A Distributed Knowledge Management Conceptual Model for Knowledge Organizations

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Abstract. In the last years Knowledge Management (KM) has caught the attention of both industrialists and researchers. Though, an important gap exists between these two domains, mainly, due to the lack of understanding of the KM concept and the activities that it implies by organizational managers. Several KM models have appeared in the research field, but none of them includes all the necessary aspects for an effective KM. In this paper, we propose a Distributed Knowledge Management Conceptual Model that presents the necessary activities in KM and proposes the means to implement them.

Keywords: Knowledge Management, Knowledge Organizations, Conceptual Model, Knowledge Creation, Knowledge Sharing, Knowledge Representation and Information Retrieval.

1. Introduction

The beginning of the new century brings about a paradigm change in which capital and work are no longer the only fundamental bases for successful management. Now, organizations strongly depend on their skill to identify and adequately use the knowledge they possess. Over the past two decades, Knowledge Management (KM) has captured enterprises` attention as one of the most promising ways to reach success in this information era. This is because companies are beginning to understand the importance of knowledge as an organizational asset that makes it possible to obtain a sustainable competitive advantage [4]. For this reason, KM is no longer just an idea in industry leaders` minds; it has become a requirement to survive in today's competitive environment [6].

Although there is a growing recognition of the importance of organizational knowledge, often managers cannot identify where knowledge value resides or how to become a Knowledge Organization. The organizational knowledge - embedded in people and communities formed inside the organization - is rarely detailed enough to be especially valuable and it is often lost when people leave the organization.

Most organizations have not yet approached KM activities in a structured way. This is because companies are still struggling to understand the KM concept and which

activities it implies. The reason for this is the lack of clarity in identifying the main characteristics of the KM process. Moreover, there is an important gap between the academic research and the practical KM initiatives. Researchers have proposed a variety of KM frameworks, models and perspectives to help understand this emerging phenomenon.

Two kinds of KM frameworks can be identified [11]: descriptive and prescriptive. The descriptive frameworks try to characterize the nature of the KM phenomena, whereas prescriptive frameworks present methodologies to follow in conducting KM. Among the descriptive frameworks are mentioned those by Wiig, Leonard-Barton, Arthur Andersen & APQC, Choo and Van der Spek-Spijkervet. The Wiig´s framework focus is on management and identifies the main necessary functions to manage knowledge. The Leonard-Barton´s framework centers on the interaction of the technological capacities of the organization and the activities of knowledge development. The Arthur Andersen & APQC´s model provides the bases for the conduction of a benchmarking process of KM between organizations and also within the same organization. According Choo´s framework an organization uses information in a strategic way for sensemaking, knowledge creation and decision-making. Finally, the Van der Spek and Spijkerver´s framework characterizes the cycle that governs the conduction of KM (conceptualize, reflect, act and retrospect).

Among the prescriptive frameworks, the ones proposed by Sveiby, Petrash, Nonaka, Szulanski and Alavi are presented. The Sveiby´s framework focuses on the characterization and measurement of organizational intangible assets (particularly knowledge). The Petrash´s model centers on the characterization and measurement of the organizational "intellectual capital", that is to say, it is oriented to the identification of knowledge resources. The Nonaka´s model presents the knowledge creation process as the interaction between two types of knowledge (tacit and explicit). The Szulanski´s model focuses on the identification of barriers that exist for knowledge transfer within the organization. Finally, Alavi´s model centers on the use of technology for KM accomplishment.

As it has been described, the focus of each model and framework reveals KM dimensions or aspects emphasized or contemplated. Each of them addresses certain KM elements. However, none of them appears to subsume all the others [11]. In this paper we present a more comprehensive and unified conceptual model for describing the nature of Distributed KM. In section 2, we discuss the nature of organizational knowledge and the activities it implies. We present the foundations along with our vision of each process. We relate knowledge creation with teaching, learning and coaching processes and the generation of individual and collective knowledge. Regarding knowledge sharing we argue that this process must be fostered between Knowledge Domains within the organization and that a Knowledge Network should support it. For knowledge representation and information retrieval we propose a Distributed Organizational Memory System based on domain ontologies.

In section 3, we present a Distributed Knowledge Management Conceptual Model that encompasses all the necessary key activities – described in the previous section–for a successful KM implementation. In section 4, we analyze the implications of this model in today's organizations. More specifically, we argue that knowledge organizations can be seen as an evolution of other organizational types that arise from partial KM implementations. Finally, in section 5, we present conclusions and future works.

