turnover rate in the United States in 2014 was 11% in all industries (Compensation Force, 2014). This is an indicator that strategies should be implemented to maintain and transfer knowledge from these and other groups of employees that are leaving organizations.

The cost of training of new employees without the efficient capture of people's knowledge can increase exponentially. According to the Association for Talent Development, the average of spending on employee training within US is around $1208 per year and per employee (Association for Talent Development, 2015). We believe that this value can be decreased if we plan staff turnover accordingly and establish mechanisms for the capture of knowledge with existing technology, for example by using learning management systems (Sanchez-Gordon, Calle-Jiménez, and Luján-Mora, 2015).

3.3 Processes

Processes are described by (Edwards, 2011) as "the way people, organizations and even technology actually do things". The importance of processes in KM initiatives are described in different papers (Bou and Sauquet, 2004) (Newell, Robertson, Scarbrough,

and Swan, 2002). Identification and digitalization of the core processes of an organization is an important step in a KM initiative. It facilitates the transfer of knowledge of tasks performed by staff since processes are divided into activities and procedures are created for easier interpretation. Processes are modeled normally in a Business Process Management (BPM) software or in an EA tool. The process models and architectures created in this software become an essential part of the knowledge base of the organization.

3.4 Proposed Knowledge Management Framework

A successful implementation of a KM initiative greatly depends on a well-defined method that supports the creation, capturing, use, distribution and transfer of knowledge. Organizational knowledge is created from different interdependent objects in different domains: strategy, product, services, information technology, applications, business processes and people (Lankhorst, 2009). Explicit and implicit knowledge can be derived from these domains. Explicit knowledge is knowledge that can be formulated, documented and reproduced. Implicit knowledge also known as tacit knowledge is knowledge that is difficult to document or formulate, and is normally associated with human knowledge.

Thus, the proposed framework intends to comprehensively create mechanisms to guide the KM process to capture knowledge from all the organizational dimensions. This framework was conceived as a part of a research project in a private university. The main goal of the research project is the design of a knowledge management framework (KMF) and the development of a web application prototype supported by databases, data mining and business intelligence tools for the planning process in the university.

One of the main objectives of the university is to position itself as a research and teaching institution, through the production, management and transfer of new knowledge based on institutional research lines. One of the projects implemented in the past year was the establishment of an institutional diagnosis in order to create a new model of corporate governance.

After analyzing the raised processes and the outputs of this project a need was identified. The identified need was to create a KMF for the planning area of the university to ensure the efficient management of knowledge and knowledge related activities. The purpose of the framework is to support planning, implementation and control of knowledge related projects and programs required for the effective management of intellectual capital.

Before the design of the framework started, a series of interviews was realized with different stakeholders in order to discover their knowledge requirements and to structure the framework. The importance of the three dimensions of knowledge was confirmed in the interviews. Moreover, certain activities to include in the framework were identified. Some of these activities were: discovering of knowledge in existing databases, digitalization of existing processes and the definition of mechanisms to convert tacit knowledge from different people in the organization into explicit knowledge. The novelty of the framework resides in the use of EA and BI to cover all the stated dimensions. Figure 2 depicts the designed framework.

The component in the right presents an analysis on how explicit knowledge is produced by using BI and EA tools. This box receives implicit knowledge as an input. The implicit knowledge is produced by people and processes in the organization. The knowledge discovery process inside the box has the following steps: analysis of existing databases and files, extraction of useful information, transformation to the target database format and loading. This process known as ETL (Extraction, Transformation, Loading) prepares data into a customizable format, cleans data with errors and eliminates duplicates. The purpose of this step is to load quality data into the target database in order to improve the analysis processes.

A data warehouse is the best target database for analysis. A data warehouse conceptual design consists of a set of dimension tables, fact tables and their relations. The populated data warehouse can be analyzed using BI and data mining tools to discover knowledge. Data mining and machine learning are popular methodologies for the knowledge discovery process. There are different methods and techniques that can be used.

