

# ORGANIZATIONAL KNOWLEDGE MODEL: A KNOWLEDGE MANAGEMENT WITH SEMANTIC WEB APPROACH

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## Abstract

*The main objective of this paper is to propose a model that has been particularly developed to demonstrate a way of interaction between knowledge management and the semantic web as a strategy to negotiate the knowledge that exists inside the organizations using the technologies of the semantic web, keeping in mind always that the main concerns of organizations are related with the optimization of their processes, human and technological resources. We assume that by negotiating the assets of knowledge with the support of the semantic web, it will reveal a good strategy for achieving this purpose. The model is composed from the most external to internal components as well as: External, Geo-cultural, Environmental and Organizational Knowledge.*

*Keywords: Knowledge Model, Organizational Knowledge, Knowledge Management, Semantic Web, Knowledge Indicators.*

## 1 INTRODUCTION

The paradigm that organization 'is a system process', it has long been dominated the theory of organization. This system has different flows at input-process-output depending of a product or service. In other words, it takes place the process of information and knowledge, and these results are a response that a problem or a necessity were solved. How a product is created inside the organization is very important, in fact this activity generates knowledge. Knowledge occurs when we have information and we have the capability to use this information to make use of better decisions about a specific activity (Nonaka, 1994).

For it, it is common to visualize the strategic, tactical and operative levels, as well as the structure where the development of intents for optimizing all resources, as when these levels interact with each other and with the external environment. In that search of a continuous improvement, it arises at the end of the twentieth century, the denominated knowledge management (KM) whose main objective is related in fact with taking efficient advantage of the knowledge resources, for the sake of gaining a bigger profitability to the generating entity of the same one.

By the time is necessary to consider two aspects. First, in the current organizations, the human element has acquired a great relevance. But even more, one of the progress keys of the organizations is centered in the knowledge that individuals possess, and it is contained, mainly; in peoples' mind; and with their contribution both have the opportunity to prosper. In this sense, it is important that the different groups or teams that integrate the organization develop the ability to learn from each other and to contribute collectively to solve daily problems, as to identify new business opportunities that permit the survival at the same time of any organization.

Second, knowledge in organizations can be found in electronic formats such as web pages, and by this, everyone is aware of the excessive growth of information in the Web. There are thousands and thousands of resources that are stored in the Web in diverse formats. Constantly new contents and users will be added, therefore, a major complexity takes place for searching and handling information, as for the assimilation of the same. One possible way to solve these complexities is the semantic web (SW) (Berners-Lee et al., 2001) which we can consider like an extension of the current Web that facilitates among other things the search of resources in the Web. In the actual organizational model something similar is happening and the intranet suffers time and again these problems. By using SW this problems could be solved.

This paper is based on Organizational Knowledge (OK) and is related to the fields of information technologies and communications, basically centered in KM, and the objective is to propose a model that relates to the KM with SW as an organizational strategy. The structure is as follows: Section 2 presents a conceptual framework about general aspects of KM and SW. In Section 3 a model about organizational knowledge is proposed, continuing Section 4 with the description of all elements related to Organizational Knowledge Model (OKM) and, finally Section 5 concludes with a current work and summary.

## **2 CONCEPTUAL FRAMEWORK**

### **2.1 Knowledge in Organizations**

To approach knowledge in organizations, it is necessary to understand its characteristics so that, parting from these, knowledge can be shared and mechanisms of reutilization can be established.

