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A Model to Improve Knowledge Management Through the Effective Integration of Computer-Supported Collaborative Learning

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ABSTRACT

Support for organizational knowledge management (KM) requires mechanisms for creation, mapping and transference of knowledge. Many organizations use computer tools, like knowledge-mapping tools, knowledge-evaluation tools and computer-supported collaborative learning (CSCL) tools, to achieve these goals. In particular, CSCL tools can support knowledge transference at the same time that improves the creation process of new knowledge. However, whole CSCL potential to transfer knowledge and foment organizational learning is not used adequately, mainly because of the lack of appropriate integration with other KM tools. We have observed that there is a lack of guidance on how to effectively integrate CSCL into KM. This paper tries to fill in this gap by proposing a model to improve organizational KM through the consistent and effective integration of CSCL into the KM structure of organizations.

1. INTRODUCTION

The main functionalities of an organizational knowledge management (KM) structure are: creation, mapping and transference of knowledge. *Knowledge creation* occurs in people's minds through the interaction between tacit and explicit knowledge [10]. *Knowledge mapping* consists in the identification and classification of the existent organizational knowledge. This, in turn, is embedded in documents, repositories, routines, processes, practices, norms and, mainly, in people's minds. Finally, *knowledge transference* consists in moving knowledge to where it can generate value. That is, to where it can be used to support the execution of some organizational activity [5].

Many organizations use computer tools to support the functionalities of KM structures. Knowledge-mapping tools are used to detect existent organizational knowledge and its localization. They generally point to people (tacit knowledge sources), but they can also address explicit knowledge sources, like documents and databases [5]. Knowledge tree is an example of a tool for knowledge mapping. Knowledge-evaluation tools identify the required knowledge for the fulfillment of some particular function within the organization. Skillview, which can evaluate more than three hundred individual abilities of an organization and to mount desirable individual profiles, is an example of such a tool [5]. Some organizations use, among other tools, *computer-supported collaborative learning* (CSCL) [2, 6, 7, 13] to transfer knowledge. These tools together support the three main functionalities of a KM structure.

Because of its focus on both communication techniques and what is being communicated (knowledge content), CSCL can support knowledge transference at the same time that improves the creation process of new knowledge [7]. Although many KM structures use CSCL nowadays, it is, normally, implemented in an independent way, that is, without a great integration with other KM tools. To the best of our knowledge, there is no literature that gives guidance on how to effectively and consistently integrate CSCL into KM. Consequently, whole CSCL potential to transfer knowledge and foment organizational learning is not being used adequately. The main contribution of this paper is the description of a model to integrate CSCL into a KM structure in a consistent and effective way. We also analyze the benefits that this integration brings to organizational KM.

The remaining of this paper is structured in the following way. In Section 2, we discuss the requirements that should be satisfied by a KM structure. Section 3 presents an analysis on how CSCL can be useful in satisfying the requirements discussed in the previous section. In Section 4, our model is detailed and its benefits are discussed. Section 5 concludes the paper with our final remarks.

2 REQUIREMENTS FOR THE SUCCESS OF KM

KM is a relatively new research area, thus, neither the correct directions to be followed, nor the difficulties to be faced, when implementing it, are yet very clear. However, a number of requirements that need to be satisfied in order to achieve success in KM have already been identified [4, 5, 12]. Some of them are

1. Knowledge Capture Without Killing It

One of the difficulties faced by KM is how to capture knowledge without killing it, that is, without knowledge devaluation. Organizations must pursue a balance between rigidity and flexibility excess of the KM structures. Rigidity inhibits creativity, while flexibility improves it. However, flexibility excess precludes the control of creativity such that it can be successfully used to address the needs of a product or a service.

Consequently, a tension is created between process and practice, that is, between the way that the activities of the organization are formally organized and the way that these activities are accomplished in fact. Practice provokes the appearance of new ideas, while process allows controlling and implementing them [4].

