Building a Strategic Oriented Corporate Memory

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Abstract – This paper shows a proposal for building corporate memory based on a general architecture. It has three layers: sources, middleware and repositories. First, we create an enterprise model, named Basic Framework (BF), with a view to building a Strategic Corporate Memory (SCM). Second, we use ontology and multi agents system as a means to organize our proposal. The BF is the main component, where we store relevant information for the organization extracted from legacy systems, databases, internet sites or beings-human. This conceptual enterprise model is based on management theory and uses constructs from, both positioning and resource-based views of strategic analysis, together with function analysis and total quality management. We also stress the evolutionary aspect of the SCM by relying on the configuration management concept of baseline.

Keywords - Business Model, Corporate Memory, Learning Organization, Enterprise Modeling, Organizational Baseline, Organizational Modeling, and Organizational Requirements.

Resumo: O presente artigo mostra uma proposta para a criação de uma arquitetura geral de memória corporativa. A mesma tem três camadas: *fontes*, *middleware* e *repositórios*. Primeiro, criou-se um modelo de negócio, denominado Basic Framework (BF), com o intuito de que serva como base para a criação de uma Memória Corporativa Estratégica. (SCM). Segundo, utilizou-se as abordagens de ontologias e de sistemas multi agentes (MAS) como médio para organizar nosa proposta. O BF é o principal componente, onde armazena-se informação relevante para a organização, a qual é extraída desde sistemas legados, bancos de dados, sites da internet ou mesmo dos seres humanos através de entrevistas. O modelo de negócio conceitual esta baseado em teorias das ciências administrativas e utiliza construtores das visões de analise estratégica *positioning* e *resource-based*, junto com a analise das funções administrativas e o gerenciamento da qualidade total (total quality management). No presente trabalho, também enfatiza-se o aspecto evolutivo do SCM para o qual utiliza-se o conceito de baseline.

Keywords – Modelo de Negócio, Memória Corporativa, Aprendizado Organizacional, Modelagem Empresarial, Organizational Baseline, Organizational Modeling, e Requisitos Organizacionais.

1. Introduction

Intuitively, people perceive that the environment surrounding organizations is characterized by continuous changes in regulations, technologies and markets. To deal with the environment, Xu et al. [52] propose a corporate radar system for strategic information scanning but without addressing the implementation issues. In the business strategy literature [2], [26], [43], [45], there is a consensus that continuous change needs to be managed by way of dynamic strategies. A dynamic strategic view should be adopted to enable an adequate understanding of both current and future competitors, opportunities and threats [14]. It is obvious that the quality of decision-making is partially based on the quality of the information available. However, given its existing volume, and its critical nature, an organization has to have tools that facilitate data acquisition, storage, sharing and dissemination. Unfortunately, only a few companies can make critical strategic information available to their board of directors and executives in a structured form, with the necessary timeliness, reliability and ease of access, for ensuring effective organizational decision-making.

In his book, *The Knowledge-Creating Company* [32], Nonaka discusses social factors that influence the knowledge creation process. The underlying assumption is that human knowledge is created and expanded in terms of both quantity and quality through social interaction between tacit knowledge and explicit knowledge. Obviously, explicit knowledge can be easier to elicit because, to some extent, it is structured and it can be found in different databases such as Human Resources, Finances, Accounting. Tacit knowledge is harder to elicit, although some types of it can be found in expert systems, issue-based information systems, best-practice databases, and lessons learnt files [1]. Therefore, it is critical to formulate a corporate memory framework that includes relevant constructs from these sources that can help the business to improve its organizational development and, consequently, its learning. Indeed, "organizational learning refers to experience-based improvement in organizational task performance" [3].

In this connection, Tsang [42] observes that: "lessons learned in the past, if properly stored in the organizational memory, are an important source of knowledge for members of the organization to draw upon". A similar idea is found in Walsh & Ungson [46] who declare that organizational memory "refers to stored information from an organization's history that can be brought to bear on present

decisions". However, "learning will automatically lead to better performance only when the knowledge obtained is accurate" [42], and it depends on a series of factors, such as the methods used to collect and analyze data, the organization's existing interpretation system [12] and its frame of reference [39].

One of the problems of the Software Engineering field is that designers "have ignored the importance of organizational issues in the design of information technology systems... (thus) ...many of the difficulties encountered have been due not to limitations in technology but to the disregard of organizational requirements" [15 pp.158]. The growing importance of socio-technical approaches to information requirement demands (eliciting) is evident in the literature published in the last few years, especially in the papers presented at conferences in this field (ICRE, RE, WER). These approaches "argue that seeking to establish information requirements cannot be reduced to either a rational process or the production of technical specification … especially in the current turbulent organizational and inter-organizational environments…".

The different definitions of Requirement Engineering [23] emphasize the relevance of the systems context, acknowledging the involvement of both social and technical concerns, explicit or implicitly. For example Sommerville [41] says that requirement acquisition and analysis is "the process of establishing the services the system should provide and the constraints under which it must operate". Davis [13] suggests that Requirements Engineering is the analysis, documentation and ongoing evolution of both user needs and the external behavior of the system to be built. Goguen [19] states that requirements are properties that a system should have in order to succeed in the environment in which it will be used. Leite [24] notes that the requirement definition process occurs in a context previously defined, that he calls Universe of Discourse (UofD), that is "the overall context in which software will be developed and operated".

The information of context is embedded in organizational structures, routines and procedures; physical layouts; stories, myths, languages and cultures; individual and groups attitudes; informal social networks, and so forth. G. Morgan studies this perspective in Images of Organization [31]. We believe the efforts involved are worthwhile in improving the competitive level of the company within the market, so it is important to build an organizational baseline, to store this kind of information. It is

fitting to point out that, before starting requirement acquisition, it essential that the Requirement Engineer possesses a reasonable vision of the organization, with the objective of understanding its links with other systems and with the organization's strategies and tactics.

Carroll [11] argues that it is necessary to recognize that the basic problem in Requirements Engineering is a total system engineering one, which entails all requirements in every viewpoint of the system (strategic, organizational, financial, operational, technological, commercial, environmental, etc.). In conclusion, Requirement Definition needs to evolve to be maximally cohesive since all system design and system solution components are keyed through it. In turn, Jarke et al. [22] show an interesting proposal, linking organizational aspects (policies, goals) and requirements in the strategic, tactical and operational levels, using scenarios.

In the context of the Requirements Engineering field, Leite et al. [25] propose a Requirement Baseline as "a structure, which incorporates descriptions about a desired software system in a given UofD". The authors point out that: "the requirements baseline model understands that software is a subsystem of a more complex system, called the macrosystem. As a consequence, the first requirements to be considered in the baseline are external requirements, that is, requirements of the macrosystem. The overall design of a macrosystem helps establish the UofD for the software production process".

So far, we cited different perspectives, such as that of the business strategy field and that of Requirements Engineering, both support our vision of building a repository that includes strategic, tactical and operational information; explicit and tacit knowledge; and past experiences. Our intention is to support the organization in the development of flexible business-oriented strategies, in changing environments, in its learning process and in the dissemination of knowledge. High turnover of professionals, keeping pace with the environment [52] and the need of well-defined software requirements are some of the motives for capturing and organizing the knowledge in organizations.

Another motivation for building a Strategic Corporate Memory (SCM), as a tailored repository, is that we have observed, like Freitas and Bittencourt [18], that the majority of decision-makers are objective in their search and interested in actual, relevant, combinable and useful information, rather

than in the web-pages or documents in which this information is located. In such sense, current Information Extraction Systems [18] aim at storing data taken from domain pages, documents and others databases into a repository that can be easily queried, with entities and relations semantically well defined. SCM will follow this strategy. However, the operational aspects of a corporate memory are not a trivial task, since that relevant knowledge has to be identified, modeled and stored.
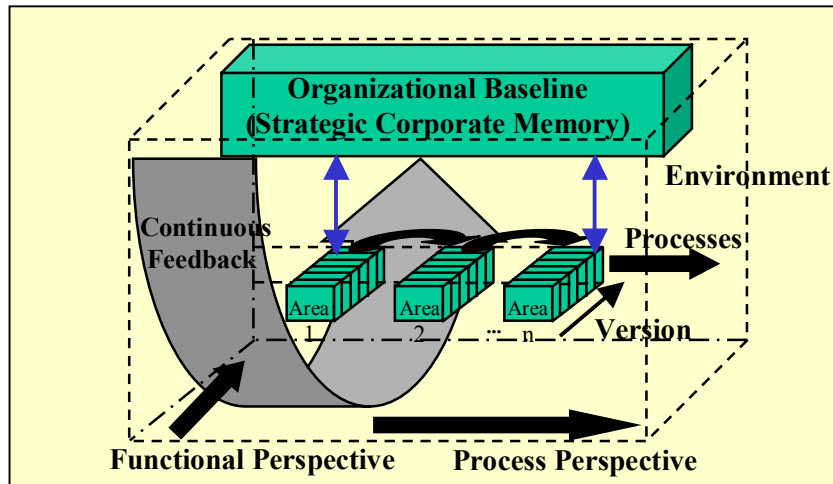

Figure 1 The context of the Organizational Baseline

To build this repository we extend the vision of the Requirement Baseline [25] to an Organizational Baseline (OB), it being a sort of organizational memory. It evolves both from a functional perspective as well as from a process perspective (see Figure 1). "The baseline cannot be considered the requirements specification, since the specification will be built based on the baseline information." [29]. The construction of an organizational requirement specification is a process that comes after the availability of an organizational baseline.

