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A METHODOLOGICAL VIEW FOR KNOWLEDGE MANAGEMENT SHARING CULTURE IN THE VIRTUAL ENTERPRISE ENVINRONMENT

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Abstract: *The knowledge management has received attention from designers responsible for the product development process because many of the design activities require a creative thought and are highly dependent on individual's knowledge. Furthermore, the product development process deals with a large amount of knowledge which makes the process more critical. Therefore, this work analyses the state of the art of the knowledge management and it proposes a theoretical model implemented in the CESICED platform at the PREMINV center. It is expected that application of this model will result in a more effective way of developing products.*

Key words: *knowledge management, collaborative design system, virtual enterprise, innovative products.*

1. INTRODUCTION

Companies in a wide range of industries are finding that success in the modern marketplace requires effective competition in global markets with reduced cost and lead-time. The concept of collaborative design has emerged both as an effect of globalization and as a prospective tool for enabling this new business approach. The opportunities and limitations presented by collaborative design, however, are not well understood, and the actual gains of applying collaborative design are not clear. A survey of recent collaborative design research shows a focus on developing tools to facilitate communication of ideas and information within collaborative design teams [1]. Because the information exchange requirements of the teams have not been fully explored, though, these tools may be inadequate or poorly directed. Further research into collaborative design should provide a clearer understanding of the communication issues faced by collaborative design teams and allow for development of better-directed tools.

The present fierce competition results in the search of even more creative solutions, continuous improvements in company products and processes and continuous investments in technological innovation. As a consequence, companies have to respond quickly to any new market opportunity as well as to (new) the customer's needs. Companies´ efficiency for knowledge creation is given by their capacity in converting the tacit knowledge in explicit knowledge. Then, this work presents a methodological knowledge management model which indicates that company's creation is dependent on how knowledge is shared among the members of the organization [2].

Virtual organization is one of the potential and ideal places for knowledge management processes since knowledge is a 'culture' among teams or partners. Therefore, it becomes a suitable place to apply the knowledge management practice to support its functional and operational process [3]. Increasing product complexity, shrinking design cycle times, and explosive global competition are forcing organizations around the world to collaborate in ways not previously considered [4]. The virtual organization focuses around the idea of a group, which is not constrained by traditional boundaries of space and time.

A strong virtual organization has to identify the strategic options for building the knowledge sharing culture in order to become competitive. In this context, the paper presents the potential implications of the knowledge sharing culture in virtual organizations and discusses the correlation between the management functions and the knowledge cycle. Further, this paper focuses on the knowledge management systems applications and tools, particularly in virtual collaborative design teams. The objectives of this work are to provide an insightful understanding of individual and collective learning, and to provide a basis to identify the similarities and differences between the requirements for computer support for individual and collective learning in design.

2. INPUT AND OUTPUT KNOWLEDGE

The elements for a design activity include design goal, input knowledge and output knowledge. The elements for a learning activity include learning goal, input knowledge, output knowledge, learning trigger, and learning operator. The learning operators transform input knowledge to output knowledge [4].

Collective learning exists in team design [4]. Similar to individual learning, collective learning elements are identified as input knowledge, output knowledge, collective learning goal, learning operators, and learning triggers. Three types of links between team design and collective learning are also identified. What is learned is stored in *Collective Memory*, which can be used for current or future design practice and is defined as the sum of individual memories and shared memories. Individual memories can be the memories of individual designers or computers. Shared memories can be the design documents, drawings, etc, shared by team members. Today, the similarities and differences between the two types of learning are further analyzed with the focus on 'the

what' (*i.e.* input and output knowledge, and the type of learned knowledge), 'the why' (*i.e.* the learning triggers) and 'the how' (*i.e.* learning operators).

In individual learning, an agent carries out learning activities without interactions and sharing information with other agents, although an agent can learn based upon multiple knowledge sources. What is learned is stored in individual memory. However, in the context of collective learning, the learning process becomes more complicated in which agents can share their knowledge and collaborate in the learning process.

Five modes of input knowledge in collective learning are identified [5, 6]: One-To-One, Many-To-One, One-To-Many, Many-To-One-Plus-Itself, and Combination of the modes.

One agent can either acquire knowledge from another, or from many other agents. Likewise, one agent can provide input knowledge for many other agents to learn. Also, one agent can learn based upon a combination of many other agents' input and its own knowledge. The fifth mode represents the possible combinations of the other four modes. Besides the knowledge that can be learned individually, there are other types of knowledge that may only be learned through collective learning:

- *Knowledge of agents' interactions*. Agents can learn how different agents interact and coordinate with each other.
- *Common knowledge*. When all the agents in a team learn the same piece of knowledge, that knowledge is considered as common knowledge.
- *Meta-knowledge*. Meta-knowledge is the knowledge of knowledge. Examples of metaknowledge can be the knowledge of how agents solve the design problem or the knowledge of which agents own what kind of knowledge.