On the other hand, digitalization of knowledge can be captured in an EA tool. An EA tool supports the creation of architectures to translate implicit knowledge into models which describe organizational structures (people), business processes, applications and technological infrastructure.

Most EA tools are based on the Archimate standard (Schekkerman, 2011). Archimate language allows the design of architectures in different domains and the creation of relations between the different objects of the organization. The

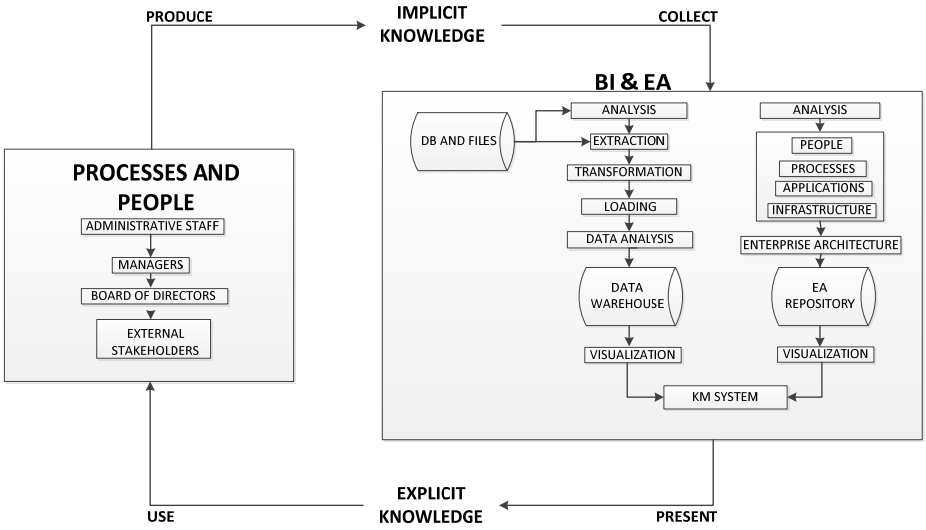

Figure 2: Proposed Knowledge Management Framework.

digitalization process includes an analysis of the different units and departments of the organization. Interviews must be realized with all the staff in order to document and model the different activities and processes realized in all architecture layers. The modeling of EA projects enables the capture and collection of implicit knowledge from the employees and the transformation to explicit knowledge in the forms of views and viewpoints of the architectures.

EA and BI are the main methodologies of creation of explicit knowledge. It is important to present explicit knowledge in an easy and understandable way. The framework suggests the presentation of knowledge by using a KM system which can be developed in a web environment. The results of the BI and EA process can be visualized and analyzed in this KM system. The output of the component in the right is explicit knowledge in the form of reports and dashboards that are presented to be used by people in all levels of the organization and can support in the design or redesign of new and existing processes. The explicit knowledge is the main input of the box in the left of the framework. Explicit knowledge can support and enhance decision making activities and can increase knowledge levels of the people in the organization. It supports as well the transfer of knowledge to new employees. As seen in the framework the KM process is a cycle in which knowledge is produced in a daily basis.

4 CONCLUSIONS

KM is a practice that organizations are incorporating to improve the creation, use, distribution and transfer of knowledge. The implementation of KM must be guided by a KMF. Many KMFs exist in the literature. However, these frameworks do not present practical mechanisms to gather and analyze all the knowledge dimensions: people, processes and technology.

The use of BI and EA tools bridges the gap of capturing all the knowledge dimensions. On the one hand, BI allows the transformation of simple information in valuable knowledge by applying data mining methods and techniques. On the other hand, EA supports the digitalization of implicit knowledge from people and processes by creating architectures in different domains. These architectures facilitate the transfer and distribution of knowledge to different levels of people in the organization. Some benefits of using this framework are: reduced training costs of staff turnover, improved decision making processes and the creation of a knowledge repository.

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