2. Organizational Knowledge

Despite the recognized importance of KM, there exists no consensus on what KM means. Moreover, as Spiegler [24] concludes, KM suffers from a lack of agreement on the definition of knowledge itself, mistaking it for data or information. In order to clarify these terms, Spiegler suggests a recursive and spiral model that relates the three concepts (data, information and knowledge). In this model, yesterday's data are today's information, and tomorrow's knowledge, and the latter one will serve like feedback for future data and information.

A diametrically opposed vision is proposed by Tuomi [25] who argues that data emerge last – only after there is available knowledge and information available. Knowledge is needed before collecting data because this previous knowledge will determine which data must be collected. For Bellinger et al. [3], data represent a fact or statement of event without relation to other things. Information embodies the understanding of a relationship of some sort among data, possibly a cause and effect relationship. Knowledge represents a pattern that connects and generally provides a high level of predictability as what is described or what will happen next.

Also, it is necessary to distinguish between information management and KM. In information management, information is stored, usually in databases, sorted and retrieved. Knowledge, on the other hand, requires a system that not only can store the existing knowledge as information, but it also can retrieve and use that information as knowledge when needed. In this manner, new knowledge can be created from existing knowledge in combination with new information [9].

Knowledge has, as an organizational asset, its own characteristics that distinguish it from the rest of manageable resources [26]. Knowledge is intangible, and therefore difficult to measure. It is volatile; most of the times it is embodied in people; it is not consumed in the process and sometimes it is even increased with the use, having as well, a high organizational impact. It is more and more evident that sharing and integrating organizational knowledge brings a number of benefits. In addition, sharing and integrating knowledge enables people to understand the widespread effect of their actions improving coordination and fostering synergy [14].

The discussion of knowledge classification is important because different types of knowledge have different KM implications and require different elements in a KM model. It is possible to distinguish between two types of knowledge: information processing in the mind of an individual produces what Polanyi [22] calls tacit knowledge. When it is articulated and communicated, this tacit knowledge becomes information or what Nonaka [17] calls explicit knowledge.

As organizational knowledge is derived from individual knowledge, KM must support the acquisition, organization and communication of both tacit and explicit employees´ knowledge. Tacit knowledge is acquired by experience. In this context, tacit knowledge includes beliefs, perspectives and mental models so embodied in people's minds that they are taken for granted [18]. Explicit knowledge is knowledge that has been captured in a code, or a language that facilitates communication. In its most advanced state, explicit knowledge is contained in codified theories [10].

Organizational knowledge is the collective sum of tacit and explicit knowledge within an organization. Organizational knowledge is processed information embedded in routines and processes that enable action. It is also knowledge captured by the

organization's systems, processes, products, rules, and culture. These definitions are good conceptual notions about what organizational knowledge is, but they offer little guidance as how to acquire, manage and transfer it among entities within the organization [19].

If many are the definitions of knowledge, not less are KM definitions. According to O´Leary [20] KM can be defined as the efforts made by organizations to capture knowledge, convert personal knowledge (tacit) into groupware available knowledge (explicit), connect people to people, people to knowledge, knowledge to knowledge, and measure knowledge to facilitate resource management and to help to understand its evolution. KM is also defined as the application of knowledge activities operating on the knowledge resources. These activities are constrained and facilitated by factors influencing KM [12].

In our proposed model, the building blocks will be the necessary activities involved in a KM process. These knowledge activities are: knowledge creation, knowledge representation, knowledge retrieval and knowledge sharing.

Knowledge creation refers to the activity that alters organizational knowledge resources through knowledge socialization, internalization, externalization and combination. *Knowledge representation* refers to the activity that facilitates knowledge retrieval by offering a common representation of knowledge objects. *Knowledge retrieval* is an activity of applying existing knowledge to daily tasks and, at the same time, generates new knowledge. *Knowledge sharing* refers to dissemination and distribution of knowledge. In others words, KM is the practice to add actionable value to information by capturing tacit knowledge and converting it to explicit knowledge, by filtering, storing, retrieving and disseminating knowledge; and by creating and testing new knowledge [16].

Although it is important to describe organizational knowledge in a comprehensive way, it is also important to understand how this knowledge is developed and maintained. Any KM model has to contemplate all these aspects to perform a successful integration of organizational knowledge. Each of these activities will be an important part of the proposed model.

2.1 Knowledge Creation

Nonaka [17] proposes that new organizational knowledge can be created through four conversion processes that involve tacit and explicit knowledge: socialization, externalization, combination and internalization.