It is very common the distinction between 'tacit knowledge' and 'explicit knowledge.' As Polanyi (1996) put it, 'We can know more than we can tell'. This phrase was used to describe tacit knowledge. Tacit knowledge is the knowledge that a person posses and that it is described as knowledge embedded in the individual's experience and it has a personal quality, which makes it hard to formalize and communicate. In his words, it 'indwells' in a comprehensive cognizance of the human mind and body. This experience can be communicated and exchanged in a direct and effective way in the socialization process (Nonaka et al., 1995). The explicit knowledge refers to the knowledge that is transferable in a formal and systematic way, by means of a language, since it can be easily articulated and interchanged, because it is independent of the individual's mind. According to Maula, Highly-structured knowledge refers to explicit, digital (possibly information systems, multimedia, printed formats, etc.), formal, and classified knowledge. It is processed in a manner that is predefined by pre-defined rules (such as conventional information systems). Also artificial intelligence systems that have expanded opportunities for defining pre-defined rules can be included in this group. Less-structured knowledge refers to explicit, digital (possibly multimedia, printed format, etc.), informal and unclassified knowledge. It can be refered to knowledge that contains unstructured personal elements, such as communication by electronic mail or discussions in intranets. Explicit but less structured knowledge that is based on man-machine interaction that consumes an increasing portion of our daily activities, and brings an element of surprises to the organizational behavior (Maula, 2000).

Another particular classification on the OK establishes a separation among the declarative, procedural and heuristic knowledge (Vasconcelos et al., 2000). Declarative knowledge is related with the physical aspects of the knowledge and responds to the questions: What? Who? Where? and When?. It is a knowledge that serves to describe specific actions to perform certain tasks. Procedural knowledge

describes actions for the following step and responds to the question: How? Finally, Heuristic knowledge describes the implicit reasoning and the individual's experience. This knowledge uses declarative and procedural knowledge to solve problems and there for to answer the question Why?

## 2.2 Knowledge Management and Enterprise Knowledge

Knowledge management is knowledge creation, which is followed by knowledge interpretation, knowledge dissemination and use, and knowledge retention and refinement (De Jarnett, 1996). KM is associated with the acquisition, uses and maintenance processes of the knowledge inside an organization. This discipline has emerged as a key activity in big corporations, since they consider internal knowledge as an intellectual asset that can help them improve their productivity, create added value and increase its competitiveness (Antonioni et al., 2004). Lots of organizations have initiated KM projects, and it has been on developing new applications of information technology to support the digital capture, storage, retrieval and distribution of an organization's explicitly documented knowledge. However, few organizations believe that the most valuable knowledge is the tacit knowledge existing within peoples' mind, augmented or shared via interpersonal interaction and social relationships (Zack, 1999).

The main process in a knowledge management system is the possibility to find knowledge sources, which are relevant for the problem at hand, as well as the process of providing knowledge sources, which can be used in resolving some problems. From this point of view, these knowledge sources can be divided into two categories: formal expert rules and (multi-media) documents. In order to enable more efficient searching for the knowledge that is contained in this second category, the content of the documents is indexed by using some ontology-based statements. These statements have conditional form: Precondition-Action, which enables us to use the same logical mechanisms in the management of both categories of knowledge sources. Moreover, a searching for relevant knowledge can result in some expert rules and/or some documents (Stojanovic et al., 2002).

## 2.3 Models used in organizations.

There are diverse models being used in organizations to analyze their strategic environment and somehow their knowledge, it is here, in the development of this paper, where we consider the following models: Strengths, Weaknesses, Opportunities and Threats (SWOT), Porter's Five Forces and Enterprise Modeling (EM). Organizations have strategic planning tools that permit the managers to formulate competitive strategies in line with the requirements of their business environments. These include SWOT analysis, which may well be used as another management technique in the process of decision making. SWOT analysis was originated from efforts at Harvard Business School to analyze case studies. Is concerned with the analysis of an organization's internal and external environment with the aim of identifying internal strengths in order to take advantage of its external opportunities and avoid external (and possible internal) threats, while addressing its weaknesses (Panagiotou, 2003).

Another interesting model is the Michael Porter's Competitive Forces Model commonly referred to as Porter's Five Forces Model (Potential Entrants, Suppliers, Buyers, Substitutes and Industry Competitors) is by far the most widely used framework for an assessment of the profit potential in the company (Porter, 1998). The collective strength of the so-called five forces differs from company to company. Each of those five forces is based on structural features (dimensions) which collectively impact the profit potential. All five forces jointly determine the intensity of the company competition and profitability. The strongest forces become crucial from the point of view of strategy formulation (Henk de Swaan et al 1999).