2. Knowledge Utilization Improvement

Organizational knowledge underutilization is other problem that should be considered when implementing KM. Some organizations only instigate creativity among elite professionals, in an attempt of solving tension between process and practice. Other people's jobs remain predictable and very close of process structures. Nowadays, due to constant

changes on the organizational strategies, caused by the market, all organization sectors need to be creative [4].

3. CP Integration

Communities of Practice (CPs) are groups of people that informally share knowledge and impressions in specific areas. They are arising in organizations that stimulate knowledge transference. However, it is not easy to build, sustain and, mainly, integrate them into the organization. Due to their informal and spontaneous nature, as well as their natural isolation, CPs are normally resistant to supervision and interference. They are created, generally, disconnected from the organizational structure [12].

4. Definition of Best Practices

A KM structure requires definition of the best practices of the organization. There are, however, some reasons that make this a difficult task. Firstly, because of the difference between what workers are expected to do and what they really do; normally, there are big differences between tasks specifications presented in process handbooks and their practical execution. Secondly, due to the difference between what workers think they do and what they really do; tasks' effective execution is full of tacit improvisations, which are difficult to be articulate by their executioners. A KM structure has to surpass these barriers in the moment of defining the organization's best practices [4].

5. Qualified People Shortage Suppression

Qualified people shortage to structure and to plan how to share their knowledge is a problem faced by most of the organizations during KM implementation. Generally, the few people that possess these abilities do not have time to place their knowledge in a system [5].

3 CSCL CONTRIBUTIONS TO THE FULFILLMENT OF KM REQUIREMENTS

CSCL contributes to the creative process because it allows greater flexibility in the acquisition and transference of knowledge. It also offers the framework necessary to support, control and address what has been learned towards a product or service of the organization.

Greater flexibility is possible due to the number of media formats (image, audio, video, hypertext etc.) that can be used for knowledge acquisition via CSCL tools. The appropriate format can be chosen depending on the aptitudes and individual preferences [1]. Further, CSCL tools normally offer a number of interaction mechanisms (synchronous and asynchronous), which can be used for knowledge transference. This learning modality allows greater flexibility to workers participating of the learning process in both the time (access to knowledge at any time) and the space (access to knowledge from anywhere possessing network connection or Internet connection) dimensions, mainly, if the CSCL interface is the *World Wide Web* [3].

On the other hand, structure can be supported by the coordination tools existent in some CSCL environments, which allow registering most of the decisions that users (e.g. workers, experts, facilitators, students, teachers, etc.) take within the environment. Further, these environments allow knowledge providers (e.g. experts, teachers) to closely follow, motivate and address knowledge recipients (e.g. trainees, students, etc.) in learning activities that can bring significant outcomes to the organization.

Based on the above discussion, we believe that the effective utilization of CSCL tools might have greater chances of allowing workers to *capture knowledge without having it killed* within a KM support system.

Regarding *knowledge utilization improvement*, we believe that the integration of CSCL tools into KM support systems allows more workers to have access to knowledge. This integration yields sharing knowledge in an uniform way in the whole organization, that is, independently of geographical location, physical limitations, organizational position etc. This learning modality allows easy access to knowledge, which can be shared with more people. In this way, it also helps in fomenting creativity in all organization sectors.

CSCL can also help in the *integration of CPs* into the organization. It can stimulate people with common interests to use these structures to interact with each other. This will increase the CP performance and its contribution to the organization. CPs can be created within the learning environment, whose tools of communication and collaboration (synchronous and asynchronous) can be used by CP members to discuss about some determined subject. Moreover, knowledge providers can foment the formation of groups with common interests, around projects that can bring interesting outcomes to the organization.

Some CSCL modalities possess problems resolution activities, where knowledge recipients participate on discussions to identify more effective ways of accomplishing their tasks. These can be added to the database of best practices facilitating the *definition of best practices*.