We argue that these conversion processes are tightly relate with learning, teaching and coaching capabilities within the organization.

As is it shown in Fig. 1, k*nowledge externalization* refers to the conversion of tacit knowledge into explicit knowledge. In this process, individuals try to articulate their tacit knowledge eliciting their experiences and beliefs. In a sense, it could be seen as a *teaching* process.

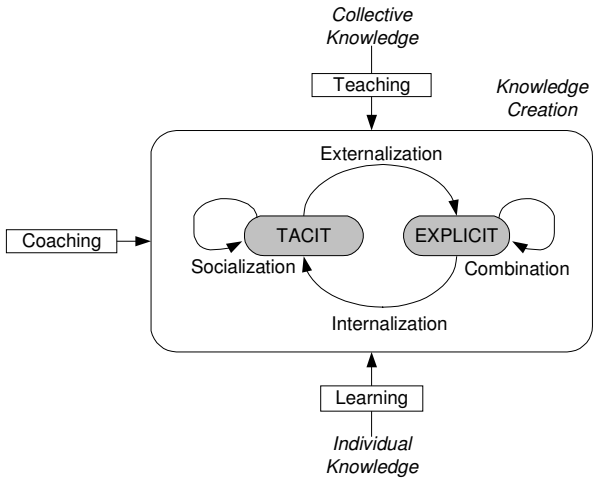

Figure 1: Knowledge Creation

The second type of knowledge conversion, *socialization*, refers to the creation of new tacit knowledge from shared tacit knowledge. Individuals acquire new knowledge through a *coaching* process where expert workers guide trainees in their learning process. *Knowledge combination* refers to the creation of new knowledge through the combination and exchange of explicit knowledge in the organization. This process must be supported by the notion of an Organizational Memory (OM) that led workers to sort, re-use, add and re-contextualize explicit knowledge.
The fourth type of knowledge conversion, *internalization*, takes place when explicit knowledge becomes tacit. In this *learning* process individuals embody new knowledge updating their mental models.
According to several authors, the interplay between the individual and collective knowledge is an important aspect of organizational knowledge creation, amplification, and sharing.

2.2 Knowledge Sharing

Knowledge is an important asset that allows obtaining and retaining competitive advantage. For this reason knowledge sharing has become a strategic priority for most organizations. Knowledge sharing is extremely important because organizations have to continually learn and innovate to remain competitive.
Alavi [1] suggests that one of the biggest reasons for focusing on knowledge sharing is that knowledge creation by itself cannot lead to superior performance for the organization. Rather, companies have to create value by using that knowledge, and knowledge can only be utilized if it is shared successfully. Therefore, organizations have to effectively manage knowledge transfer process to obtain success.
Knowledge sharing occurs when knowledge is diffused from one entity (e.g. an individual) to others. This process can unfold through processes of coaching, teaching

and learning. Knowledge may be purposefully shared or it may occur as an outcome of another activity.

Knowledge sharing may be challenging due to a number of factors, including the type of knowledge, and an inability to locate and access the required knowledge source [1].

We argue that this sharing process must be fostered between Knowledge Domains (KD) within the organization. A KD is the area of knowledge one community agrees to learn about. It is negotiated among participants, especially the community's experts. KD exists both internal and external to the organization [15].

Each individual within an organization ultimately obtains the needed knowledge, either directly or indirectly, from the various KD. The filtering of knowledge from these KD into the organization's core processes is done by Knowledge Communities (KC) and Communities of Practice (CoP). These kinds of learning communities provide support to higher levels of learning in organizations. A CoP is a social-technical system that can provide the means to develop and share knowledge among professionals, particularly when they are not co-located. A CoP is capable of providing individuals and organizations with a single-source solution for education, training and performance support [13].

Although both, CoP and KC, are communities formed within the organization, there are two principal characteristics that distinguish KC from CoP. The first is that the firm takes responsibility for identifying likely areas of interest and establishing KC. Contrarily, CoP are organic in nature; that is, they form spontaneously in response to professional interests that lie within the firm. The second quality is that while the organization actively establishes and supports KC, they do not typically have well-defined goals, other than to expand thinking along common areas of interest. Direction and objectives of KC tend to be less well defined [15]. Unlike KC, which are organized by the firm for the purpose of filtering knowledge for potential value, a CoP is a community whose main goal is learning.