Finally EM is the art of externalizing and formalizing structural and behavior knowledge on how the work is organized, and in a certain level which are the company's functions. It is applied to an organization, as well as the net, or to a part of both (Reyes et al., 2005). The objective is to build models to analyze, design, represent and simulate several facets of an organization (functional, information, resources or decisions support), as well as the flows (control, information or materials flows). Depending on the level of detail and precision, these models can be use as the base for

reengineering of the business processes, or they can be shared among users using the means of communication or the aid systems for such purpose. They can even be used to control the company's operations. The EM is in a crossroad of several disciplines that include: system's engineering, organizational management, information systems engineering, control theory or the company's sociology, just to mention some.

Typically SWOT and Porter's Five Forces Model and EM are excellent models to illustrate the flows of information in the organization, according to the flows of the elaboration of a product or service, and express explicit knowledge, however, tacit knowledge is very difficult to formalize and exteriorize. Great part of the necessary information/knowledge for the elaboration of these models is found in the high-structure explicit knowledge as in documents and spreadsheets, meanwhile the majority of explicit knowledge is less-structure and it is found in web pages, electronic mail, forums, online conversions, etc. most of this information becomes occupied space in hard disk, or in backups. The problem resides in the lack of classification of information and knowledge in an appropriate way, besides that the available tools for searching only permits us to find sequences of characters, for what the context of the information gets lost, in recent years, a strong initiative is being developed to solve this problem and it is known as SW.

#### 2.4 Semantic Web

The Web represents an enormous repository of information formed by a group of fragments that somehow are integrated and interrelated, in association with particular domains and companies. However, the way information is stored at the time in most situations; it doesn't have a clear meaning that facilitates its acquisition and manipulation, in an automated or manual way. The main goal of SW is to treat this deficiency.

SW was originally proposed as "an extension to the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation" (Berners-Lee et al., 2001). It is a universal means for exchange of data and uses metadata to add meaning to data so that they can be understood, shared, processed and integrated by machines autonomously.

In other words, web contents are not only for human consumption, machines will also be able to participate. This ability of intelligent agents greatly increases the power of the web by having machines undertaking work on behalf of humans. The understanding of data is built upon giving data well-defined structure and meaning, which is accomplished by ontologies. These are used to represent concepts and relationships of data on the web and they are expressed in terms of ontology languages.

SW is the new generation of the World Wide Web, based on the semantic network knowledge representation formalism, which enables packaging information in the form of object-attribute-value statements, so called triplets (Stojanovic et al., 2002). It is assumed that the terms used in these declarations are based on formally specified ontologies (for the interest of the community); these triplets can be semantically processed by the agents in an automatic way.

The official definition given by the World Wide Web Consortium (W3C) can be summarized with the purpose that SW is as wide as the Web, it creates a universal environment for the interchange of data (W3C website). It will work with an efficient interconnection to manage personal information, it will integrate the enterprises applications, and it will share commercial, scientific, and cultural data. The services to provide comprehensible information by machines is becoming a priority for many organizations, individuals and communities.

The SW is not guided only for the World Wide Web, but rather it represents a group of technologies that can also work well on corporate intranets (Daconta et al., 2003). When OK is distributed between diverse experts and documents, the technologies based on SW can support the processes of acquisition, modeling and management of this distributed knowledge. The creation of a corporative memory can be very promising because it could be materialized in a corporate SW formed by documents, ontologies and semantic annotations on these documents using a conceptual ontology vocabulary (Buffa et al., 2005).

In organizations the structure of information and knowledge resembles each time more to the Web. Everything is dispersed and badly organized, by integrating SW technologies in the organizations this could support to give a bigger order to this chaos.

