Knowledge Management in E-Learning Systems

Rodica MIHALCA, Adina UŢĂ
Anca ANDREESCU, Iulian ÎNTORSUREANU
Department of Informatics in Economy, Academy of Economic Studies Bucharest

Current knowledge management systems focus on knowledge acquisition, storage, retrieval and maintenance. Yet, for that knowledge to be operational, to become knowledge rather than information, requires internalization and learning. E-learning systems and courseware, on the other hand, are all too often monolithic and inert and fail to facilitate the development and sharing of knowledge. In this paper we discuss some aspects about knowledge providing and present our research in this field through an e-learning system for major risks management.
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1 Knowledge, Data, Information and Knowledge Management

Knowledge is commonly distinguished from **data** and **information**. Data represents facts often in the form of measurements. Information places data within a meaningful context. Knowledge is an understanding of information acquired by study, investigation, observation, or experience. A tactical definition of knowledge is the ability to turn information and data into effective action. In this sense "managing knowledge" means delivering the understanding of information and data people need to be effective in their jobs. Knowledge can be viewed both as a thing to shared and as an applied process. As a practical matter organizations need to manage knowledge both as an object and as a process.

The relationship between data, information, and knowledge can be view as a pyramid where data forms the foundation, information forms the middle section and knowledge resides at the top. In terms of volume, data takes up the most space, information takes up a little less, and knowledge forms the small portion at the top

Extracting knowledge involves interpreting volumes of data and information to arrive at concepts and guidelines that can be documented, packaged and delivered.

Knowledge can be classified as *tacit* or *explicit*. Tacit knowledge is subconsciously understood and applied, difficult to articulate, developed from direct experience and action, and usually shared through highly interactive conversation, storytelling and shared experience. Explicit knowledge is consciously understood and can be more precisely and formally articulated. Explicit knowledge is readily codified, documented, transferred and shared.

Explicit knowledge can be of several types:

- *declarative knowledge* - knowledge about something - concepts, categories or descriptors
- *procedural knowledge* - knowledge of how something occurs or is performed
- *causal knowledge* - knowledge why something occurs

Knowledge management is particularly challenged in attempting to explicate, share, and leverage tacit knowledge.

Knowledge management is a discipline originating from management studies, but always going hand in hand with information technologies both as a reason for its necessity and as a technical solution for the implementation. Knowledge management takes an organizational perspective on learning, and the main problem it tries to address is the lack of sharing knowledge among members of the organization.

The language of knowledge management is to some degree naïve because it assumes that knowledge is an asset that can be "produced", "captured" or "transferred" and that can be summed up to a corporate memory. Starting from metadata-driven document management, knowledge management has now adopted communication and collabora-

tion solutions in order to address the problem of tacit knowledge.

Still, knowledge management does not fully realize that it is mainly about facilitating purpose-oriented *learning* in organizations and that thus understanding how *learning* takes place is extremely important to consider. And learning – in the view of modern constructivist learning theories – is not just transferring knowledge; it is a highly individualized task of construction.

In some ways, educational systems are like knowledge management systems; both involve the creation of useful knowledge from information or data found in available resources.

Knowledge management is a system and managerial approach to collecting, processing and organizing enterprise-specific knowledge assets.

Accentors views knowledge management functions as a six-step process: acquire, create, synthesize, share, use to achieve organizational goals and establish an environment conducive to knowledge sharing. Ernst and Young promotes a 4-phase knowledge management approach: knowledge generation, knowledge representation, knowledge codification, knowledge application.

Implementations of knowledge management focus on four main aspects: *people* (knowledge users, knowledge authors and knowledge analysts), *culture* (create a culture where knowledge sharing is the norm, *content*: (creating and managing data, information, and knowledge), *technology* (technical infrastructure that enables the capture, storage, and delivery of content to those who need it, when they need it).

2. E-Learning Systems

E-learning can be defined as learning using electronic means**:** the acquisition of knowledge and skill using electronic technologies such as computer- and Internet-based courseware and local and wide area networks Another definition of e-learning is as education via the Internet, network, or standalone computer. e-learning is essentially the network-enabled transfer of skills and knowledge. E-learning refers to using electronic applications and processes to learn. E-learning applications and processes include Web-based learning, computer-based learning, virtual classrooms and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM

E-Learning, focuses on the individual's acquisition (or rather construction) of new knowledge and the technological means to support this construction process.