The importance of these communities stems from the fact that knowledge cannot be separated from its context. In all types of knowledge activities, even where technology is very helpful, knowledge contributors as well as seekers require a common community to share general conversation, experimentation and experiences with other people who do what they do. While they are inside the community, knowledge workers are informally as well as contextually bound by a shared interest in knowledge sharing, and applying common practices [21].

A challenge encountered in KM initiatives is how to connect these communities (CoP and KC) to enable sharing across, not just within, communities. A possible solution, as shown in Fig. 2, is the establishment of a Knowledge Network (KN) among these communities. A KN is an informal network of communities between KD. A KN facilitates knowledge transfer and sharing between KD and helps to channel worker's efforts. KN are vehicles through which knowledge may be communicated and shared. Essentially, KN are the media by which knowledge (as well as information and data) are conveyed [15].

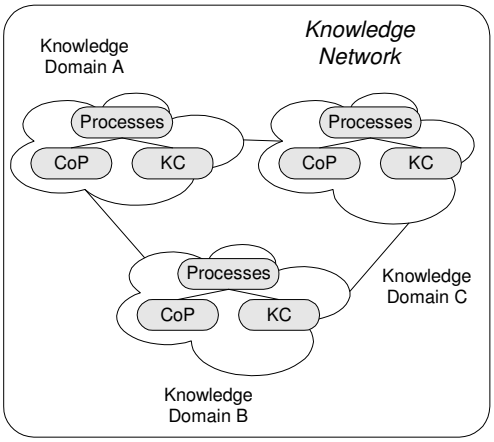

Figure 2: Knowledge Sharing

2.3 Knowledge Representation and Information Retrieval

Remembering what an organization has learned and reusing its relevant knowledge (generated internally or acquired externally) is an important aspect of effective KM. Like individuals, organizations may lose track of their knowledge and forget. Thus, organizations codify their knowledge in order to preserve and reuse it.

Since organizations are continuously engaged in the process of knowledge generation and application, it would be useless to attempt to codify and store all organizational knowledge. The approach to codification of knowledge depends on its type (tacit or explicit).

Some organizational KM systems proposals focus on the application of information technologies for the capture, storage, and retrieval of organizational knowledge. In these approaches, *Organizational Memories* (OM) are proposed as support for knowledge effective representation, use, handling and conservation through time and space - up to where it is possible - without human intervention.

In this paper, OM are defined as the means by which knowledge from the past is brought to bear on present activities resulting in higher level of organizational effectiveness [5]. As KD are distributed across the organization it is necessary to represent and retrieve Knowledge Objects in the same manner.

We propose, as it is shown in Fig. 3, to associate every organizational KD with its own OM and add an interface that enables knowledge retrieval from other domain OM if it is necessary [2]. In this particular type of OM, the characteristics, attributes, and semantics of the Knowledge Objects, as well as the relationships among them are represented through a domain ontology. Ontologies aim to capture domain knowledge in a generic way and provide a commonly agreed understanding of a domain, which may be reused, shared, and operationalized across applications and groups [7]. An additional benefit of ontology modeling is the context representation. Ontologies provide a domain model that allows Knowledge Objects to be seen in their context and

this can be crucial for subsequent reinterpretation or use in a new task or project.

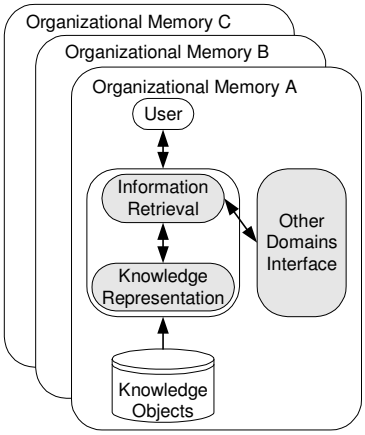

Figure 3: Knowledge Representation and Information Retrieval

Moreover, since knowledge is generated and used in a distributed way it is essential to facilitate knowledge retrieval connecting the seeker with the corresponding knowledge source. Again, a information retrieval layer within the OM is supported by the domain ontology that allows complex knowledge retrieval strategies.

3. Distributed Knowledge Management Conceptual Model

KM requires a suitable infrastructure for creating and managing tacit and explicit knowledge. Although conventional enterprise information systems typically support explicit knowledge, few of them support tacit knowledge. Providing pathways, channels, and mechanisms for sharing, distributing, and locating tacit knowledge sources is therefore a challenge.