### **3 ORGANIZATIONAL KNOWLEDGE MODEL**

#### **3.1 Relationship between Knowledge Management and Semantic Web**

Hopefully with SW it will be possible to develop an advanced system for KM that allows, among other things for knowledge to be organized in conceptual spaces according to its meaning; automatic tools that will perform maintenance, verification of inconsistencies and extraction of new knowledge; searches based on questions instead of being based on words. The requested knowledge will be extracted and presented in a friendly way for all, it will be possible to make searches based on questions over several documents and it will be possible to define who can see certain parts of the information even when being in several documents (Antoniou et al., 2004). An organization centered in knowledge will be able to incorporate the SW technologies in each part of the life cycle of the process of knowledge including its production, analysis, storage, search, dissemination and reutilization (Daconta et al., 2003).

SW can support the management of OK by beginning to facilitate the structure of knowledge in such a way that it can be materialized in SW pages inside the corporate intranet. Once being in this structure, all members of the organization will continue interacting in a transparent way with the SW technologies to make specific searches of knowledge and to facilitate the generation of the new knowledge. Possibly the first stories of success won't emerge from opened and heterogeneous environments of the World Wide Web but rather they will come from the intranets of big organizations. In such environments, the centralized control will impose the use of standards and of technologies, and possibly the first real record of success will emerge from that environment.

#### **3.2 Proposal Model**

Given the apparent lack of specific models arising from the KM in relation with SW, the proposed OKM has been designed to become a model to analyze and measure the availability and/or lack regarding OK, in particular, we can not only know the KM systems ability for increasing the organization's performance, but we can also know the assets to support a better exploitation of the organization's intangible assets.

After analyzing several authors (Antoniou et al., 2004), (Berners-Lee et al., 2001), (Buffa et al., 2005), (Daconta et al., 2003), (Kaplan et al., 1966), (Potok et al., 2005), (Stojanovic et al., 2002) we consider that the SW offers a group of technologies that can support KM. Without losing the view of the general context of the organization, we believe that KM with SW both target in the organization's objectives. Therefore we propose an Organizational Knowledge Model (OKM) according to the definition of systems (a group of interacting, interrelated, or interdependent elements forming a complex whole) and recapturing ideas from SWOT, Porter's Five Forces and EM (figure 1).

All activities in organizations are interrelated and try to reach particular goals. These activities take place when considering all the 'input-process-output' that generate a product or service. At this moment it is necessary to measure their development, we need to monitor in base of indicators (Kaplan et al., 1996), these will permit us to know their actual performance and find out if there are improvements when implementing an action to measure and evaluate their progress through time, to detect problems/opportunities and to propose new strategies, this way will have a form to evaluate the organization's progress, how is its productivity and take advantage of this knowledge if we want to generate more benefits.

### **4 DESCRIPTION OF OKM**

For a better understanding we divide the OKM. This action is to facilitate a good comprehension of this model, and for this reason, the following steps are to expose and explain that OKM is conformed

by different layers, the explanation starts from the center and more main elements (nucleus model) until we reach the most external elements related to this model.

Nucleus Model is the first and main layer and is related by the interaction of: Processes, Human Resources, and Technologies, since these are elements from the core processes in all organizations. A process is a collection of activities that transform input to output in results. Core processes are a collection of organizational inter-functional activities that are essential to obtain customer satisfaction and fulfill the organizational mission. These activities integrate people, materials, energy, equipment and information (Gryna, 2001).