In the literature, we found different proposals about Organizational Memory (OM) or Corporate Memory (CM) but often they neglect the strategic aspect. For example Abecker et al.'s CM [1] is only focused on knowledge intensive activity with respect to the business process (workflow), not showing anything about strategic and tactical information. Basili's work [6], called Experience Factory (EF), is another example of OM, in this case for software developing projects; storing code, problems and solutions. We believe that Basili's proposal is similar to Abecker's proposal in operational and task-oriented concerns. We think that both approaches aim to improve workflow process utilizing past experiences, based on Total Quality Management theory.

There are several commercial products available in the market relates to the idea of corporate memory, such as: AskMe Enterprise™ [49], XpertRule Knowledge Builder® [50], and QuestMap™ [51]. AskMe is people-centered, making the location of people expertise in the organization an easier task; it creates a knowledge base from Frequently-Asked-Questions helping business process decision-making. XperRule tries to automate the "Business Rules" (rules, expertise, know-how, procedures, policies and regulations) by incorporating them. It also provides facilities to capture tacit knowledge through a graphical knowledge representation, utilizing knowledge maps constituted by units of knowledge (decision trees or case tables). QuestMap endeavors to capture the sense by which people make decisions, through use of a map where questions, solution ideas, pros and cons, decisions, notes, and references are located, allowing the logical sequence to be stored on the way to reaching a final decision. One characteristic of all these tools is that they are only linked to their own repositories and, in some cases, to specific documents, via hypertext. We believe these tools could improve their performance if they were connected to a CM repository, where relevant knowledge and information are stored.
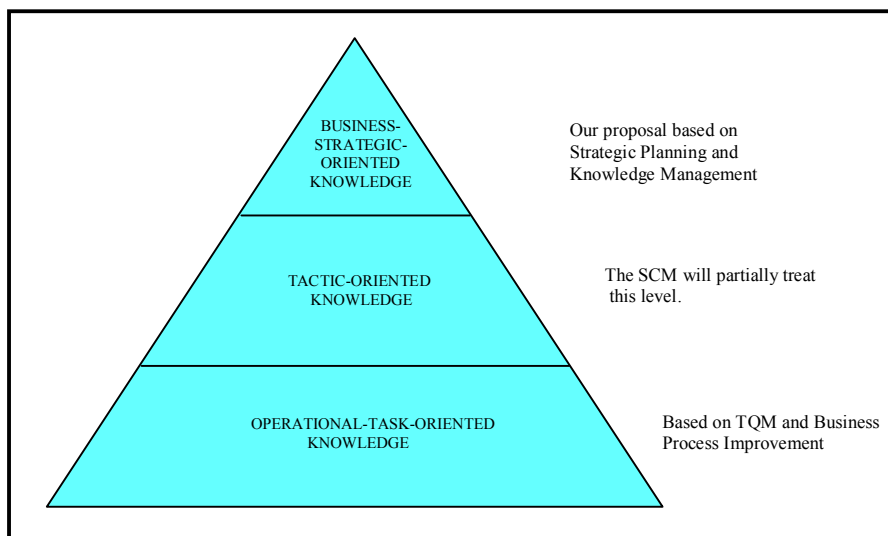

Figure 2. Knowledge Levels

Our goal is to propose a CM that includes strategic, tactical and operational aspects to support executives' decision-making and serves as source to elicit organizational and domain requirements (see Figure 2). It will allow not only storing knowledge, but also will facilitate eliciting, reutilization, sharing and dissemination throughout the whole organization. It captures Abecker and Basili et al.'s ideas as well as some strategies utilized in the above-mentioned tools (hypertext, FAQ). The SCM (Strategic Corporate Memory) architecture has the Organizational Baseline [29] as its main component,

referred to here as the Basic Framework. The other components are Ontology, Case Base, Hyperlink History, Basic Framework Upgrading and Users repositories. The Basic Framework has various concepts taken from Management Sciences [2], [14], [31], and these were formalized utilizing the ontological technology. In order to implement this SCM, we will utilize Multi Agent Systems (MAS) technology making use of *information agents (e.g. discovery*, *search and retrieve), interface agents*, and *task agents.*

At Section 2 we introduce the underlying principles of the organizational baseline, by revisiting some important work in business theory. Section 3 describes the ontological approach and its application to strategic analysis, in order to build the SCM's Basic Framework. Section 4 illustrates characteristics about agents and multi agent system (MAS) technology. Section 5 shows the SCM architecture using MAS. Section 6 relates a case study where we show the advantages of utilizing the SCM's Basic Framework. We conclude by emphasizing the strong points of our proposal and comparing it with the ongoing work in the area.

2. Strategic Analysis

In knowledge modeling a central theme is exploring which part of the organizational knowledge can be captured in formal schemata [20]. To deal with this issue, we decided to use strategic analysis approaches as a cornerstone for building the SCM's Basic Framework. We focus on the following dimensions: environment, competition and resources.

From the business literature in Management Sciences [14], [27], [47] we identified a trend towards adopting integrative approaches for creating and sustaining competitive advantage, that synthesize elements from both the Positioning and the Resource-Based schools, inasmuch as these are complementary views for understanding the different aspects of strategic analysis. Using constructs from the positioning school we map the important factors impacting both on the direct and the indirect environments (macro system) of an organization (Figure 3). Next, we provide an overview of two positioning proposals, Porter's Five-Force Model and The Environmental Framework, as well as a general description of the resource-based view.
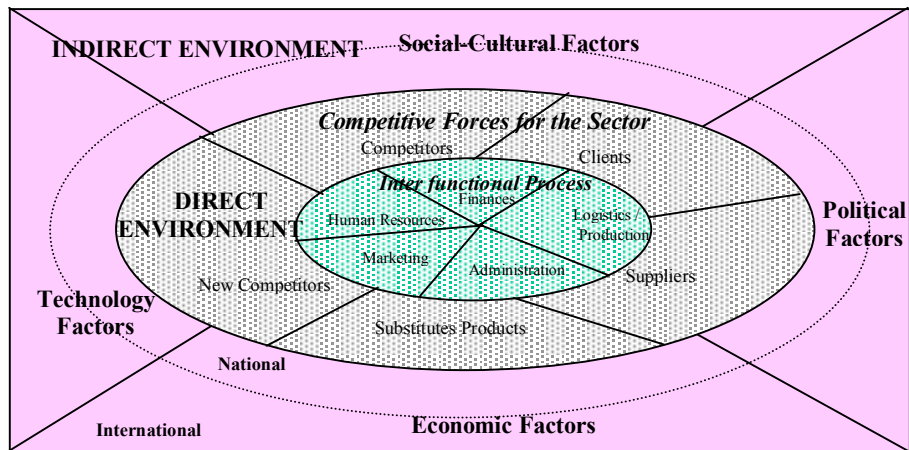
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Fig. 3 The organizational environment

a) Porter's Model: This model is based on Mason's theory of industrial organization [9], and emphasizes the importance of industry structure analysis for understanding an organization's strategy and its performance [34], [35]. Porter argues that the degree of competition in an industry goes beyond the behavior of its current competitors. As such, he proposes that strategic analysis be based on the following five competitive forces:

- *Bargaining Power of Suppliers*

- *Customer Bargaining Power*

- *Direct Rivalry among Competitors*

- *Pressure from Substitutes*

- *Threat of New Entrants*

Each of these forces has to be well understood by the organization so that it can gain or maintain its competitive advantage in the market. The correct extraction, validation and modeling of this information are not trivial tasks; they are critical for the organization's survival.

b) The Environmental Model: The proponents of this view [4], [5] are mainly concerned with what we call the indirect environment (see Figure 3). Although beyond the influence of the organization and its managers, the variables at issue in this view directly affect the firm's operations. The Environmental Model proposes constructs to deepen the analysis of the social, economic, political and technological factors that influence the competitive forces. In keeping with this view, the impact of these factors should be considered at four levels: *international*, *national*, *industrial* and *organizational*.

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c) The Resource-Based View: The proponents of this perspective, [14], [36], [47], link superior performance to the organization's resources. These resources are a combination of *assets* and *competence* that reflect the history of the organization and, as such, may limit its ability to change. The assets and competence determine how effectively the company carries out its functional activities. In other words, a critical set of superior assets and capabilities underlie the firm's positional advantage. Thus, in order to achieve a favorable position in the market, the organization must understand and map its resources. The literature divides these resources into two categories: ***Superior assets***, that refer to the tangible *quality* resources that can be price tagged and, as such, are accounted for in monetary terms; and ***Distinct*** aspects of competence, that are the glue that puts together the organization's superior assets. Each of these categories represents a complex package of skills and knowledge, operationalized by way of business organizational processes to coordinate activities, utilize its assets, and to continuously learn and improve. The competence aspects are not easily price-tagged and are more rooted in the cultural heritage of a given organization. Furthermore, most of them are tacit knowledge, which is spread along the following four-dimensions [14]:

- *Employee's knowledge*

- *System's embodied knowledge* (software, databases, and formal processes)

- *Knowledge management systems*

- *Information policies*

3. The Basic Framework of Strategic Corporate Memory using Ontology

Ontology [44] specifies conceptual knowledge for a given area of knowledge and is the essence of domain knowledge. The main elements of ontology are **concepts**, **relationships** and **axioms**. The concepts are its basic unit, linked through a network of relationships. Axioms are rules that prevail in a given ontology [30]. In our proposal we have used the following types of relationships:

- **Taxonomic:** - specializes concepts, and uses notions of class and sub-class in an *is-a* hierarchy. This relationship has non-reflexive, transitive and asymmetric properties.