KM systems integrate existing components at both infrastructural and content levels, bringing together people and information systems associated with collaborative, knowledge intensive tasks. Tools that handle explicit content, as well as components that enable sharing and distributing tacit content, must be temporally and spatially integrated. In order to promote a common understanding of KM, it is essential to organize and consolidate knowledge manipulation activities in a way that not only describes each activity clearly and completely, but also identifies their interrelationships.

Similarly, it is important to recognize the influencing factors in a comprehensive and unified way.

There are two tendencies related to KM modeling focus: the repository model and the network model [1]. The repository model aims at codification of knowledge (i.e. creation and maintenance of stocks of explicit knowledge). The network model aims at using the power of information and communications technologies to support the flow

of knowledge in organizational settings and among networks of KD. We argue that both approaches (repository and network models) are needed for a successful KM implementation.

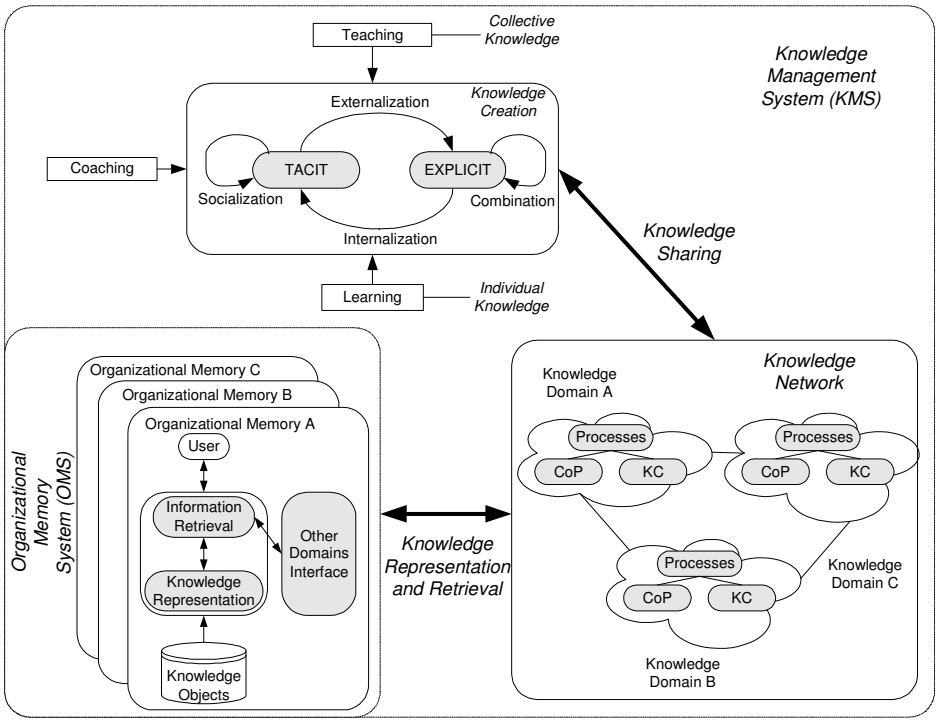

Figure 4: Distributed Knowledge Management Conceptual Model

In Fig. 4, we present a Distributed Knowledge Management Conceptual Model that encompasses all the necessary – previously described – key activities for a successful KM implementation. In this model we distinguish between an Organizational Memory System (OMS) and a Knowledge Management System (KMS).

OMS consists of the processes and Information Systems components used to capture, store, search, retrieve, display, and manipulate an OM. A KMS consists of the tools and processes used by knowledge workers to identify and transmit knowledge to the knowledge base contained in the OM [5]. That is, the knowledge creation process is carried out through four conversion processes. The knowledge combination process refers to the creation of new knowledge through the combination and exchange of explicit knowledge in the organization. This process requires the knowledge transfer and sharing among domains OM, which is allowed by the KN that helps to channel the worker's efforts.

4. From Learning to Knowledge Organizations

Successful organizations are often described as Knowledge Organizations composed of knowledge workers who continually perform knowledge intensive tasks using and creating new knowledge. To become a Knowledge Organization it is necessary to manage organizational knowledge in a holistic manner. Many authors [17][18][8] have analyzed the concept of Knowledge Organization and its role in the knowledge creation process. These successful companies create new knowledge, share and spread this knowledge through the entire organization and quickly embody it in new products and technologies. This is important because knowledge that cannot be shared within an organization remains the property of a few people, rather than of the organization, and will have a limited impact on the organization's ability to create value [14].