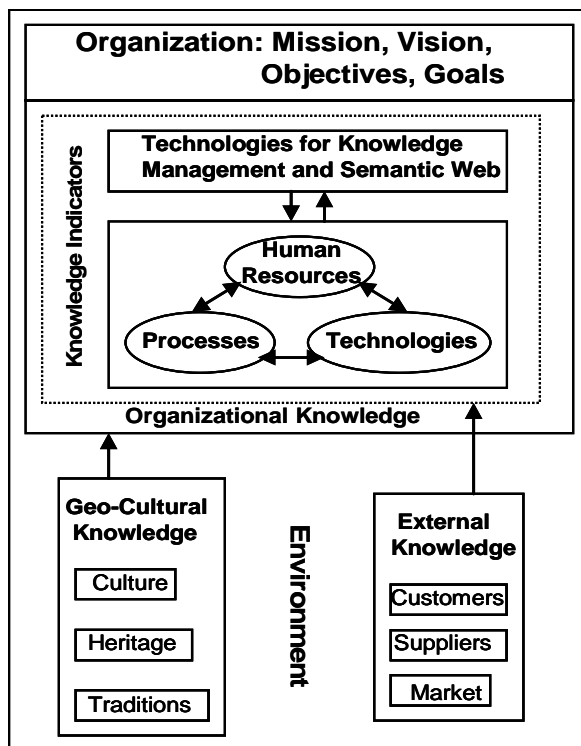


Figure 1. Organizational Knowledge Model

manager manages the state of a business process, and routes requests among participating applications.

**Processes** are generally identified in terms of beginning and end points, interfaces, and organization units involved, particularly the customer. High impact processes should have process owners. Examples of processes include: developing a new product; ordering goods from a supplier; creating a marketing plan; processing and paying an insurance claim; etc.

**Human Resources (HR)** are all the people necessary in the elaboration of a product or service in the organization, in general are: professional and manual employees, administration and main staff. We emphasize at this point, that HR has aptitudes and abilities to develop and perform a job; nevertheless something very important is the knowledge in their minds, because every brain has experiences and shortcut activities. Every day, its innovation process increases and develops new knowledge. In fact in HR takes place the process of knowledge: Socialization, Externalization, Combination and Internalization (Nonaka, 1994), because knowledge is created by individuals and without individuals organizations can not create knowledge. People are a crucial element in each organization, and in fact, are a big problem when certain workers leave the organization, because their knowledge in general is not documented and consequently, the organization loses this knowledge.

**Technologies** commonly are referred to tools and machines that may be used to help solve problems. At this context, technology may include both simple tools, such as a wooden spoon, and complex tools such as the space station. In both cases, technologies are the current state of our knowledge of how to

Independent of the area or field of any organization, this elements are the most relevant factors in theirs production for the economy and society. By this reason we denominated the center as nucleus of model.

Process is a persistent unit of work started by a company's event such as an invoice, request for a proposal, request to transfer funds, decision making or manufacturing a tool. The process is driven by business rules that trigger tasks and subprocesses, when each state transition is being executed within a transaction and audited for business reasons when required. Tasks and subprocesses are assigned to resources, which are organizational units that are capable and authorized to play specific roles in the processes.

The scripting of the rules, tasks, sub-processes, and resource policies, constitute a process description. An execution of a business process consists of invoking existing business services, which can reside anywhere. The context associated with the process is usually stored in a database and archived on completion. The process

combine resources to produce desired products, to solve problems, to fulfill needs, or to satisfy wants. Technology in this sense includes technical methods, skills, processes, techniques, tools and raw materials according to the problem and its solution.

To take advantage and to be able to use the knowledge in the Web and the resources of SW, it is important that the knowledge be stored in electronic means. Also, this will be represented and structured in function of metadata that is the medullar part of representing the semantics of the knowledge. It is here where the importance of the use of a language for the ontology representation must have a better approach and structures of representation of the knowledge; it is in this particular proposal that we denominate metadata of OK. These metadata can be represented by groups or by a single individual and they represent the integration of the different types of knowledge of the organization. In this case metadata of knowledge represents the integral entities of knowledge that can contain mixtures of different types of knowledge, related to the answers of basic questions: What? Who? When? Where? How? and Why?, these metadata is technically structured through ontologies.

