Some Considerations About Collaborative Systems Supporting Knowledge Management in Organizations

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Abstract: In the present global economy, strongly influenced by IT (information technology) and information systems evolution, the modern organizations try to face the challenges by adjusting their strategies and restructuring their activities, for aligning them to the new economy requirements. It is certain, that the enterprise's performance will depend on the capacity to sustain collaborative work. The evolution of information systems in these collaborative environments led to the sudden necessity to adopt, for maintaining the virtual activities/processes, the latest technologies/systems that are capable to support integrated collaboration in business services. Stating this, we mean collaborative systems of different type: conversational tools, multi-agent systems, and all these, among various enterprise applications, integrated in portal-based IT platforms.
It is obvious, that all collaborative environments (workgroups, practice communities, collaborative enterprises) are based on knowledge, and between collaboration and knowledge management (KM) there is a strong interdependence. Therefore, we focused on how collaborative systems are capable to sustain knowledge management and their impact on optimizing the KM life cycle. We explore some issues regarding collaborative systems and propose a portal-based IT solution that sustains the KM life cycle through a distributed architecture. All considerations have a strong research background, our portal-based proposal for sustaining knowledge management in organizations being subject of some Romanian research projects that are fitting in the European research demarches.

Key-words: collaboration, collaborative environments, knowledge management, distributed knowledge management, collaborative systems, portals, knowledge portals.

1 Some Collaborative Systems

Collaborative technologies fundament a large range of tools, systems and IT platforms that sustain collaboration in the modern global economy, contributing decisively on the consolidation of different types of virtual collaborative communities, virtual world constituting a reality superstructure.

The orientation toward a collaborative business represents a necessity for developing a competitive business in the actual global economy [Muntean 2006; Ghilic-Micu, Stoica, Mircea, 2008]. At the end of 2008, Forrester Research Inc. surveyed business environment inquiring about companies' opening towards adopting new IT collaborative platforms; a trend was obvious, more than 50% heading to collaborative technologies. Based on our research, we propose the adoption of portal platforms at the level of collaborative communities/environments, and followed by integration of a series of systems, collaborative instruments, and enterprise applications which help to consolidate portal's SOA architecture (Service Oriented Architecture) meant to sustain collaboration as a business strategy.

It is obvious that collaborative systems maintain knowledge management (KM) at the level of collaborative environments, interfering into all stages of KM life cycle (subject developed in 2.1).

Without iterating different consecrated approaches in the field of collaborative systems [Mooney, 1974; Giboin, 2000; Marakas, 2003; Crabtree, 2003; Pels, Wortmann, 2003; Cil, Altrup, Yazgan, 2005; Kurdel, Sebestyenova, 2007; Nițchi, 2006, 2007, 2008], we will develop our scientific intercession around some consideration towards:

- collaborative systems based on software agents;
- collaborative tools (in fact, conversational tools);
- portal-based IT platforms; initiative sustained by the following considerations:
  - ❶ in the actual global economy, in which collaboration is imposed as a business strategy, collaborative environments based on any kind of knowledge presume the existence of informatics systems, tools and technologies being able to maintain collaborative work, collaborative solving of different tasks, collaborative decisions and consolidating value;
  - ❷ multi-agent systems imposed themselves as facilitating collaboration, maintaining economic processes/activities, as well as collaborative solving of specific complex problems;
  - ❸ on the other hand, collaborative tools are indispensable in every collaborative organization/community, concurring on sustaining the knowledge dissemination between its members;
  - ❹ but, the IT infrastructure of collaborative communities presumes the existence of complex platforms, with various capabilities in order to virtualize a big part of the communities' reality.

    This can be achieved only with the help of portal technologies, at their level being integrated multi-agent systems with specific functions as well as a diverse range of conversational tools.

1.1 Considerations Regarding Multi-Agent Systems

Multi-agent systems are computer based environments that contain multiple software agents to perform certain tasks [Turban, 2007].