Simulations close to the real world are the answer to constructivist learning theories, demanding situated learning with a high degree of engagement of the learner.

Learning process can be seen as a process for:

- acquiring information;
- acquiring information and processing experience;
- acquiring information and processing experience that effects a long-term change in the consciousness of the learner;
- acquiring information and processing experience in which the learner integrates new information and experience into his/her current knowledge base;
- acquiring information and processing experience in which the learner perceives, selects and integrates new information and experience into his/her current knowledge base, thereby changing it;
- acquiring information and processing experience, in which the learner selects and constructs knowledge that is useful and appropriate for him/herself and in turn uses this to drive and determine his/her own continuous learning process;
- learning that becomes an individual process of interaction between the individual and his/her environment, in which the subjective reality of the learner is actively constructed.

Learning process in a e-learning systems can be seen in two approach

- a technology driven development approach: Learning media → Learning environment → Categories of learning → Learning objectives → Learner

• a pedagogical driven development approach: Learner → Learning objectives → Categories of learning → Learning environment → Learning media

Thus, the use of computer technology to support learning leading to the development and creation of knowledge requires new pedagogical processes. However, the tendency towards technology driven development has led to a focus on the dissemination and acquisition of information. Pedagogic strategies and computer based technologies to support knowledge development and creation require development schema based on the needs of learners. Researchers have recognized the importance of different types of knowledge including know-what, know-why, know-how, and know-who.

3. Eduknowledge – A Framework for Educational Purposes

What is eduknowledge? A relatively new concept in the learning domain, eduknowledge could be defined as an object like educational tailored knowledge.

Eduknowledge could be also defined as a process of developing and adapting specific knowledge for educational purposes. As the new method is based on individual interaction between the training system and the trainee, the subject of training could individually improve his/hers training paths and rise the efficiency of personal training contributing to the increase in the whole training process.

After understanding the basics in his specific activity the trainee interacts with various scenarios, in order to use the acquired knowledge and develop his abilities in virtual environments re-enacting the real ones.

Eduknowledge could be also seen as a framework to structure knowledge for educational purposes, whose general schema is presented in figure 1.

From the figure could be individualized the main eduknowledge components:

• The eduknowledge header- which gives details regarding the specific eduknowledge chunk and also acts as an user-friendly interface;

• The preliminary examples- which are introducing students in the specific domain of activity;

• The basic chunk of knowledge that gives the ways to perform the specific task for which the eduknowledge was built (for example, a specific eduknowledge is oriented towards the design and development of expert systems- this basic chunk of knowledge is a step-by-step procedure for development of an expert system from scratch);

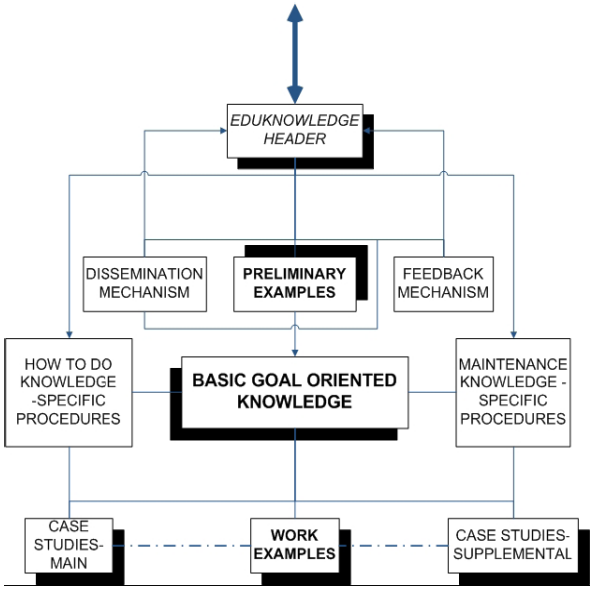

Fig.1. The eduknowledge framework

• How to do (HTD) knowledge- which shows how to perform specific tasks related to the main task (for example, an efficient expert system uses data from databases, as the eduknowledge is centered around efficiently building expert systems one of HTD is centered around the development of databases that could be used in conjunction with the expert system)