- **Mereologic**: - a *parts-of* relationship and has non-reflexive, non-transitive and asymmetric properties. It means a concept is part of other concept, and can appear in pairs like: member/set, part/whole, local/area, phase/process and part/object.

- **Temporal:** - a precedence relationship, with non-reflexive, transitive and asymmetric properties. It enables one to establish temporal relationships between concepts and is particularly useful for task modelling.
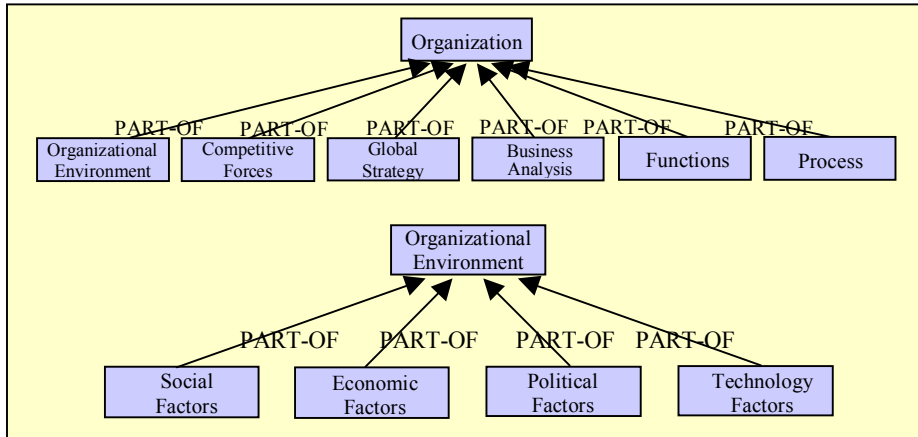
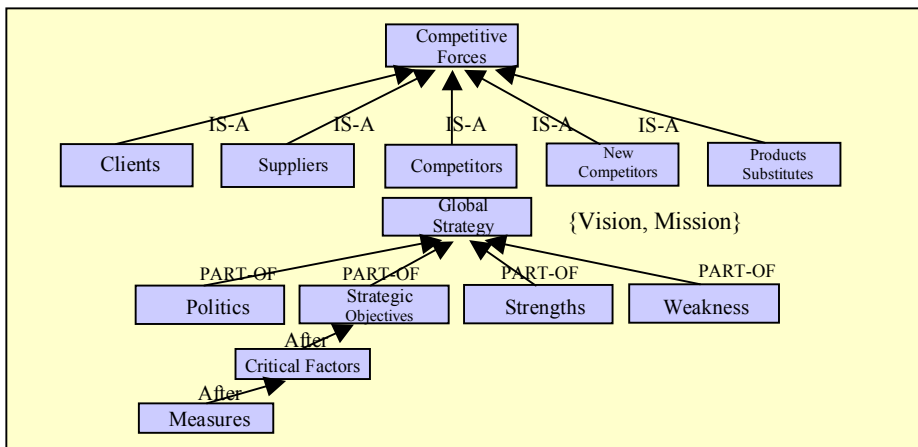**Fig. 4** The Organizational Ontology

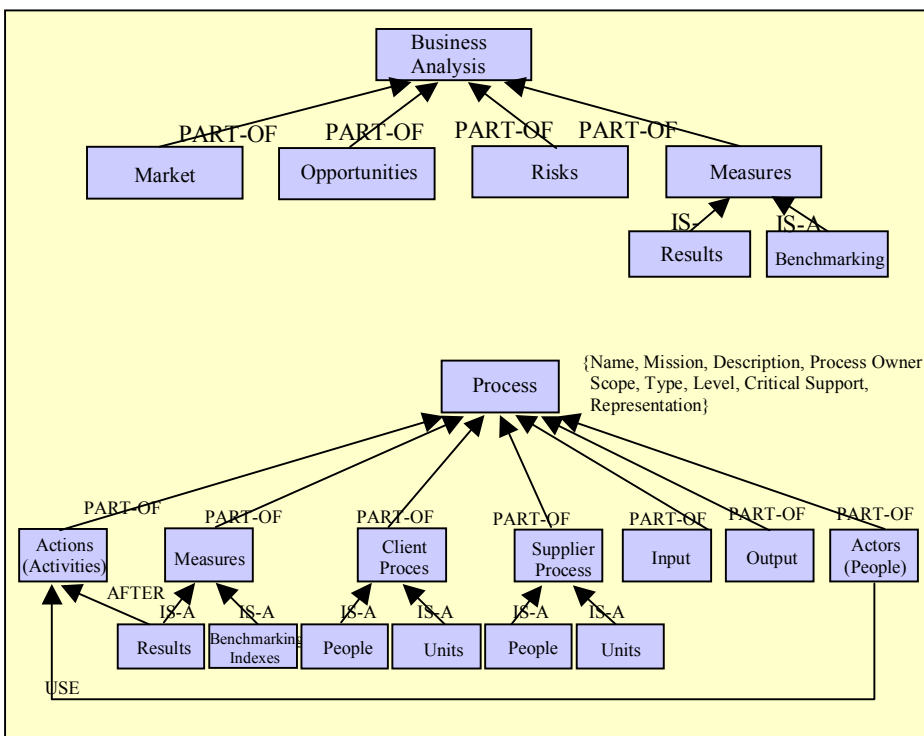**Fig.5** Competitive Forces and Global Strategy Ontology

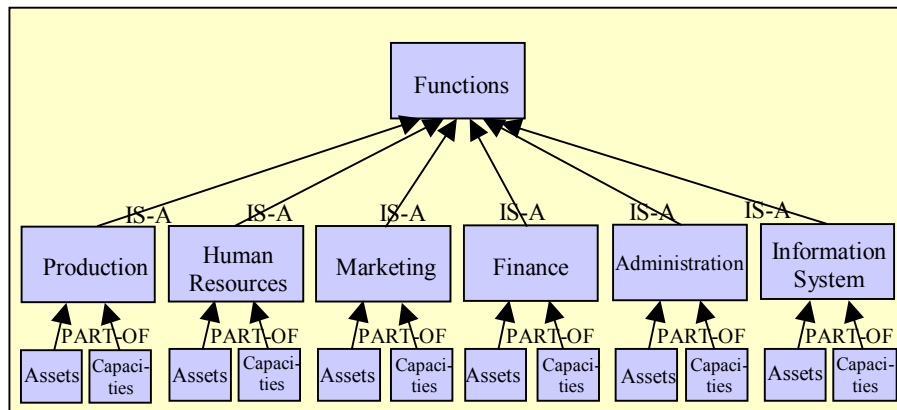**Fig.6** The ontology for Business Analysis and Processes

Fig.7 The function ontology

Figures 4, 5, 6 and 7 show the application of the business concept detailed in Section 2 - strategic analysis – in terms of ontology concepts and relationships[1]. Figure 4 shows the overall model of the Organization (mereologic) and details of the Organizational Environment concept. Figure 5 shows the details of Competitive Forces and of Global Strategy, the first uses taxonomic relationships, the second uses mereologic together with temporal relationships. Figure 6 specifies the concept of Business Analysis and the concept of Process, and mixes both taxonomic and mereologic types. Figure 7 details the concept Functions using taxonomic and mereologic types of relationships.

Based on the ontology presented above, we have built [29] an Entity Relationship (ER) model of a Basic Framework that details the concepts as well as their relationships (see Figure 8). This was done in the context of general organizations, because, as earlier mentioned, we are utilizing as theoretical basis approaches widely accepted and used in management sciences. From the ER model of the Basic Framework [29], we emphasize the entities[2] and relationships[3] listed below.

1. Every organization (**Company**) *owns* a set of strategic objectives (**Global Strategy**), business units (**Business**), **Functions** and **Processes**. Processes have *(has)* scope, representation, **Inputs**, **Outputs**, **Client Process**, **Supplier Process** and several hierarchical levels. Each Processes is *coordinated by* a work group (**Team**) *composed* of actors (**People**). **Results** are *managed by* **People**.

2. Strategic objectives (**Global Strategy**) have (*has*) **Critical Factor**, which are *controlled by* the **Benchmark Indexes**.

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[1] In this version of SCM we did not model the axioms of the ontology.
[2] The entities will be marked by boldface.
[3] The relationships will be marked by italics.

3. Comparing the **Results** with the **Benchmark Indexes** (*compared*) we can perform continuous evaluation of the organization at Company, Business, Function or Process levels. If needed, **Improving Actions** are taken (*affect*) over **Business**, **Functions**, **Processes**, **Client Process**, and **Supplier Process**.