Multi-agent systems offer an innovative perspective on the capacity of configuration virtual communities. But some of their capabilities must be perfected, as follows [Muntean, 2009]:

- incrementing the intelligence level of the agents through perfecting their capabilities, aiming autonomy, cooperation and learning;
- introducing new valences as for agents collaboration within MAS (Multi-Agent Systems) and, maybe even new approaches at protocol level and communication languages (KQML, KIF, COOL, etc.);
- upgrading the MAS's security level (processes, systems, respectively network security – securing communication between agents).

Agents in a multi-agent system are characterized by autonomy, adaptability, interoperability and dynamism. A multi-agent model includes a number of informative agents who share their results with a just-in-time middle agent [Maracine, 2007]. The middle agent does not only suggest its own documents of relevance, but information found by other agents as well. Agents deposit information for later use by themselves or by other agents. In this way, knowledge sharing between agents is possible, but it is controlled in such a manner as to allow modular inclusion of agents within the framework.

From the knowledge management point of view different ways of sustaining this process must be developed, ***an important part being held by manipulation agents' knowledge in different ways***.

It is obvious that developing MAS is a complex process which can raise real problems virtualizing some collaborative communities. In the last years it is ascertained the emergence of some specialized platforms for developing multi-agent systems, which contributes substantially to reducing the effort of developing those kinds of systems.

1.2 Considerations On Collaborative Tools

Collaboration tools or groupware, were the first tools to be used to enhance tacit knowledge transfer within an organization.

Social or conversational technologies imposed themselves in the last years as tools that sustain knowledge management in collaborative environment [Wagner, Bolloju, 2004; Roll, 2004; Anghel, 2009].

Bypassing the stage of simple conversational support, these instruments maintain tacit knowledge dissemination at the community level, consolidating collaboration through offering various facilities of collaboration based on the considered environments' demands/necessities, in literature contouring the concept of „on demand collaboration anytime/ anywhere" [Marcus, Coleman, 2006]. Therefore, it is recommended the

integration of this kind of tools in IT virtualizing collaborative environments platforms.

We consider that:

- collaboration within different work groups, communities, virtual environments, can't be achieved without the help of social/conversational tools. These are the first to be adopted, adding, based on the community's demands and necessities, advanced collaborative systems and technologies;
- from the knowledge management point of view, tools such as forum, blog, wiki, etc. bypassed a long time ago the level of a simple conversational instrument, sustaining it's life cycle stages;
- developing of some collaborative tools, in the last years, implies using technologies and web programming, because of the boom of open-source solutions, in order to reduce their development effort.

1.3 Considerations Regarding Portal Technologies

With each portal generation, portal producers promise amending of work quality through supplying extra services for the members of collaborative communities. These services are the result of integration and unification of different applications, information system and collaborative tools, necessary to maintain current activities, business processes held at the level of virtualized environment.

Integration represents the key concept, around which portal technologies developed, with the help of some integration mechanisms/schemes like portlet, gadget, iView, skin or dashboard [Guruge, 2003]. Portlets became the most popular ones, being the most efficient integrator in portal type architecture [Sullivan, 2003], the majority of portal server developers adopting this concept.

In essence, the role of portlets at Application Layer is to be in charge of the correct functioning of information systems integrated into the portal's platform management, to make the necessary links with the Presentation Layer, and with the different sources of information/knowledge at Information Service Layer (figure 1).

Portlets permit the maintaining of attached applications independent of the rest of the portal. They cover the presentation level and business logic, but are connected to information/knowledge sources from back-end.