• Maintenance (M) knowledge- which has the role to help in solving specific problems that could appear during the task performance (for example, in building an expert system the inference mechanism is not closing on the production rules that are leading to the solution- maintenance knowledge gives the solutions for tracking and debugging the inference process);

• Examples and case studies- are used in order to give the student the possibility to see

in practice the applications of the knowledge;
• Dissemination mechanism- the tutorial mechanism used to train the student;
• Feedback mechanism- the mechanism used to take the feedback from the student and use it to adapt accordingly the tutorial process.

4. How Does Knowledge Management and E-Learning Interact?

Knowledge management and training are integral and closely associated parts within a single framework. Knowledge management allows effective control and management of the corporate memory – the knowledge that is within the organization.
As a result of corporate knowledge, a virtual classroom evolves, which in addition to the classic "live training program" makes a dialog / interaction possible despite "distance learning." For example the interaction of virtual teams and how they can process information together. Especially the exchange of experience and interaction in form of chats, discussion forums is one of the most efficient ways of informal training.
On the other hand corporate memory that has been collected, managed, organized and has been made accessible to everyone within the company through a KM program, could work proactively pushing knowledge and new information to interested parties (alerting) so that they could better accomplish their job.
The training is provided through 4 different media: User Guides (available on knowledge management community of practice), FAQ documents, CBTs and Digital Library.
User Guides - When new versions of each tool becomes available or changes occur. Users receive an email or announcements on the knowledge management newsletter regarding changes and upgrades and are encouraged to download the latest version of the guide.
FAQ - FAQ documents are created based on questions received from users over time and sent to K-advisors and reflect user's needs and feedback.
Computer Based Training was developed by the knowledge management team and are stored on Learning Management System the knowledge management community of practice which is available to everyone and can be downloaded from there.
Digital library - While curriculum tools support class functions, digital library tools focus on locating resources. These functions support the exploration and collection phases of information search. Digital library tools help users find the right information amidst a huge amount of digital material. Digital library features usually include search, browsing, and discovering special collections or exhibits. Search and browsing are used to locate resources and explore related topics. Special collections or exhibits contain organized materials representing a unique treasure for interested users.

5. Rules and Rules Engines

As in e-learning systems knowledge will evolve more rapidly than the rest of the system, this is sufficient reason for us to try to implement it in such a way that it should be easier to change knowledge implementation structures without affecting the rest of the application. This is where the concept of rule will play an important role.
Also known in software development as business rules, rules are pieces of knowledge that intend to assert business structure, or to control or influence the behaviour of the business. Their roots come from artificial intelligence community and database tradition, the oldest business rules management approach being the creation of a so-called expert system shell. According to different classification schema, business rules can take various forms, like if-then or event-condition action statements. Rules engines or inference engines are software components capable to manage, execute and separate rules from the rest of the system.

6. Use of Knowledge Management in E-Learning Systems

An efficient e-learning system should also be based upon knowledge, and not exclusively on information. As an example and argue for the previous affirmation, we will present an e-learning system for major risks management, built on the eduknowledge framework

presented above. The system has been developed by the authors of this paper during the development of a research grant in the year 2004. Such a system should offer to interested parties information regarding the specific legislation and also a knowledge database useful in the prevention of accidents prone to major risks. The system was functionally organized in tree main modules, which will be briefly depict in the following paragraphs.

Training Module aims to:

a) provide information about domain specific legislation;

b) provide knowledge using case studies. Each case contains a description of the event that took place (through movie, photos and natural language text), specify the managerial, technical and natural causes that lead to the accident and also the actions that have been taken and the effects of these actions.

Testing Module has the following roles:

a) evaluates acquired information regarding legislation using tests with single choice questions;

b) verify acquired knowledge, through simulation tests. A simulation starts with the presentation of the event and the causes that have led to it. Students have to choose correct actions to take for the given simulation case. Then the system will evaluate their choices and indicate the consequences of these actions.

Administration Module manages student information and educational content. Only the system administrator and the course manager have access to this module.