4. The enterprise (**Company**) relation with the environment is *affected by* the **Competitive Forces** (new entrants, substitute products companies, trade unions), **Organizational Environment** (social-cultural, economic, political and technological aspects) and **Sector Analysis**.

5. **Policy**, **Patterns**, **Standards** and **Procedures** may be applied to **Company, Functions** and **Process** (*own*), while **Operational Objectives** only refer to Functions and Process (*own*).
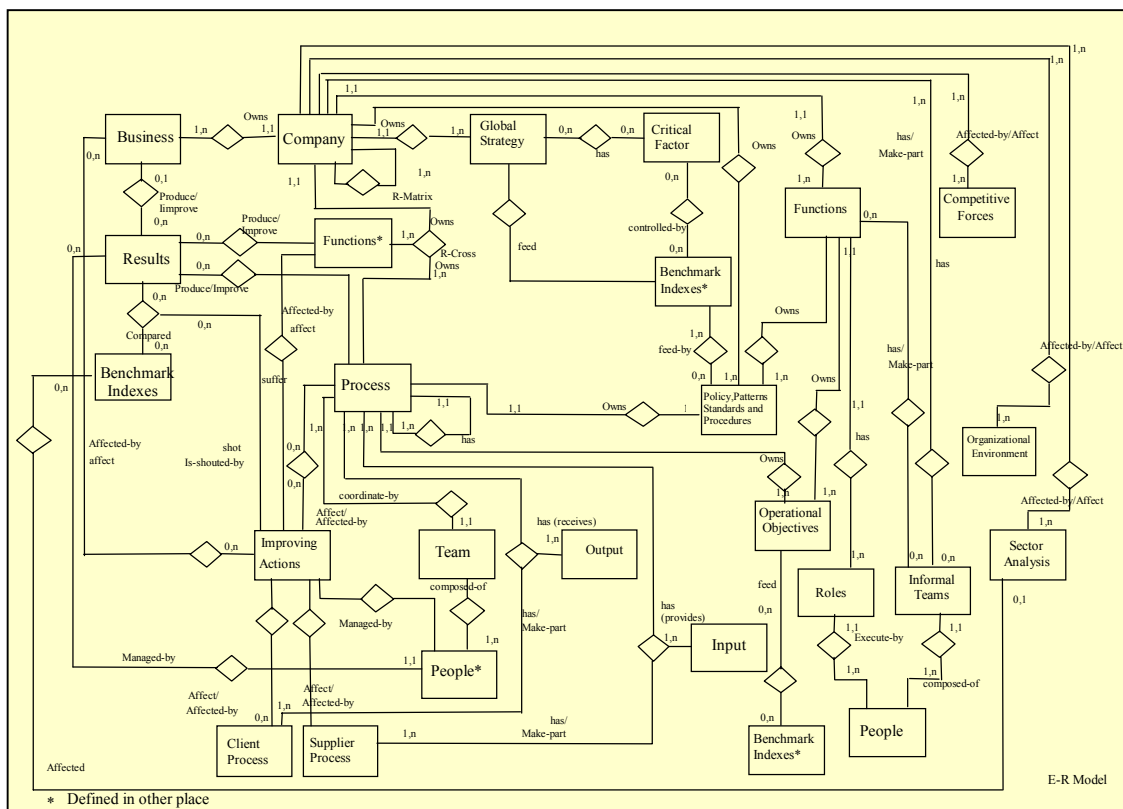

Fig.8 Basic Framework of Strategic Corporate Memory

Although the model we are working on is mainly a data-oriented model, we do account for the improvement process as seen in item 3 above. Currently, our model is too generic. Since we are emphasizing the integration of ontology concepts, more detail is necessary, for instance, on the description of the benchmark indicators, which will be based on a measurement program. The integration of a measurement program with continuous learning can, for instance, be performed using an approach proposed by Cantone et al. [8]. Another important characteristic of our model is the

description of social relations. Based on our concern with organizational actors (**People** and **Functions**) and their responsibilities (**Roles** and **Procedures**), we understand the importance of social aspects in the process of decision-making. Although our proposal of a Basic Framework includes constructs pertinent to the strategic, tactical and operational levels, here we stress the strategic dimension for building a strategic corporate memory.

4. Agents and Multi Agent System (MAS)

During the last decade, the agent approach has been developed extensively in the artificial intelligence field. Consequently, many examples can be found in a wide variety of applications, ranging from small systems as email filters or Internet agents to large, complex, critical mission systems such as air traffic control or manufacturing process control in real time. Nonetheless, concrete definitions about agents as yet do not exist, because each author defines them differently. Thus, for Wooldridge et al. [48], an intelligent agent "is a computer system that is capable of flexible (responsive, proactive, social) autonomous action in order to meet its design objectives". As such, an agent system must satisfy the following characteristics:

- **autonomy**, the system should be able to act without the direct intervention of humans or (others agents) and should have control over its own actions and internal state.

- **responsive**, agents should perceive their environment and respond in a timely fashion to changes that occur in it;

- **proactive**, agents should not simply act in response to their environment, they should be able to exhibit opportunistic, goal-directed behavior and take the initiative where appropriated; and

- **social**, agents should be able to interact, when they deem appropriate, with other artificial agents and humans in order to complete their own problem solving and to help others with their activities.

The state of an agent is formalized by knowledge, and is expressed by mental components such as *beliefs*, *goals*, *capabilities* and *plans* [33], [38]. Agents can be classified as information agent, task agent and interface agents, and each one in turn can have other sub-classifications, for example, discovery, search and retrieve agents are types of information agents.

An agent-based approach is used when software is required to have human-like attributes, such as, apparent intelligence, social ability, learning capability, adaptability, goal-directed decision-making and so on. The main reason is that *objects* are based on an analogy with *inanimate objects*, while *agents* are based on an analogy with *animate objects* (typically human beings). [16]

Multi agent system (MAS) application is composed of agents that interact with a view of achieving a common goal. So, the resultant system should have its own capabilities beyond those of a simple "sum" of the agents. We believe that SCM could be completely implemented using a MAS, because our domain has an external environment, goals (objectives) to be achieved, business capabilities needed to support these objectives, and a set of plans (explicit or tacit) to be selected. Considering that the SCM is a business-oriented distributed software system, dealing with intelligence, adaptability, and learning concerns, which are difficult of reaching with object-based approaches, we rely on a multi agent system based approach. To model the SCM application we utilize MESSAGE (Methodology for Engineering System of Software Agents) [16], which is an extension of existing methodologies for object-oriented software development to agent-oriented applications. It combines the best characteristics of MAS-CommonKADS [21], Gaia [48] and KAOS [7] methodologies.

5. SCM's Architecture

Figure 9 presents the major elements of our proposal, showing how they will be used. The questions (keywords), represented by the input vector, are submitted to the SCM by the users (managers, consultants, requirement engineers). The agents, using the semantics contained in the ontology, searches the repository (CM), extract relevant information included within its entities and attributes and, finally deliver the results to the users.
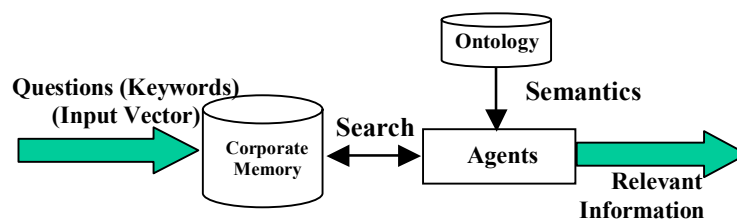

Fig. 9 Consulting Process in the Corporate Memory

5.1 SCM's Architecture Layers

Considering that our proposal of SCM is a type of materialized information integration [37], it includes sources as diverse as legacy systems, database systems, web sites or XML documents, news wire, and even multimedia sites. Another source is the information elicited from human beings. All these types of sources are shown in Fig. 10 as *source layers*.
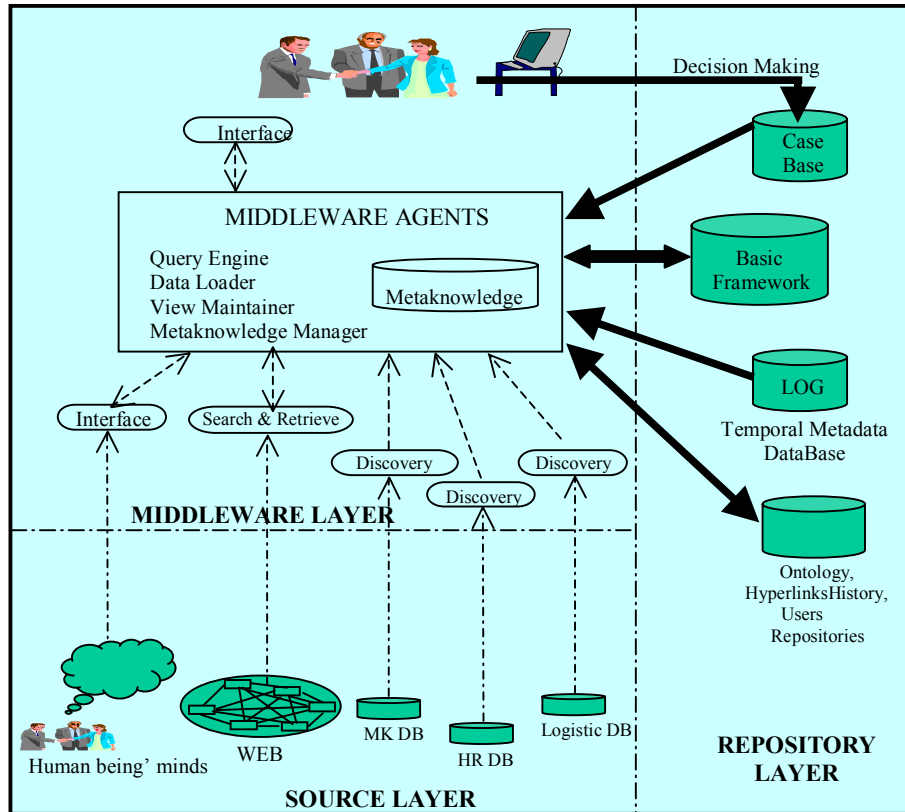