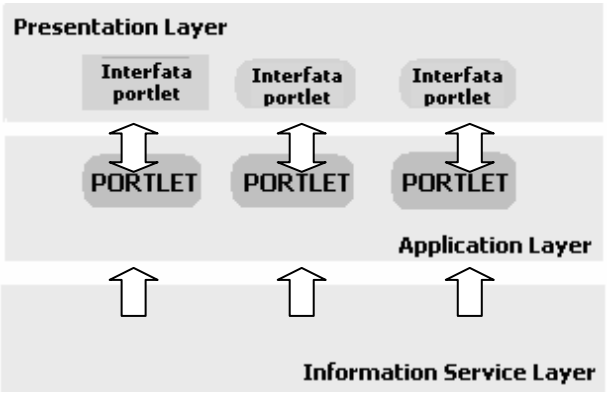

Fig. 1 Integration & Portlets

Collaborative and integration portal platform:

- offers to all extended community members un unique, personalized, based on user roles access, to the multitude of integrated systems and applications (including enterprise applications ERP, SCM, CRM, HR); these enterprise applications can be constituted in sub-portals, being integrated into the collaborative environment, based on knowledge, unitary platform portal;
- in the last years we can ascertain the developing of some facilities of remote accessing of the portal with the help of some mobile devices and vocal systems;
- promotes dynamic and efficient communication, including virtual collaboration spaces maintained by a series of collaboration tools;
- permits business process modeling and deploying in dynamic environments, the applications that sustain them covering the whole chain value;
- offers the managers the information/knowledge and the necessary tools for making a decision in the shortest time; with the help of some dedicated portlets the integration of Business Intelligent modules that sustain decisional processes at any level is possible;
- a collaboration management is promoted at the collaborative organization level, decision making processes being marked by this desideratum.

Being an important factor from the KM

(Knowledge Management) triad, information technology, through collaborative systems exponents, contributes essentially to maximize knowledge value [Bair, 1998; Cain, 1999; Firestone, 2000, 2001, 2002; White, 2000; Bock, 2001; Barette, 2003; Guruge, 2003; Sullivan, 2003; Torsten, 2004; Collins, 2004; Hoolahen, 2005; Herrmann, 2006].

These systems produce changes into the organizational structure, exercising managerial functions into business models throughout the world.

2 Supporting Knowledge Management in Organizations. A Portal - Based Proposal

Knowledge based organizations are intelligent, complex and adaptive systems constituted by networked people, knowledge workers and intelligent agents that together are able to combine knowledge and solve problems, creating business value and adapting functioning of that organization, according to environment changing, increasing the competence of the organization [Niculescu, 2009; Scorta, 2009].

The knowledge portal, a top exponent of portal technologies, represents a knowledge management concrete IT solution, formed, after Firestone, from the informational portal solution by developing its intelligent capacity of maintaining the whole KM life cycle, including the help of some collaborative performant tools. When enterprise information portals first entered the market, they did not contain knowledge management features.

Respecting SOA philosophy, all these instruments will be integrated, with the help of some special portlets, as services, in the portal's architecture and will be available for the collaborative community's members [Muntean, 2005].

A knowledge portal should be a gateway and a destination for employees and should provide transparent, tailored access to distributed digital resources. One of its main characteristic is the integration of as many applications possible and communications between them.

Virtual organizations become more and more an economic reality, so the need for mutual knowledge transfer between their components increases.

The real business advantage for virtualization has yet to be realized for most companies [Wittmann, 2008]. So far, from this study, the major advantages to its use have been for test and development, and for server consolidation. Companies reduced development times and lowered cost to test infrastructure, but they didn't vastly reduce the number of servers, yet the rate of growth in server counts was substantially slowed.

2.1 Sustaining KM Business Cycle

From a collaborative environment based on knowledge point of view, a successful portal means the ideal IT infrastructure, capable of maintaining the knowledge management life cycle (pieces of organizational knowledge coded and memorized in the so-called portal's database of knowledge) [Muntean, 2005, 2007, 2008]. IT extends the reach and range of knowledge use and enhances the speed of knowledge transfer [Turban, 2007].

The knowledge portal, the most advanced exponent of portal technologies, sustains key processes that are important to the organization, maintaining its success in global economy.