As it was previously mentioned, the e-learning system provides both information and knowledge, introducing knowledge management in the case studies and simulation sub-modules. Starting from the information that was given about the accident and its causes, the process of knowledge identification involved information rehashing. The results of this process is knowledge about adequate actions and their results.

The flow diagrams in Figures 2 and Figure 3 describe the process of knowledge identification for case studies and respectively for simulation tests.

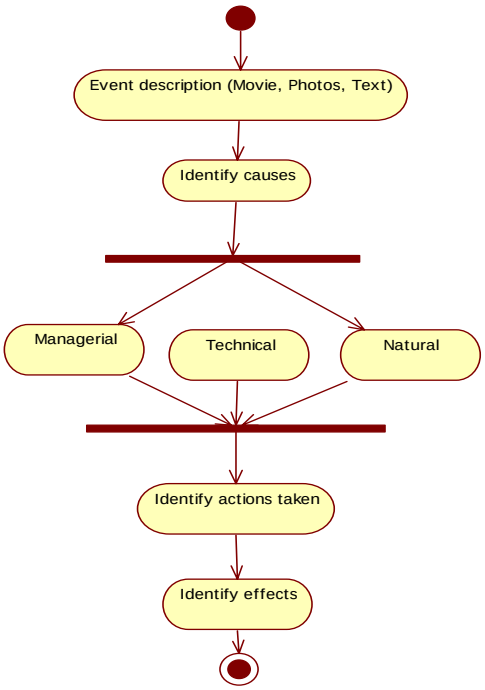

Fig.2. Knowledge structure in case studies

According to previous knowledge classification, in our e-learning system knowledge is of causal type. Knowledge representation uses a system of rules in the form of causes/actions – effects. In fact, these rules are similar with production rules and are implemented as "IF cause/action THEN effect" constructions. The left hand side of a rule can be a complex statement constructed from simpler ones (causes and actions), connected by logical operators. The right side of a rule is always an effect.

Causes can be of three types: managerial (eg. transport of chemical substances in inadequate storage conditions), technical (eg. use of inadequate substances for fire extinction), natural (eg. rain, wind). As an example of effect: explosion, fire propagation and reduction of noxious gas.

The rule-based structure allowed knowledge to be managed by a rule engine. The main advantages of such an approach are: rules can be externalized from the rest of the application code, and thus changed more easily; we are able to define rule sets for complex business rules; rules priority levels can be provided.

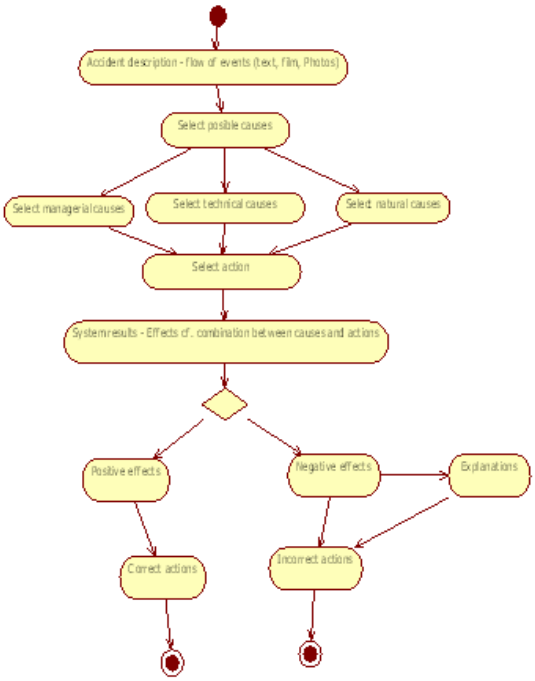

Fig.3. Knowledge structure in simulation tests

7. Conclusions

E-Learning alone is not enough. Though online training will have dramatic benefits, it's only a part of the solution. The benefits of true organizational learning go beyond the traditional "course," whether it is in the real world or in the virtual world. What is equally important is to harness the collective knowledge and experience of the entire company.

This paper discuss the problem of knowledge and e-learning interaction by using an e-learning system for major risks management, based on eduknowledge. The knowledge structure lead us to the conclusion that rules are appropriate for representing knowledge in this case. Also, an implementation solution based on rules engine capabilities was chosen.

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