Fig. 10 Strategic Corporate Memory Layer Architecture

The agents responsible for capturing (scanning [52]) relevant information from these sources and that feed SCM's Basic Framework are part of the *middleware layer*. The latter consists of a collection of tools in charge of the exploitation of services provided by the individual sources and the proper management of the integrated SCM. Cases in point of such tools are those for filtering and merging information from several sources, for managing a metadescription of the information space and for maintaining the SCM under any change notification from sources. The metaknowledge facilitates the discovery and integration of particular information sources into the Basic Framework, and typically contains some information about the schemes and capabilities of registered information sources. Since the middleware layer also includes the user agents, which includes the executives, we decided to model

their main characteristics and functionalities, establishing a set of information needs for each of them so as to be able to determine their specific tasks.

The third level, the *repository layer*, is composed of the Basic Framework and Case Base (documents on past experiences). However, one important challenge is how to recover the most suitable information from these repositories to accomplish the requirement of a particular user. To support the extraction and dissemination of the knowledge contained in the main repositories, we planned a set of auxiliary repositories that are explained in Section 5.2.

The architecture also provides a type of automatic information retrieval, which functions when a sensor agent observes any change in the Basic Framework, then the system should automatically trigger a message on the user's browser.
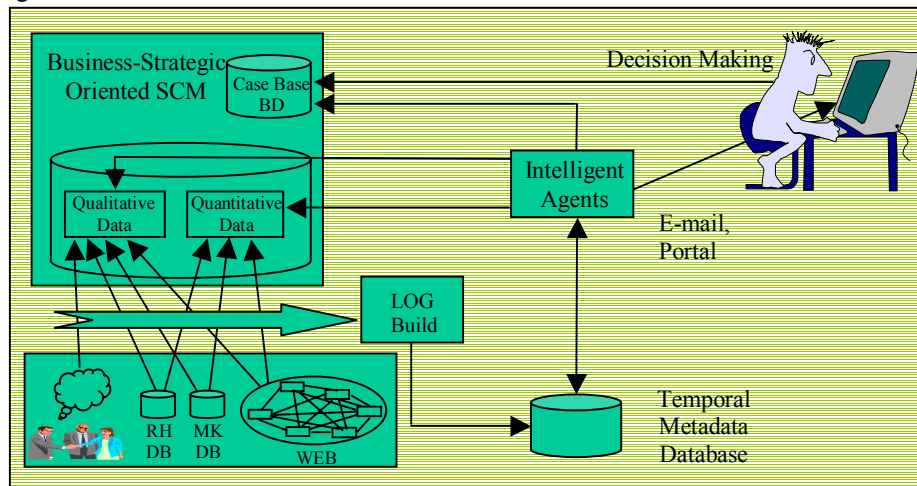

Fig. 11 Strategic Corporate Memory Architectural View

In Fig. 11 we present another view of SCM architecture, outlining the structure of Temporal Metadata Database as a result of *log* when the framework is updated, and how intelligent agents interact with the latter.

Since our proposal of SCM is an approach of tailored information repository construction, it has the following advantages: [37]

- At setup time, relevant information is extracted from different information sources on the network, transformed and cleaned as necessary, merged with information from other sources, and then loaded into a centralized data store.
- During query processing time, queries posed against the system are directly evaluated against the SCM without further interaction with the original sources.
- During operation time, modifications of the sources are filtered for relevance and are then propagated utilizing intelligent agents to upgrade the SCM.

In summary, the SCM's architecture allows for storing, reusing, sharing, and disseminating knowledge through the organization.

5.2 SCM's Repositories Structural View

Figure 12 shows the knowledge repositories (Basic Framework and Case Base) and auxiliary repositories (Business Ontology, Hyperlink History, LOG and Users) that support the recovery and dissemination process. The content of the Basic Framework is reflected in the Basic Package, which stores relevant strategic information for the organization. Below, we describe all repositories of the SCM.

a) **Basic Framework:** It represents the organizational context highlighting usable and relevant information to the company, showing the information entities that are necessary to be collected to map and manage the information contents. These information items are collected from the source layer by manual and automatic processes.
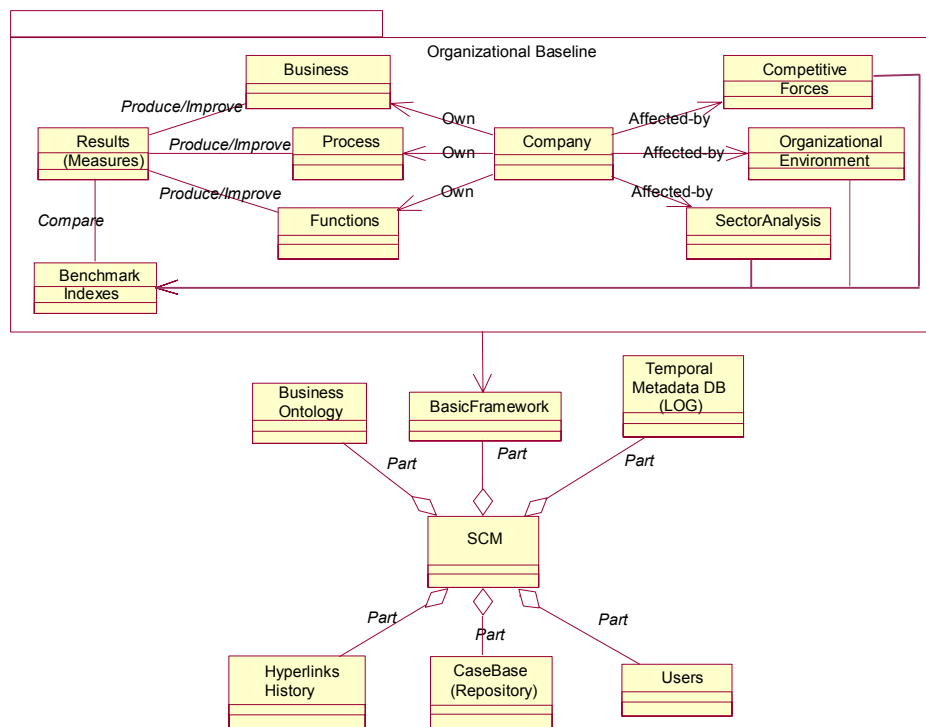

Fig. 12 SCM's Repositories Structural View

b) **Case Base:** It gathers projects or problems experiences solved in the past, which are stored for its posterior reuse. These experiences can be queried to find relevant *know-how*, to guide and to give support to the organization in its decision-making process. Relevant experiences are identified in

this repository based in the characteristics of the context, type of problem or objectives, using similarity heuristics. The best candidates for reuse are suggested to the user via a navigation system (hyperlinks), allowing the interactive exploration of the candidates.

c) Business Ontology: It stores the SCM's domain ontology including the concepts and relationships of the entities and attributes that form part of the Basic Framework and Case Base. It also provides the semantic support for the access to the required information. For example, when a user makes a search for the '*organizational structure*' term in the Basic Framework, first the SCM queries on the *Business Ontology*, if it is found, exists a set of relationships (pointers) addressing to entities or attributes of the Basic Framework to extract the contained knowledge. If the term is not found, the SCM will show the entities that are more similar and where it is more probable to find some relevant information.

d) Hyperlink History: It stores the number of "hits" for each one of the entities of the Basic Framework or Case Base. The purpose is to supply the user with a classification based on access statistics about like another users made its choice considering similar situations in the past.

e) Upgrading Basic Framework / Case Base (LOG): Each time that the Basic Framework or Case Base is updated, a register is created in the LOG (Temporal Metadata Database). It allows that given any change in the main repositories, the users are opportunely communicated (automatic recovery), depending on users' profile. This is done through a sensor agent who is observing the changes that happen in the main repositories. The communication is made by mean of a message on user's browser.

f) Users: It stores the profiles of all SCM's users, expressing their main characteristics (attributes), information necessities and relationships among them when it exists.

5.3 SCM's Design View

There are three options for modeling a MAS [16]:

1) *Goal-Based Decomposition*, which is usually most appropriate when clearly defined goals can be formulated.

2) *Task-Based Decomposition*, that will often work well when there is a clear definition of the tasks to be carried out.

3) *Responsibility-Oriented-Decomposition*, which is the most appropriate when the Agent system must interface to or "wrap" legacy components.