The implications for computer supported collective learning in design are that it should include:

- *Mechanisms for knowledge sharing*. Interested agents can share both input and output knowledge. To achieve this, some communication mechanisms between agents are required.
- *Learning operators*. The learning operators can transform input knowledge into output knowledge and shall be equipped within agents.
- *Learning triggers*. Its (*e.g.* failure or success of a design) will trigger one or more agents to learn.
- *Collective memory*. Individual agents shall have their own memory for knowledge storage. Also, there shall be a common memory where all the agents can access to acquire knowledge and likewise agents can store their knowledge in the shared memory.

In this paper the workers (each professional actor) construct different models of an agent used in their applications owing to their different aims. An agent ought to be modeled as consisting of the following basic parts:

- Knowledge base, containing the data and domain knowledge necessary for the agent to carry out all its activities;
- Problem solver, carrying out independently learning, planning, reasoning, decision making to execute corresponding activities to accomplish task;
- Coordination unit or knowledge management, controlling interactions with other agents including communication, negotiation, coordination and cooperation.

3. KNOWLEDGE MANAGEMENT OVERVIEW

Knowledge has become the more important economical factor for competitiveness. This knowledge is mainly based on market demands, technical processes, customer requirements, technology improvements, competitors etc. In this new era of information, the fundamental sources of wealth are knowledge and communication, and not natural resources or labor work. During the first decades of the computer science, the emphasis was data management. In order to transform data into information it is required tools. However, in order to transform information into knowledge it is needed time. Knowledge is to use information (and as a consequence data) to generate new ideas or solutions.

Also, today, are differentiating these three classes of elements as [5]:

- Data (a discreet and objective group of facts of a certain event);
- Information (a message containing an originator and a receiver and whose meaning involves a new interpretation based on a group of data);
- Knowledge (a mixture of experiences, values, contextual information and intuition, forming a framework in a person's mind that enables him/her to evaluate and to obtain new experiences and information).

The larger is individual's knowledge the best will his/hers appreciation and analysis of the data and information available. As a consequence, the better is the quality of the decisions taken within the product development process.

Today, the main studies are identified two important distinctions of types of knowledge that has been used (Fig. 1):

- The tacit knowledge (it is the knowledge that the people possess but it is not described in any place. It is just residing in your heads);
- The explicit knowledge (it is the knowledge that is registered in some ways and therefore it is available for the other people)

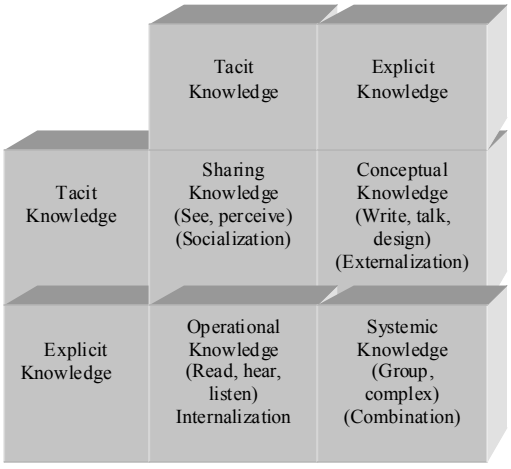

Fig. 1. The four basic standards for the knowledge creation or ways of converting knowledge.

Many studies on knowledge management are based on the successive passages from tacit knowledge to explicit knowledge and vice-versa.

Today, these studies have also suggested four basic conversion patterns for the knowledge creation in an organization. These four basic standards are presented in Fig. 1 in such a way that the creation of the organizational knowledge is based on a continuous and dynamic interaction between the tacit knowledge and the explicit knowledge:

- From *tacit knowledge to tacit knowledge*: it is a process of sharing experiences and, therefore, the creation of tacit knowledge. The base input for the acquisition of this knowledge type is experience.
- From *tacit knowledge to explicit knowledge*: it is a process of articulation of the individual's tacit knowledge in explicit concepts. This conceptual knowledge usually happens through: symbolic representation of the tacit knowledge (through metaphors, analogies, models, concepts, hypotheses by using the figurative language); oral reports and films; description of part of the tacit knowledge through spreadsheets, texts, images, illustrations, rules, scripts, design history, lessons learned etc.
- From *explicit knowledge to explicit knowledge*: it is a conversion process of some type of explicit knowledge generated by an individual to add up to the explicit knowledge of an organization. Individuals exchange and combine knowledge through documents, meetings, chats etc. Usually this systemic knowledge happens by grouping and processing different explicit knowledge that could generate into a new knowledge.
- From *explicit knowledge to tacit knowledge*: it is the process of incorporating explicit knowledge from the organization into individual's tacit knowledge. This operational knowledge usually happens through: reading/visualization and individual studying of documents from different formats; individual interpretation and experimentation.

Two problems were already present today [6] and are always waiting for an answer: What does one capitalize? How does one capitalize?

The organizational knowledge is not only found in documents, databases and information systems. They can also be found in the business processes, group practices and in the accumulated experience of individuals. The knowledge is transmitted from people to people through means such as videos, books, documents and Internet. Furthermore, individuals can gather knowledge from those who already have it by interpersonal learning and sharing experiences and ideas. New technologies such as Internet, Intranet and Extranet have been used to propose interesting ways of communication among communities of common practices.