Finally, information systems for KM can be useful to solve the problem of qualified people shortage in KM, since they can provide support for workers in the planning, structuring and sharing of their knowledge. KM systems allow knowledge transference in simple, fast and efficient way. A CSCL system can be considered an example of KM system, because workers using it can easily share their knowledge with colleagues through its several tools of communication and collaboration. CSCL can also be used to qualify workers in technologies, methodologies and required abilities to implement KM, by releasing training for workers. This is other way of solving the problem of qualified people shortage in this area.

4 THE MODEL

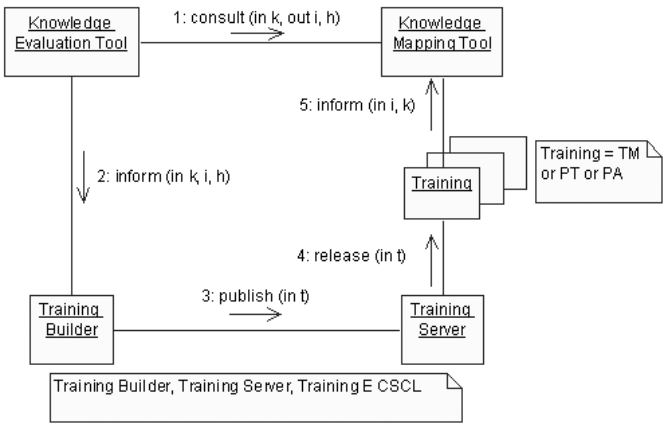
In this section we present a model to improve organizational KM through the effective integration of CSCL. It is represented in UML (Unified Modeling Language) [11], which allows object oriented modeling. *N (in a1, a2..., out b1, b2...)* represents messages exchanged among objects, where: *N* is the message name, *in a1, a2...* represents the list of request arguments and *out b1, b2...* represents the list of reply arguments. The messages types can be:

- Informative: message that brings an object up to date with necessary information;
- Interrogative: message requesting information from an object; or
- Imperative: message requesting an object to execute some task.

Figure 1 presents the model, which consists of a diagram showing the collaboration between CSCL and other KM tools. This model gives a general vision of how CSCL can bring benefits to a KM support system.

The knowledge-evaluation tool facilitates the identification of necessary knowledge for some particular function or worker. This information can be used, for instance, to search in the knowledge-mapping tool for any worker that is currently executing a particular function without holding the necessary knowledge to execute it with efficacy; further, the search can also discover whether there are workers holding such knowledge within the organization.

Figure 1: *The Model*



This operation is represented in the model (Figure 1) by message: *consult (in k, out i, h)*, which passes as parameters the necessary knowledge to execute a particular function (k) and receives as result the list of individuals that execute (or should execute) such function but do not hold the necessary knowledge (i) and the list of holders of such knowledge in the organization (h).

This information can be used to inform the CSCL environment's *training builder tool* (used to create training material), about: knowledge that should be contemplated (k), list of individuals that should be trained (i) and specific knowledge holders (h). This can help to define training scope, target public and possible knowledge providers, respectively. This operation is represented in the model by message: *inform (in k, i, h)*.

The training to provide the knowledge (which was identified as necessary by the knowledge-evaluation tool) can be published in the organization's *training server*. This is represented by message: *publish (in t)*, where t is the training material (e.g. a course). Later on, this training can be released to its target public, which can be: whole organization (Training in Mass - TM), an individuals group (Personalized Training - PT) or a particular individual (Personalized Accompaniment or mentoring - PA). This operation is represented by message: *release (in t)*.

The individual knowledge map of all individuals that were trained (i) should be informed about the new knowledge (k) after the training accomplishment. This is represented by message: *inform (in i, c)*, closing, this way, the model cycle.

4.1 Benefits of the Effective Integration of CSCL into KM

Among the direct benefits of the effective integration of CSCL into organizational KM, we can list: reach, objectivity, speed and effectiveness. How these benefits are attained is discussed next.