The Goal and Task decomposition items are similar, but the first tends to defer decisions on the mechanics of how the system operates and the sequence in which tasks are carried out. In our work we are utilizing a mix of the three of them. For example, to determine the tasks in the SCM's design, we utilize Goal/Task approaches, but to generate the knowledge base adopt a Responsibility approach.

The SCM specific packages are described in Figure 13. It shows the SCM structure (agents and roles), purpose, workflow (tasks and results) and control (sensor agents). The SCM resources represented by non-autonomous entities such as databases are included implicitly within the tasks. To deal with the tasks: *Generate Knowledge* (from DB), *Capture Knowledge* (from Internet), *Disseminate Knowledge*, *Store Decision Making*, *Upgrade Basic Framework*, and *Search Knowledge*, we define a set of information agents. Moreover, for the tasks: *Elicit Knowledge* (from people), *Capture Knowledge* and *Search Knowledge* it was necessary to establish a set of interface agents. The task outcomes are the *Knowledge Base* (Basic Framework), *Display Knowledge* (on the browser), *Decision Making Case Base*, *Output Vector* (indicates the entity, attribute or case where relevant information can be found) and *Statistics* (number of hits).
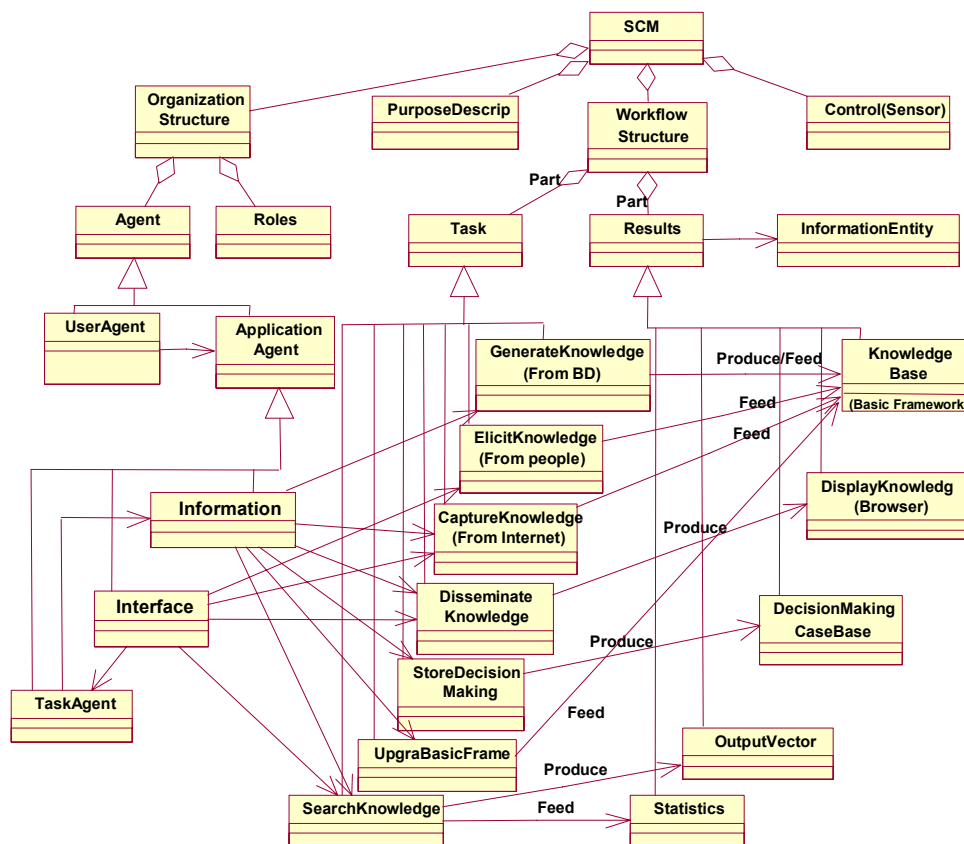

Fig.13 SCM's Design View

Following, we describe the task Search Knowledge (see bottom of Figure 13). This task uses the following agents: *user agent* (interface), *task agent* (broker, planner, integration), and *information agent* (search, extractor, dissemination). We briefly describe the responsibility of each agent:

User Agent: It is responsible for the consultation formulation through keywords (input vector). It provides an interface for the business ontology based on categories.

Broker Agent: It is responsible to routing the requisitions for more specialized or appropriate agents.

Planner Agent: It receives the input vector and generates sub-queries plans to be used by appropriate search agents.

Search Agent: It receives the sub-query and maps to the Basic Framework' entity that better satisfies its specifications. It is made using the semantics contained in the business ontology, capturing the pointers to form the output vector.

Extractor Agent: It receives the output vector, finds the more relevant entity or entities located into the Basic Framework, returning the results to the integration agent.

Integration Agent: It integrates the results and passes these homogeneous knowledge sets to the broker agent, which directs their information to the dissemination agent.

Dissemination Agent: It shows the results to the user.

6. An Example

This example was extracted and adapted from G. Morgan's *Images of Organization* [31]. "Multicom is a small business company dealing with Public Relations. It started its activities in 1979 with J. Walsh (Marketing specialist) and W. Bridges (with Public Relation knowledge) as majority partners, each of them holding 40% of stocks. They had worked for many years in a medium sized communications company. Before leaving the company they convinced two other colleagues, M. Beaumont (films and videos specialist) and F. Rossi (author and editor of excellent reputation), to join them as partners. Multicom had a customer oriented organizational model (each customer was a project). However, four years later things started changing, as Walsh and Bridges attempted to improve the company's structure. Initially, Beaumont and Rossi did not approve of the changes and many employees found that Multicom was loosing its special characteristics. One year later, Beaumont and Rossi decided to create a new company Media 2000, and take with them some important customers and

employees. Consequently, Multicom gradually started to loose its reputation as a leading company in the market, while Media 2000 rapidly established itself as an able and innovative agency.

Since Beaumont and Rossi left the company, Multicom's financial performance declined and its organizational climate deteriorated. Walsh and Bridges therefore decided to contract a consulting firm to carry out a thorough organizational assessment and propose a new strategy for Multicom."
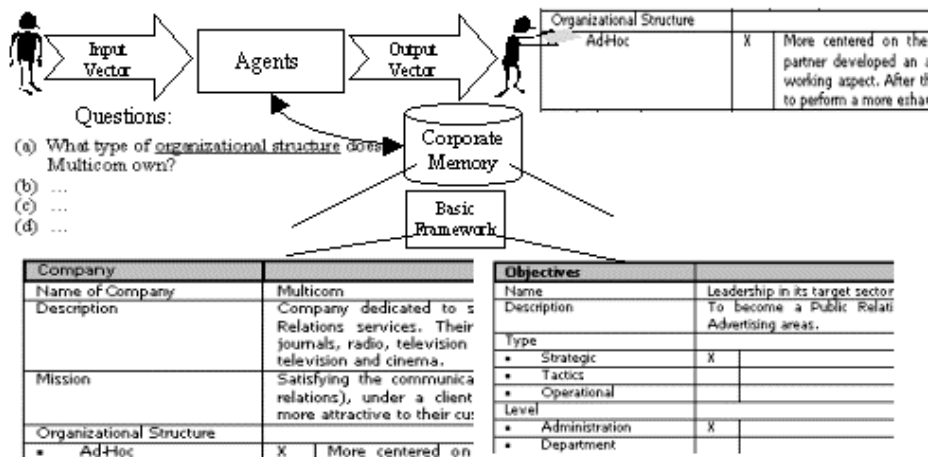

Fig. 14 Use of the SCM

Based on the above description we show how our approach would work. Figure 14 shows a query example, "What type of '*organizational structure*' does the Multicom own?", posted by the consultant and also shows how the SCM's agents access the corporate memory to extract the information. These agents catch the results and deliver it to the requester. In our example the keywords of input vector are underlined, while the entities and possible attributes where these are found are pointed by output vector (attribute Organizational Structure of the Company entity).

Tables 1, 2, 3 and 4 describe the Basic Framework's Company, Objectives, Target Market and Competitors entities, being the attributes represented in columns. Below we list others questions that could be handled by our proposed architecture. For each question we indicate where the answers (entities and/or attributes) would be found in the Basic Framework (see Tables). Thus, we give evidence that proposed architecture can answer these types of questions.

(a) What type of <u>structure</u> does Multicom own? This information is found in the items Organizational Structure and Form of Governance of Company and Business entities.

(b) What is the type of <u>organizational environment</u>? The answer is found in the items Leadership Style and Corporate Culture, of the Company and Business entities.

(c) What are the <u>critical activities</u> that influence <u>surviving organization</u> capability? See Strategic Objectives, Critical Factors, and Business Process.

(d) Does Multicom own a <u>market niche</u>? See Industrial Sector Scope, Target Market, Strategic Objectives and Critical Factor.

(e) Is Multicom adequately <u>defending</u> its <u>market niche</u> or does it have to find a <u>new market niche</u>? Evaluate strengths and weaknesses of organization, as well as Marketing Function and Benchmarking Indices.