Starting from the life cycle of organizational knowledge management proposed in [Muntean, 2009] we will particularize phases 2.1.1 – 2.1.4 for the process of organizational knowledge management modeled by a portal. In this approach, phases 2.1.1 – 2.1.3 have an equivalent on the portal platform level, the last phase 2.1.4 being a characteristic of the organizational environment external of the informatics platform.

Organizational knowledge is a result of phases of combining, internalizing, externalizing and socializing – fig. 2. This dynamic process is build using rules of communications between the groups of users within different organizations [Radu, 2005].

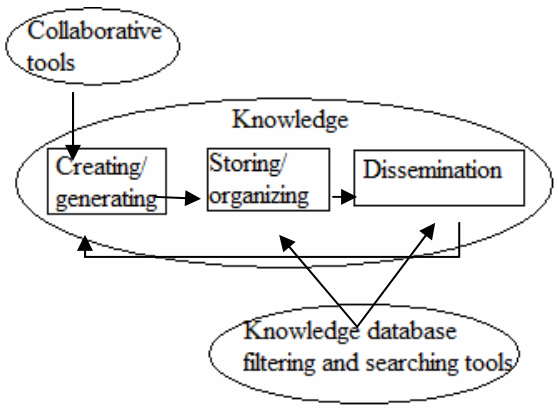

Fig. 2 – Generating organizational knowledge

2.1.1 Knowledge Generating/Developing

At the portal level, creating new knowledge is possible through acquiring/attaining of some knowledge pieces from the collaborative organizational environment (or even external from the organization), or is a following of some intelligent reasoning made by modules of artificial intelligence incorporated in the portal's architecture. The knowledge created that way are collected and refined to eliminate unjustified redundancies and filtering the ones most "valuable" for the organization.

Creating documents represents a significant percentage of the current activities, so the less time is allocated to this activity, more time will remain for the members of the organization to achieve the other tasks. Therefore, at the portal level, we will have to integrate some instruments that facilitates creating knowledge of a document type, such as: text editors, multimedia, Web pages, images, sounds, video editing systems, spreadsheet editors, graphic programming's.

Knowledge about collaborative processes can itself be divided into the following types of knowledge [Niculescu, 2009]:

- subject matter knowledge – identifies the location of knowledge and requires a broad level ontology to evolve as knowledge is developed;
- collaborative knowledge – defines the best way to carry out activities within an organization;
- organizational knowledge – defines the objectives of workspaces and tasks needed for their achievement; defines the knowledge needed to carry out the tasks, contains information of the location of any tacit knowledge.

2.1.2 Knowledge Storing/Organizing

At the portal level, in the central or distributed knowledge database (meta-base), different kinds of knowledge are coded efficiently, assuring quality, accessibility, and their representative ness with the help of some specific tools/technologies.

Knowledge can be stored in data warehouses, knowledge databases specific to artificial intelligence, content specific structures or in a documents management system; all these will form the portal knowledge meta-base. One of the forms in which knowledge can be stored is knowledge repository, which stores knowledge that is often text based and has very different characteristics. It is also referred to as *organizational knowledge base*. A knowledge repository is not a knowledge base of an expert system, the repository containing all the organizational knowledge, not only the one needed in solving a specific problem.

Concordant with the different knowledge storing technologies, we will use specific methods/techniques to access/locate them.

2.1.3 Knowledge dissemination

The opening of the portal to its users, the members of the collaborative community, permits accessing the knowledge database and the use of different knowledge.

The sharing of knowledge is a process distinct than managerial decision making which deserves consideration [Maracine, 2007]. A knowledge sharing process may consist of several repositories, from the most common ones being:

- structured internal knowledge (knowledge embodied in documents);
- informal internal knowledge – a less structured form of knowledge in a form of discussions, know-how, usually referred as *best practices* or *lessons learned*;
- external knowledge – competitive intelligence knowledge encompassing analyst reports, journal articles and external market research on competitors.

Knowledge sharing goes beyond communication – it provides additional support by ensuring fast access to the latest information, being able to assist users in finding the most up to date knowledge needed for their task and the effective use of that knowledge.