There are other organizational classifications that arise from partial KM implementations. The ***Learning Organization*** (LO) is an organization that facilitates the learning of its members and continuously transforms itself. A LO is an organization that is continually expanding its capacity to create its future. It is a place where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free and where people are continually learning how to learn [23].

It is widely recognized that running an organization requires learning support for knowledge acquisition and creation and to reinforce the relationship between individual and organizational goals. In a LO everyone, and the organization as well, is engaged in a continuous learning process. There is a knowledge feedback between the organization, which is more than the sum of the individuals, and its components that emerge from this learning process.

A ***Teaching Organization*** (TO) is one in which everyone is a teacher, everyone is a learner, and reciprocal teaching and learning are embodied into everyday activities. In this kind of organizations the teaching process is fostered inside the organization and strategic knowledge is systematically taught to everyone. The teachers belong to the organization and the teaching process is completely developed with organizational resources.

A ***Coaching Organization*** (CO) is an organization that creates an environment where the behaviors and practices involved in continuous learning exchange both explicit and tacit knowledge; reciprocal coaching and self-leadership development are actively encouraged and facilitated. Coaches play a more proactive role in orienting a person to the realities of the organization, helping him or her to remove barriers to optimum performance whilst maintaining personal and professional integrity. The coaching relationship with his or her trainee involves mutual commitment, trust and respect. It encourages freedom of expression, is pragmatic in employing useful models and is reciprocal, with both coach and trainee learning.

In this paper, the term "coach" refers to a leadership approach or technique that helps others to recognize their own potential to solve problems. It must not be confused with the initial training of a new employee. During the learning process, the coach articulates emotional, corporal and psychological elements tying them to the trainee experiences. The main objective is to get rid of acquired knowledge preconceptions and to enter in the zone of effort and arduous training. Some important ties found in this process are mental models that prevent the incorporation of new concepts. In this sense,

the coach that leads the learning process will impel the other to learn and to be a different observer and to identify the goal towards which he or she goes.
Finally, ***Knowledge Organizations*** (KO) obtain a competitive advantage from continuous learning, both individual and collective. In organizations with a well-established knowledge management system, learning by the people within an organization becomes learning by the organization itself. This type of organizations fosters KC and CoP formation. These communities that are organized around the principles of entrepreneurship have the best chance of success. Members of these communities would act less like followers and more like empowered founders and builders of a new organizational value. To become a Knowledge Organization it is necessary not only to give support to learning, teaching and coaching processes, but also to go beyond the implementation of these processes in isolation. In a way, as it is shown in Figure 5, a Knowledge Organization could be seen as an evolution of the other types of organizations.

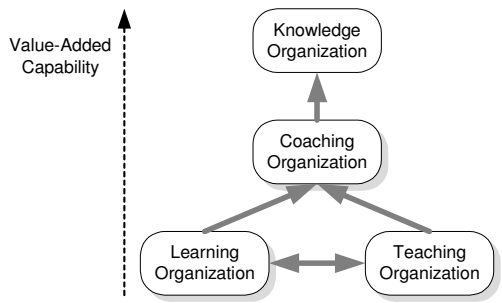

Figure 5: Knowledge Organization

We argue that any organization can become a Knowledge Organization through the systematic application of the entire key activities presented in our Distributed Knowledge Management Conceptual Model.

5. Conclusions and Future Works

The importance of KM will continue being increased in the coming years. This paper presents a KM model that can be seen as a guide for managers through the implementation process of a KM solution. By means of the systematic application of the activities of our model an organization can become a knowledge organization.
It is necessary to define the roles of the main agents that participate in the KM activities defined along with group and individual performance measures. Experience shows that it is not easy to measure direct results of KM efforts. Some indicators can be obtained form statistics such as the growth of the knowledge base, the growth in usage of the knowledge, and the rate of activeness of users in the KM systems. However, those measures are only indicators and not reliable as measurements of the

effectiveness of KM (the fact that a user searches for some documents does not imply that this document is useful).

Furthermore, it is also necessary to highlight that in the proposed model, the learning, teaching and coaching processes are limited to the organizational boundaries. It is necessary to extend these processes beyond organizational limits. In this new interorganizational context, the nature of these processes should change from a competitive to a collaborative point of view. These processes have to be re-defined to take into account the complexity of collaborative relationships between different organizations. Collaboration requires the integration of resources from different organizations and this is not completely fulfill by traditional KM approaches.

Finally, a support tool for the proposed model will be developed. This tool will allow model implementation and validation.

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