(f) Did Multicom adopt an <u>organizational and managerial style</u> adequate for dealing with its <u>environment</u>? Analyze Company and Business entities and their attributes: Organizational Structure, Managerial Style, Corporate Culture, Industrial Sector, and Target Market. Also, its direct and indirect environment impacts on the organization.

(g) Does Multicom own an adequate <u>strategy</u>? Analyze Mission, Vision, Strategic Objectives, and Politics.

(h) Is Multicom satisfying the needs and desires of its employees? See People entity (item necessities of satisfaction).

(i) What are the <u>entrance barriers</u> for <u>new competitors</u>? See Sector Analysis, (item entrance barriers), Probable New Competitors, and Substitute Product Companies (item strengths and weakness).

(j) What <u>collaborative and competitive</u> <u>relations</u> exist with other <u>similar</u> or <u>non-similar</u> <u>companies</u>? See Sector Analysis, Competitors, and Benchmarking Indices.

(k) Are <u>learning</u> and <u>development</u> encouraged? Does the organization tend to be open and self-regulating? Analyze Company and Business entities (Managerial Style, Form of Management, Corporate Culture, Strengths, Weakness and General Diagnostic attributes).

(l) What is the <u>Organizational Culture</u> of Multicom? See Company and Business entities (attribute Corporate Culture).

Company		
Name of Company	Multicom	
Description	Company dedicated to selling of consulting and Marketing and Public Relations services. Their products are announcements in newspapers, journals, radio, television and cinema. Also it produces films and videos for television and cinema.	
Head Office (Main)	NA	
Mission	Satisfying the communications needs of its clients (marketing and public relations), under a client orientation approach, turning clients' business more attractive to their customers.	
Vision	Become a leader company of sector, offering products of high quality with competitive prices.	
Organizational Structure		
• Functional		
• Divisional		
• By Matrix		
• By Process		
• Simples		
• Ad-Hoc	X	More centered on the client, under a project orientation. Each partner developed an adequate competence level in every agency working aspect. After the main partners decided, "better organizing" to perform a more exhaustive control of employees.
Leadership Style		
• Impeding		
• Negotiator		
• Competitive	X	(2) Subsequently changed because new gain or loose type situations arose, using power games to reach new objectives, forcing (compelling) submission among company members.

• Accommodative		
• Collaborative	X	(1) Initially, the differences that eventually could arise were resolved sharing ideas and information. Seeking integrative solutions in which everybody gains.
Form of Govern		
• Autocracy		
• Bureaucracy	X	(2) Changed for a more structured, therefore bureaucratic form, with a clearer definition of the responsibilities for each position. Procedures more formalized to regulate the exchange of personnel among projects and a better control of conditions under which company members could stand down.
• Technocracy		
• Co – Administration		
• Participate	X	(1) All new employees were encouraged to develop same skills and global capacities in addition to specialized aspects, creating more substantial flexibility.
Corporate Culture		
• Beliefs - Sentiments – Images		Initially, it held the belief that Multicom's progress and development, could only be reached through combined efforts and cooperation among all of the members. There was much emphasis on interdependence, shared worries and mutual assistance. Employees regarded the company as an extension of their families.
• Practices	X	To hold meetings celebrating the ending of large projects or signing new client contracts. This helped to keep high moral and to project an image of the company as an excellent place to work.
• Patterns	X	There is a uniform culture standard among the different groups at Multicom, as result of workgroup policy.
• Organizational Attitude	X	Multicom's employees work hard, starting early morning and ending late at night.
• Organizat. Stereotypes		
• Ideology		
• Values	X	• Enthusiasm for the job / Problem and idea sharing practices, in a free atmosphere, conducive to dialogue / Honesty / Tenacity aimed at improvement / Gratitude
• Laws (Rules)-Ritual		
• Religion	X	Majorities of members are non-practicing catholic.
• Conflicts	X	Conflicts among majority and minority partners resulted in the retirement (release) of minority partners.
Scope of Activity	All sectors of the economy	
Target Markets	Not specified	
Threats (Risks)	Minority partners left taking away some important clients and are probably trying to capture other Multicom clients. There is also the chance that some employees plan leaving and starting their own businesses.	
Opportunities	The company should take more advantage of promotional opportunities at Christmas and New Year, Carnivals, Mother's Day, Father's Day, Children's Day, etc.	
Strengths	Experience in the sector, team spirit , good contacts, and latest generation equipment.	
Weakness	It has not defined its target market. Absence of adequate management policy. Employees lack motivation.	
General Diagnosis	As a result of minority partners leaving the company, some important clients were lost to the detriment of basic revenue. Competition strategy needs to be re-defined.	

Table 1 Company Entity

Objectives		
Name	Leadership in its target sector	
Description	To become a Public Relations company leader in the Marketing and Advertising areas.	
Type		
• Strategic	X	
• Tactics		
• Operational		
Level		
• Administration	X	
• Department		
• Section		
• Area		
Critical Factor	Qualified employees, high quality equipment, good contacts in the market.	
Critical Support	Persons responsible for each area must have the required experience	
Impacts	Services and products of quality.	

Table 2 Objectives Entity

Target Market		
Name of the Sector	Marketing and Public Relations	
Description	Tends towards selling services and consulting	
Growth Rate of Sector	5%	
Income by Sector		
• State	10%	
• Regional	10%	
• National	8%	
• Mercosul	10%	
• International	8%	
Technology utilized	Text Editing, CAD products, filming equipment	
Strengths	Characterized by membership maturity.	
Weakness	Weak protection against competitor penetration.	
Threats (Risks)	As result of globalization the transnational companies are closing their marketing of many contracts with worldwide marketing companies	
Opportunities	In recession times companies need to make stronger campaigns for promoting their services and products. Nowadays, marketing is an indispensable tool for companies.	
General Diagnostic	Even regarding the ongoing recession, the sector is in constant growth.	

Table 3 Target market Entity

Competitors		
Name of Company	Media 2000	
Description	Company dedicated to Marketing and Advertising services. Its activities include: • Graphic Design for enterprise identity, (logotypes, logos, brands); • Compiling and producing of catalogs, manuals, handouts, brochures, direct mail shots • Preparation of journals and newspapers • Publications, interviews and advertisements in every type of media (TV, radio, journal, newspaper, out-door, etc.) • Institutional videos • Others: Home page, gifts, promotional material • Photographic services.	
Address	Rua Santa Catarina, 244 8º andar - conj. 805 CEP 09510-120 Rio de Janeiro – RJ	
Phone	(21) 2224-5657	
Type		
• General	X	
• Specialized		
Strengths	Large working experience of main partners, small but lucrative client portfolio. Accommodating working environment Innovative and talented company.	
Weakness	New company in the market, principal partners have little managerial experience. Weak financial structure.	
Shared of Market	Small (2 %)	

Table 4 Competitors Entity

7. Conclusions

Our work on strategic corporate memory architecture is targeted at a general audience. We are utilizing theoretical approaches taken from management sciences, which have gained value over time in a wide variety of cases, in different industrial sectors and by consulting companies, to build the main component, the Basic Framework (Organizational Baseline). Therefore, our proposal is anchored on past work [17], [28] and basically aims at providing a model in the form of a framework and architecture not specific to any industrial sector. As such, our initial goal was to present a model with concepts from the field of business strategy.

Indeed, in the short term we are interested in defining, in detail, the different agents required for implementing the strategic corporate memory. However, in the medium term, we would like to enlarge the scope of SCM's Basic Framework proposal, including other kinds of constructs that can be useful for building a global corporate memory, namely information items at both the tactical and operational levels.

We believe that a significant contribution of the work presented here is to integrate constructs from, on the one hand, strategic management frameworks, namely, the "structure-conduct-performance" model, the environmental model and the resource-based school, with constructs, on the other hand, from functional analysis and Total Quality Management (TQM), with a view to designing an organizational model as base for building a corporate memory. This model includes explicit and non-explicit (tacit) knowledge in accordance with Nonaka's definition, in the form of information items of contextual information, documents and unstructured/semi-structured information. The architecture facilitates access, sharing, re-utilization and dissemination of this information, permitting enhancement of the organization's competitiveness according to how it manages its knowledge.

However, it is important to stress that SCM also has other important components (Ontology, Case base, Neural Network, Hyperlink History), which contribute to making it more robust. Our research also includes providing hypermedia functionality to SCM through the WWW as mentioned in [10].

It is obvious that all knowledge management processes need both technological and managerial facilitators. In this sense, it is very important to implement a program of organizational development to encourage staff members to use the model at issue as soon as possible. We believe that our proposal has a more holistic approach to knowledge management than the usual proposals that concentrates themselves on the "class of relation development" [20], that is are more technological oriented. By focusing on the overall context of the organization, and its relation to the environment, we believe that our proposal has more grounds to integrate knowledge oriented systems with the organizational need for knowledge management.

In order to exemplify our proposal, we presented an example where we show the usefulness and the functionality of the Basic Framework, main component of SCM. In the short term, we are planning to conduct new real-life case studies in different types of organizations from different industrial sectors. We expect, in spite of the data collection problems, to gather new insights from these case studies to refine our proposed Basic Framework model. At the same time, we are developing a web tool support to disseminate gathered organizational knowledge as well as to validate the other architecture's components.