4. METHODOLOGICAL MODEL FOR KM

The product development process has become an intensive process of knowledge application and it consists of a process of transformation of information [6, 7]. Each activity of the product development process should be seen as a theoretical-empiric framework, limited by the time, where a group of information is treated, transformed and passed ahead to another activity at the appropriate time. The information do not enter at the beginning of each activity and nor leave in the end of each activity, the flow of information happens at every moment of the product development process. Knowledge is created through the interaction and sharing that happens among people during the execution of those activities and the flow of information happens in a chaotic way during that process [8]. The tacit knowledge that emerges from this process is interactive and it is the base of the process of knowledge creation within the organization. The decisions taken based on the information and the knowledge created within the process are responsible to determine, for instance, the product concept that will be developed and the level of its corresponding quality. When considering product quality, the initial phases of the product development are decisive because they define which information will be taken ahead. The potential contribution of the tacit knowledge is still underestimated. This is due to old fashion culture that still remains in the current organizations. Currently manners of transmitting knowledge privilege the explicit, formal and logical side of the knowledge transmission process. A methodological model of knowledge management for the product design process in the CESICED platform is presented in Fig. 2.

Fig. 2 presents the company's knowledge and it shows a simplified manner to present how organizations can generate, retrieve and dispose its knowledge to strategically create adding value for their products.

Besides the four conversions of the knowledge (*i.e.* sharing experience, conceptual knowledge, systemic knowledge, and operational knowledge), many other steps were added in order to increase the knowledge of the company and, consequently, to improve the product development process. Also, the additional steps are: obtain and use, learn and contribute, evaluate and sustain, discharge and support. The knowledge of the organization

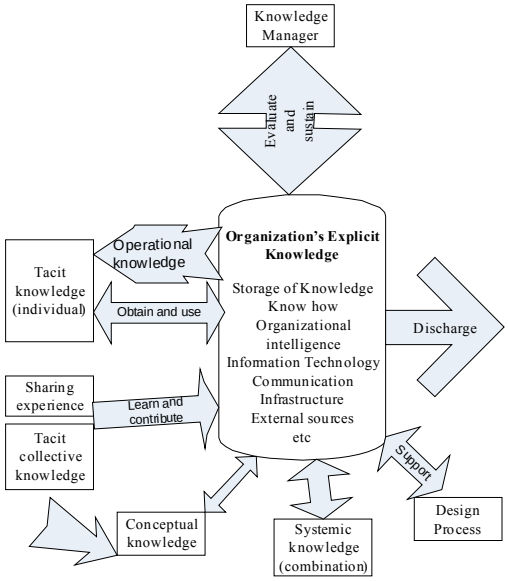

Fig. 2. Organization knowledge management model.

is composed by the sharing knowledge of each individual. Based on the steps described in the Fig. 2 an efficient and effective management of the intellectual capital of the company is obtained.

The steps obtain and uses are well known within organizations. People always seek information and use them later to solve their problems, to take decisions or to create new products. Therefore, new technologies (*e.g.* intranet/internet/extranet) allow that the large amount of information that flows within organizations can be correctly managed.

The steps learn and contribute are relatively new for organizations. For example, it has been difficult to convince employees to contribute to the organization's knowledge base. New technologies have helped companies easily organize, send and transfer certain types of information. However, this facility has been seen by the employee as a threat for his/hers own job security. The most difficult task is to convince individuals that their contribution will give return to their organization as well as to themselves.

The step evaluate indicates that the organization should define its own necessary knowledge for its mission and classify its own currently intellectual capital. In other words, the knowledge manager does more than organize the content in system on-line; he/she should understand and foresee the community's needs.

The step sustain or maintain should assure that the future intellectual capital will maintain the organization viable and competitive. Organizations tend to build their own intellectual capital through their relationships with customers, employees, suppliers etc. The knowledge manager should also be responsible for the maintenance of the organizations knowledge base. The step discharge excludes any useless knowledge from the organizations knowledge base. However, some knowledge can be more valuable if it can be transferred to outside of the organization.

The step support can be used for the continuous improvement of the product design process.

5. CONCLUSION

In this paper we have presented our initial efforts to explain the strategic options for building a knowledge sharing culture in virtual collaborative research/design teams [9]. Using the analysis of the key activities considered in the model for collaborative research/design process we have explain the interaction between people working together in a virtual team for attending authentic tasks. Then, based on the knowledge creation process we have described the management activities for building a knowledge management model.

Today, the knowledge management has received attention from designers responsible for the product development process because many of the design activities require a creative thought and is highly dependent on individual's or collective knowledge. This paper analyses the state of the art of the knowledge management and it proposes a methodological model, based on the occurrence of types of conversions of the knowledge to be used during the product development process. The validation of this methodology will be carried out based on a practical application in a CESICED project and Romanian SME. It is believed that this sector is a good example of application of design and production practices. The aim of the CESICED project (university-SME's partnership) is to determine the new organization type for integrating in the virtual enterprise medium and to outsourcing shared resources service PREMINV center for industrial partners [10].

In this paper, a methodological model for knowledge management within the product development process was developed based on a extensive theoretical review on knowledge management, organizational learning and product development process management issues.

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