In the second layer, takes place the main interaction with Processes, Human Resources and Technologies, with technologies associated to SW and KM. In this level, the knowledge community needs to be responsive to the needs of management in the organization by trying to adequately measure the organization's intellectual capital and assess the worthiness of the KM initiatives. Developing metrics and studies for measuring intellectual capital will help to consolidate the KM field and give the discipline further credibility (Liebowitz et al., 2000). In another hand, the structure of the SW includes the software agents, SW services, metadata of knowledge, mechanisms to find and connect semantic resources in the intranet, and the use elements. The critical problems of information include applications such as, acquisition and organization of information, findings of knowledge, data mining, and the visualization of these processes (Potok et al., 2005).

At this layer, we propose the relationships between nucleus and technologies support of KM, linking them by the interphase related to technologies that support SW. This structure is centered in ontologies and vocabulary that illustrate the different relationships among the elements that conform this layer, using for it tools and techniques recommended like W3C, Resource Description Framework (RDF) and Web Ontology Language (OWL) (W3C website), or DARPA Agent Markup Language Ontology Inference Layer, DAML+OIL (DAML website), that basically will support the development process to detect the assets of knowledge. By this interaction between the nucleus of model and KM and through SW, we will use indicators to measure performance or metric of knowledge (Kaplan et al., 1996), that could have support and measure the flown of explicit and tacit knowledge in relationship of productivity in the organization.

In relation to the third layer, the External Knowledge is aimed with the nucleus model and knowledge indicators as they interact with KM and SW technologies because External knowledge is represented by customers, suppliers and market. All of them are strong forces that impact in all organizations. By customers we understand all the people that interact with the organization, in fact, in the production line, the first customer is the one that is next to the one who is performing the action. There are a lot of customers, and of course the main customers are the final customers. Suppliers are all that contribute to develop the activity, and the Market is the competitive force around the organization. At this point all the previous elements related to this and prior layers constitute the OK, and it is all this that will target the Mission Vision, Objectives and Goals.

In the Fourth layer occurs the interaction with the Geo-Cultural Knowledge that is related to culture, heritage, traditions, beliefs, etc. this type of knowledge is very interesting, because societies are different form country to country and more between continents. Enterprises want to obtain best utilities and more money, therefore is necessary to analyze their Geo-cultural knowledge, because it impacts directly with the company's main objectives.

Finally, we reach the most external layer, that is related with the interaction of External and Geo-Cultural Knowledge and both conform what we denominate the Environment, where all the elements that interact against the prior levels and target the organizations goals. Of course, all the layers

impact and are related with the knowledge indicators and performance metrics of knowledge inside the organization and by this idea we conceptualized this alternative OKM to take advantage from the relationship between KM and SW in order to generate a better productivity for the organization.

## 5 CURRENT WORK AND SUMMARY

OKM is a proposed model to take advantage of the diverse forms to harness knowledge, considering from this, its semantic structures, and an option would be, to take advantage of the SW technologies to support KM, considering that the knowledge must be without a doubt related to support the organization in reaching profits, its objectives, mission and vision, and for it is necessary not to lose the strategies which the organization has settle down for such aim, considering that the center of the nucleus is formed by people, processes and technologies.

The model proposed is a form to illustrate the relationship and interaction between KM and SW as an organizational strategy. The development of models as presented here, propitiate a better use of the knowledge assets, their storage systems and extract of daily information generated inside the organizations. An alternative to companies to begin a correct classification of the information that they generate is the use of the ideas of SW. Later on with the use of technologies of SW, this information will be processed and transformed into usable knowledge to make decisions and offer the organization a competitive advantage.

The integration of KM and SW technologies, will allow the development of systems based on knowledge that will provide more efficient, easy and oportune information, this will aim with more effectiveness in the organizations objectives. At the present time, we are working to propose a methodology that supports and detaches with greater detail the OKM model, to carry out the knowledge management, considering the possible semantic structures that have the potential knowledge to manage.

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