Collaborative tools sustain and facilitate the transfer of knowledge. Some tools and technologies facilitates the use of knowledge: Business Intelligence tools, expert systems, simulations of dynamic complex processes, decision support systems, ERP applications (Enterprise Resource Planning), CRM (Customer Relation Management) and other enterprise applications, visualizing tools that permit understanding of some complex knowledge structures, etc. The latest technologies used are knowledge applications (Kapps) [Guran, 2008]. These applications can analyze large amounts of data from any business model and determine the personalized preferences of all potential customers, than enrich them with relevant

information. This new class of applications allows companies not only to collect but to analyze data and information, in order to develop better supplier and customer relationships.

2.1.4 Auditing

Practice proved that if we don't take into account aspects of economic efficiency the costs of maintaining the informatics systems are much more that the profit and most of the time the life cycle reduces drastically.

Auditing represents a complex activity of verifying the conformity degree of the knowledge database with the standards in that domain, and its capacity to sustain the achievement of the strategic objectives of the organization. The main subjects tested are regarding the reliability and performance of the product, the efficiency of the operations and, not last, the security facilities [Lungu, 2003].

Auditing the organizational knowledge implies analyzing its impact on decisional processes, the contribution of each piece of knowledge in optimizing business processes, therefore in raising the quality of the products and services offered. At the end of this process, it is possible to have to regenerate some knowledge pieces.

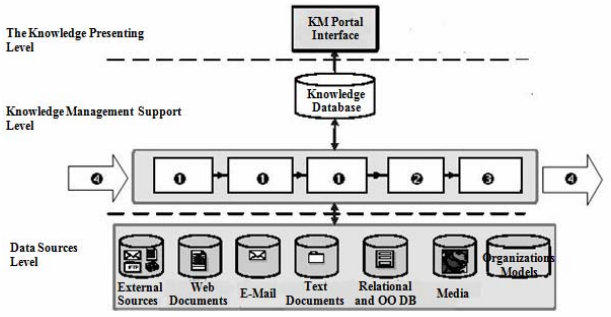

Fig. 3 – MK life cycle phases implementation at the portal level (adapted from [Kirschenberg, 2003])

In the figure presented above we present an implementation of KM's life cycles at the portal level. The first three phases are implemented at the knowledge portal's level, while the fourth one, auditing, stays on the exterior level of the portal; it's users from organizational environment audit the knowledge stored in the portal.

A collaborative enterprise represents an adequate environment for developing a strategy for a better performance of the knowledge management, taking into consideration the social and cultural specific aspects and having an adequate IT infrastructure.

The challenge with KMS is to identify and integrate the three essential components – communication, collaboration technologies and storage and retrieval technologies – to meet the knowledge management needs of an organization.

2.2 Distributed knowledge management

In the global economy, interconnected organizations that forms a collaborative network can be considered, based on their cumulative know-how, to be inter-connected knowledge nodes (KN) [Kirschenberg, 2003]. In this approach, collaborative community becomes an environment that must sustain two different kinds of processes:

1. knowledge management specific to each node (organization);
2. coordination of different knowledge nodes.

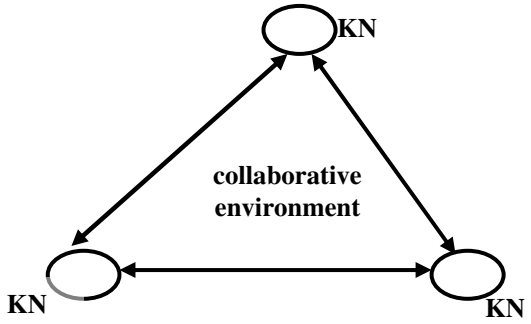

Fig. 4 Inter-connected knowledge nodes

Each organization is an absolute manager (from conceptual and technical point of view) of its organizational knowledge. Coordinating different KN arises some problems that can be overcome from the technological point of view by adopting some knowledge-based portals with intelligent capabilities of communication at the level of the nodes. Starting from the technical architecture proposed by Firestone in 2001, 2002, 2003 for a knowledge-based portal, collaboration between KNs can be accomplished with some collaborative intelligent software agents that are integrated into the organizational portals [Muntean, 2005]. These agents assist the members of a KN to formulate queries (requests of knowledge) to other nodes and they respond to queries that came from the other KNs.