4.1.1 Reach

Generally, knowledge transference is local and fragmented. The larger the organization, the greater the probability of the existence of some required knowledge, but the lesser the probability of a person (which needs it) to know how and where to find it [5, 8]. A solution to this problem is to offer knowledge automatically to people when they need it, that is, without the need of explicit requisition for knowledge. This is important because most people do not know which knowledge is available and, consequently, they never search for it [9].

The effective integration of CSCL into KM allows releasing knowledge to workers without need of explicit requisition. Our model allows the identification of the necessary knowledge for particular individuals and the automatic release of appropriate training to them. Automatic identification of workers needing determined knowledge and TP implementation destined for this target public allows greater reach in knowledge transference. TM about strategic knowledge areas can also be released to all workers as another way of obtaining reach. In this case, workers should decide on participating or not of the training offered.

4.1.2 Objectivity

It is possible to release TP to train a specific public after the identification of the necessary knowledge for some particular organizational function or worker, as shown in Figure 1. TP allows more objectivity in knowledge transference, because it avoids waste of time and resources with knowledge transference to workers that do not need it. Knowledge will be transferred objectively to workers that can really use it for the execution of their activities (right knowledge to the right person on the right time). This increases the possibility of knowledge use and adds more value to the organizational intellectual capital, which increases when knowledge is used.

4.1.3 Speed

The speed with which knowledge arrives where it can generate value is an important evaluation factor on how efficiently the organizational intellectual capital is being used.

Generally, knowledge transference happens on demand in the organizations. When a worker needs a specific knowledge, either she searches in the knowledge base, or she interacts with specialists in this subject. In both cases, this might take precious time. The utilization of CSCL allows releasing focused training as soon as the lack of a particular knowledge is detected, thus increasing knowledge transference speed.

4.1.4 Effectiveness

Knowledge transference effectiveness, that is, the knowledge percentage that has been really absorbed and applied, is influenced mainly by the method used in the transference process [8]. Further, the richer and more tacit is the knowledge, the more effort should be placed to enable individuals to share it directly [5].

It is possible to reach greater effectiveness in knowledge transference through the utilization of PA. Direct interaction with a specialist (knowledge holder) during certain periods of time allows acquiring more consistent and deeper knowledge about a particular area, as well as obtaining a greater amount of knowledge. This is true because the knowledge recipient obtains more detailed and implicit knowledge. The long process of trying to extract and to understand specialist's knowledge by conversation, observation, interrogation etc., provides workers with a better comprehension about the subject being learned than that acquired through learning processes based on non-interactive means (e.g. consulting knowledge bases, reading papers).

Our model creates the means to efficiently identify knowledge requirements to improve organizational activities, workers requiring this knowledge, as well as specialists to act as mentors in a PA training program.

5 CONCLUSIONS AND FUTURE WORK

The main contributions of this paper are an evaluation of the interrelation between KM and CSCL (evaluation of the requirements that should be satisfied by KM implementation and how CSCL can be useful to satisfy them), a model for integration of CSCL into organizational KM and an analysis of its benefits to KM.

An important point related to this discussion is that a model for integration of CSCL into KM should be generic enough to contemplate the main aspects involved in different structures of KM and CSCL. The integration model proposed can be used in an organization that already implements KM and/or CSCL but does not obtain benefits of the effective integration of these structures. It can also be used in an organization where some integration already exists but it is not complete. In both cases, the model should allow, among other things, to verify if the tools that are being used in these structures fully satisfy KM requirements.

The proposed model is only an example of how should be a model of this type. It requires still to be expanded and to be improved to satisfy different structures of KM and CSCL. It should also contemplate the utilization of the main tools that can be used in these structures and to allow the accomplishment of a cost-benefit analysis, which will facilitate the decision on what tools should be used, and how they should be used to achieve particular needs.

As future work, we intend to accomplish a case study in an organization that uses both KM and CSCL. We believe that this experience will give us insights on how to extend and refine the model, so that it becomes more general and effective for integrating CSCL into KM. This will also allow us to identify new benefits that can be obtained by this integration.

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