8. Bibliography

[1] A. Abecker, A. Bernardi, K. Hinkelmann, O.Kühn, M. Sintek. Toward a Technology for Organizational Memories. *IEEE Intelligent Systems* 13(3): 40-48 May/June 1998.

[2] G.G. Alpander, C.R. Lee. Culture, Strategy and Teamwork: The keys to organizational change. *Journal of Management Development*, August 1995, v.14, n.8, p4(15).

[3] C. Argyris, D. Schon. *Organizational Learning: A Theory of action perspective*. Reading, MA: Addison-Wesley, 1978.

[4] J.E. Austin. *Managing in Developing Countries: Strategic Analysis and Operating Techniques*. The Free Press. 1990.

[5] H. Ayvar, F. Falcon, N.A. Mamani-Macedo, J. Rodriguez. Strategic *Planning and Implementation of a Electrotechnical Company*. Dissertation of Master in Administration. Business Administration School for Graduates, ESAN. Lima, Perú. April 1989. (In Spanish)

[6] V. Basili, F. McGarry. The Experience Factory: How to Build and Run One, *19th Int'l Conference on Software Engineering,* (ICSE'97), Boston, Massachusetts, May 17-23, 1997.

[7] P. Bertrand, R. Darimont, E. Delos, P. Massonet, A. van Lamsweerde A.. GRAIL/KAOS: An Environment for Goal Driven Requirements Engineering. *Proceedings ICSE'998* – 20th Int'l Conference on Software Engineering. IEEE-ACM. Kyoto, April 1998.

[8] G. Cantone, L. Cantone, P. Donzelli. Organizing Software Technology Models, Measures, and experiences for Conceptual Learning. *Proceedings of the 2nd Workshop on Learning Organizations*. Edited for Klaus-Dieter Althoff. Frauhofer, IESE, KL Germany. 2000.

[9] J.M. de Chabert, *A Model for the Development and Implementation of Core Competences in Restaurant Companies for Superior Financial Performance*. Dissertation of Phd. Virginia Polytechnic Institute and State University. June 1998.

[10] C. Chiu Towards integrating hypermedia and information systems on the web. *Information & Management*. In press. Elsevier Science B.V.

[11] D. Corrall. Requirements Engineering Needs Total Systems Engineering. *Requirements Engineering* Volume 2, Number 4, 1997. Springer-Verlag.

[12] R.L. Daft, K.E. Weick. Toward a model of organizations as interpretation systems. *Academy of Management Review*, 1984, 9(2), 284-295.

[13] A. Davis. *Software Requirements: analysis and specification*. Prentice Hall, 1990.

[14] G.S. Day, D.J. Reibstein, R. Gunther Ed. *Wharton on Dynamic Competitive Strategy*, USA. John Wiley & Sons. 1997.

[15] J.E. Dobson, M.R. Strens, Organisational Requirements Definition for Information Technology Systems, *Proc. IEEE*, ICRE'94, Colorado Springs, April 1994.

[16] EURESCOM. MESSAGE: Methodology for Engineering Systems of Software Agents – Deliverable 1. Initial Methodology. July 2000. Project P907-GI.

[17] S. Fiorini, J.C.S. do P. Leite, T.D. v. A. de Macedo-Soares. Integrating Business Processes with Requirements Elicitation. *Proceedings of Fifth Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises*. IEEE Comp. Society Press, 1996, pp. 226-231

[18] F.L.G. Freitas, G. Bittencourt. Cognitive Multi-Agent Systems for Integrated Information Retrieval and Extraction over the Web. *IBERAMIA-SBIA* 2000, LNAI 1952, pp. 310-319. Monard M.C. and Sichman J.S. Eds. Springer-Verlag Berlin Heidelberg 2000.

[19] J.A. Goguen. The Dry and the Wet, in Information Systems Concepts: Improving the Understanding. *Proc. IFIP WG 8.1 Conference* (Egypt) Elsevier Holland, 1992, pp. 1-17.

[20] P.H.J.Hendriks, D.J. Vriens. Knowledge-based systems and knowledge management: Friends or foes? *Information & Management* 35 (1999) 113-125. Elsevier Science B.V.

[21] C. Iglesias, M. Garrijo, J. Gonzalez, J.R. Velasco. Analysis and Design of Multiagent Systems using MASCommonKADS. In *Intelligent Agents IV: Agents Theories, Architectures and Languages*. 1997. LNCS 1365. Springer-Verlag. pp. 313-326.

[22] M. Jarke. X. Tung Bui, J. Carroll. *Requirements Engineering*, Volume 3, Numbers 3&4, 1998. *Special Issue on Interdisciplinary Uses of Scenarios*. Springer-Verlag.

[23] M. Jirotka, J. Goguen Eds. *Requirements Engineering: Social and Technical Issues*. Academic Press Limted. 1994.

[24] J.C.S. do P. Leite. *Requirement Eliciting*. Classroom Notes PUC-Rio. 1994 (In Portuguese)

[25] J.C.S. do P. Leite et al. Enhancing a Requirements Baseline with Scenarios. *Requirements Engineering* Volume 2, Number 4, 1997. Springer-Verlag London Limited.

[26] D. Lewis, The Organizational Culture saga from OD to TQM: A Critical Review of the literature. *Leadership & Organization Development Journal.* January 1996. V17,n1 p12(8), March 1996. V17, n2 p9 (8).

[27] T. d. L. v. A. de Macedo-Soares. An Integrative Model for Strategic Management Analysis: Application to Organizations in Brazil. *Proceedings INFORMS-KORMS* Seoul, South Korea, June 200, pp.460-467.

[28] N.A. Mamani-Macedo. *Integrando Requisitos Não Funcionais aos Requisitos Baseados nas Ações Concretas.* Dissertação de Mestrado. Computer Sciences Department, PUC-Rio. 1999.

[29] N.A. Mamani-Macedo, J.C.S. do P. Leite Building an Organizational Memory under an Approach of Ontology. Ideas'2001, *Workshop Iberoamerican of Environment and Software Developing.* San Jose, Costa Rica. 2001. (In Portuguese)

[30] R. Martinez-Bejar, *"Knowledge modeling technologies: ontologies and ripple-down rules".* Lecture given at ICMC-USP São Carlos 14, 17 November 2000. Professor at Murcia University, Spain.

[31] G. Morgan. *Images of Organization.* Ed. Atlas, 1996. (In Portuguese)

[32] I. Nonaka, H. Takeuchi. *The Knowledge-Creating Company.* Oxford Univers. Press. 1995.

[33] Object Management Group – Agent Platform Special Interest Group. Agent Technology – Green Paper. Version 1.0, September 2000.

[34] M. E. Porter. *Competitive Strategy.* 1980. Free Press, A Division of Macmillan Publishing Co., NY, USA.

[35] M.E. Porter. *Competitive Advantage.*1985. Free Press, A Division of Macmillan Publishing Co., NY USA.

[36] R.P. Rumelt , D. Schendel, D. Teece. Strategic Management and Economics, *Strategic Management Journal,* 12 (winter), 5-30, 1991.

[37] E.A. Rundensteiner, A. Koeller, X. Zhang. Maintaining Data Warehouses over Changing Information Sources. *Communications of the ACM.* June 2000/Vol.43 N°. 6, pp.57-62

[38] Y. Shoham. Agent-Oriented Programming. *Artificial Intelligence*, 60: pp. 24-29, 1993.

[39] P. Shrivastava, S. Schneider. Organizational frames of reference. *Human Relations*, 1984, 37(10), 795-809.

[40] H.A Simon. Bounded Rationality and Organizational Learning. *Organization Science* 1991, 2(1), 125-134.

[41] I. Somerville. *Software Engineering*: 3rd edition. Addison-Weslwy, Norwood, NJ, 1989.

[42] E. Tsang. Organizational Learning and the Learning Organization: A Dichotomy between Descriptive and Prescriptive Research. *Human Relations*, January 1997, v 50, n 1, p 73 (17).

[43] Andrew H. Van de Ven, Marshall S. Poole. Explaining Development and Change in Organizations. *Academy of Management Review*, July 1995 v 20, n 3, p 510 (31).

[44] G. Van Heijst, R. Van der Spek, E. Kruizinga. Organizing Corporate Memories. In B, Gaines, M. Musen Eds. *Proceedings of Knowledge Acquisition Workshop'96*, Banff, Canada, November, pp. 42-1 42-17.

[45] T.E. Vollmann. *The Transformation Imperative: Achieving Market Dominance through Radical Change.* Boston, M.A. Harvard Business School Press, 1996.

[46] J.P. Walsh G.R. Ungson. Organizational Memory. *Academy Management Review*, 1999. 16 (1), 57-91.

[47] B. Wernerfelt. A Resource-Based View of the Firm. *Strategic Management Journal*, Volume 5, April-June 1984, pp. 171-180.

[48] M. Wooldridge, N. Jennings, D. Kinny. *The Gaia Methodology for Agent-Oriented Analysis and Design*. Kluwer Academic Press Publishers. Boston 1999.

[49] www.askmecorp.com

[50] www.attar.com/pages/info_xr.htm

[51] www.gdss.com/wp/DOM.htm

[52] X.M. Xu, G.R. Kaye and Y. Duan. UK executives' vision on business environment for information scanning. A cross industry study. *Information & Management. In press.*. Elsevier Science B.V.