We support the strategy of a distributed KM approach based on two general principles:

1. **Autonomy** Principle – each node/organization manages its own knowledge; the enterprise portal will

represent a unique access point to the knowledge meta-base, that stores a part of the organizational knowledge;

❷ **Coordination** Principle – each node must permit exchange of knowledge with other nodes, without having to adopt a unique interpretative scheme at the level of collaborative network, but through a mapping mechanism of the context of the node queried to its own context, taking into consideration their own perspective on knowledge.

As any distributed system, this one will also have to fulfill some requirements such as connecting users and resources, failure safety, scalability and standardization.

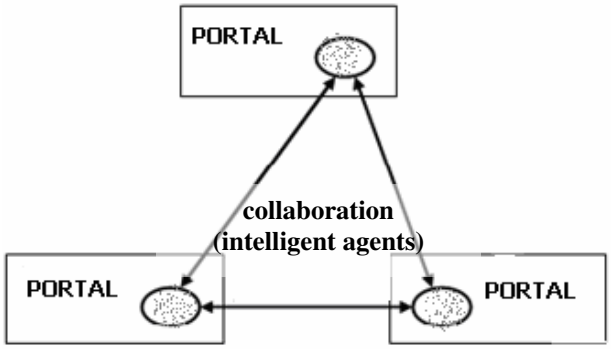

Fig. 5 Infrastructure based on portals sustaining a distributed KM

This will be achieved with the help of some collaborative intelligent agents specially integrated, with this purpose, in the nodes' portals. In these last years, software agents evolved spectacularly, gaining unexpected intelligent capabilities being able to sustain virtual collaborative environments. [Weiss, 2000; Kimatura, Yamada, Kokubu, 2001; AgentLink, 2004; Dang, 2004; Silaghi, 2005; Sycara, Sukthankar, 2006].

3 The Place of Our Proposal Within European Research Programs

Organizations that promote collaboration within them and in their extended environment, that contains different actors from economic/business environment, are identified by the name of collaborative organizations, presenting the following specific features [Skyrme, 2003]:

- collaborative – from the business philosophy, the strategy adopted and all the operational activities;
- team-work oriented;
- centered on collaborative formation of organizational competences & knowledge creator;
- client and partner centered;
- adaptable to changes;
- agile from the strategic point of view.

IT represents an indispensable sustainer of collaborative organizations, of collaborative environments in general [Harmon, Rosen, Guttman, 2001]. These represent (virtual) communities which, even if they are not subordinated to a business objective, ***adopt the collaboration and elaborate knowledge management principles***.

Strategic demarches are scheduled in order to achieve this objective, at the level of different research networks specialized in setting up visionary studies – business models evolution collaborative enterprises related (figure 6).

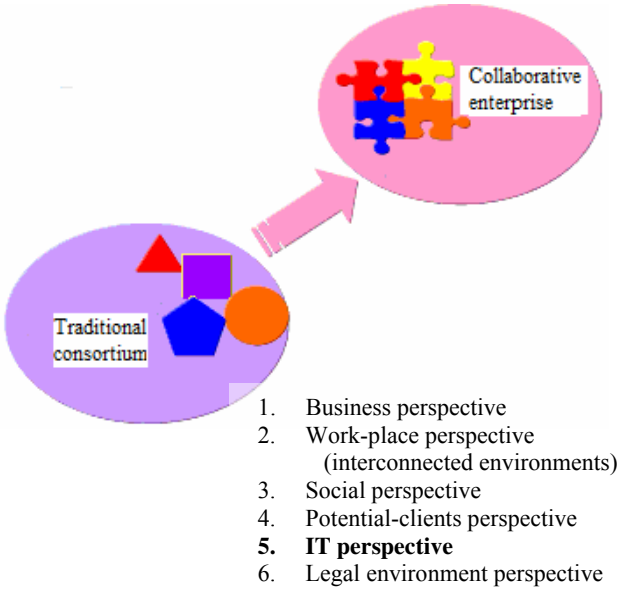

Fig. 6 Strategy to evolve to the model of collaborative enterprise [CE-NET Consortium, 2004]

The focus on collaborative business processes orientation dictates identification and configuration of the collaborative technologies capable of sustaining these processes.

Portal technologies that permit building a fundament for a collaborative virtual environment based on knowledge was imposed, the proposal

presented in figure 6 being an innovative scientific demarche of the IT perspective[1].

We consider that:

❶ it is important for the organizations to have the capacity of underlying and putting forward tacit knowledge pieces (individual or collective ones, belonging to an informal group, being the result of some accumulated practical experience; they can be categorized as being „contextualized", non-fundamented, less accessible, difficult to describe and maybe unconscious) through their integration within organization functions. We refer to an organizational learning process sustained by KM and collaboration, developed at the collaborative environment level and which contributes decisively to the process of competitive knowledge pieces generating [Kim, 1993; Nonaka, Takeuchi, 1995; Malhotra, 1998; Flood, 1999; Bontis, 2002]. At the collaborative organization level creation of a knowledge capital is the main desideratum, organized under the form of organizational knowledge (best practices, expertise, learned lessons, competences), in the same time ***focusing on the best IT solutions, capable of incorporating as much as possible from the organization know-how, under the form of a knowledge base (meta-base)***.

❷ knowing the clients represents an important asset in all business. To remain competitive, organizations must collaborate with clients (or suppliers and even competitors) in order to remix its capacities with the ones of possible partners. According to collaboration spirit and the CKM (Customer Knowledge Management) politics adopted, it is pursued the adoption of clients competences in designing services and product.

❸ At the level of network organizations, KM applies within each organizational entity, considered a knowledge node, as well as to sustain collaboration between these KNs. ***A portal based IT infrastructure, like the one presented in figure 5, is vital to sustaining management strategy of distributed knowledge***.

[1] Detail elements represent the subject of some grants/research programs such as CNCSIS Grant no. 8/2005 „Informational Collaborative Systems in the Global Economy"; PN II Project nr. 92-100/2008 „Collaborative Support Systems for Economic Projects Management"

4 Conclusions

- It is obvious that inside every collaborative environment, starting with small work-groups or practice communities (of interests, scope, action, etc.) and ending with the collaborative environment, there is a strong fundament based on knowledge and ***a powerful interdependence between collaboration and knowledge management***.
- Collaborative communities represent organizational manifestation forms that wish to remain competitive in the competitive environment. Being entirely or partially transposed into the virtual environment, they have to adopt a malleable business strategy, to take fundamental decisions based on knowledge regarding consumers, suppliers, stockholders, investors or even competitors.
- ***Collaborative systems, tools and technologies sustain work teams, communities and collaborative enterprises, portal type IT platforms proving their efficiency as infrastructures of those environments:***

  ❶ depending on particularities of each organization/community (organization dimension, working needs, etc) it can be chose from an unique portal solution or one based on a distributed model;

  ❹ in a distributed approach, collaborative community can be assimilated with a network of knowledge nodes at which level it is recommended a policy of distributed knowledge nodes (see paragraph 2.2);

  ❹ portal based IT infrastructure (figure 5) must sustain KM distributed strategy, therefore knowledge management at the level of each node and the communication between them;

  ❹ integration of necessary collaborative tools, MAS and enterprise applications at each portal's level in order to satisfy its needs.

In our future work our attention will be focused on optimizing the technical architecture of those portals, studies that will be made by the research interdisciplinary team of the on-roll grant.

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