Collaborative Knowledge Management

ŞTEFAN IOAN NIŢCHI, ALIN MIHĂILĂ
Faculty of Economics and Business Administration
Babeş-Bolyai University of Cluj-Napoca,
Teodor Mihali, No. 58-60, 400591, Cluj-Napoca
ROMÂNIA
stefan.nitchi@econ.ubbcluj.ro, alin.mihaila@econ.ubbcluj.ro

Abstract: The globalization, the explosive development of the Internet and other communication systems generated a high dynamic and a new kind of society. Two of the main characteristics of this society are the collaboration and the knowledge management. These characteristics form a binomial relation, that means, collaboration cannot be realized without knowledge and vice versa, the knowledge in the new global society cannot be obtained without collaboration. The problem is so complex, because generally, in the collaborative systems, the knowledge is heterogeneous and the Knowledge Management System (KMS) needs to translate a large variety of tacit knowledge, the knowledge that can be acquired by experience and communication [15], in explicit knowledge, the knowledge included in documents or books [15], and reversely. Consequently, a new field named Collaborative Knowledge Management (CKMS) has emerged. In this paper, the authors try to present some aspects of KMS. Some authors underline [6] that the body of literature in this field is ambiguous, normative and often conceptual. As such, in our note, the general results will be applied in an empirical case study based on a project developed by the authors. The project focuses on the economic education in Romanian high schools. It will be treated as a two-phase CKMS, that means, that in the first phase, the CKMS of a Virtual Organization (VO) is built and in the second phase, this construction will be transformed in a virtual community which will function as a Social Network (SN).

Key word: collaboration**.** virtual organization, knowledge management, social network

1. Introduction

The globalization and the ITC developments imposed the collaboration and the knowledge management paradigms. These paradigms interact, generating the new denominations of the society like collaborative society or knowledge based society. One of the main challenges in the academic researches, but also in practice is to study this mechanism and how it works in the real world. In this respect, there are many studies concerning the economic environment, but these are less frequent in education. The problem is more important in economic education in high schools in the developing countries like Romania, where the experience in the market economy, but also in CKMS is at a very low level. EU proposed some grants to improve the theoretical and practical experiences of these countries in CKMS usage. In this respect, in the present note, we propose an analysis of CKMS and implement it in an education environment through a project supported by the European Union (European Social Fund).

2. Collaboration

The collaboration is adopted from different point of views. A general definition of collaboration can be considered the following [11]: the collaborative systems represent an interdisciplinary field, being at the intersection of informatics, cybernetics, cognitive sciences, psychology, linguistics, decision support systems, management etc.

In this respect, some specific meanings for collaboration can be considered:

- collaboration is the most sophisticated level of relationship, because it requires efforts to unite people and organizations in order to achieve common goals that could not be achieved by any single individual or organization acting alone [24].
- collaboration is a process in which entities share information, resources and responsibilities to jointly plan, implement, and evaluate a program of activities to achieve a common goal [7].
- the authors used [21] the following definition (3C paradigm): collaboration means

cooperation, communication (networking) and coordination [9, 12].
  - cooperation is considered as a common effort to achieve the common objectives;
  - communication is the activity of changing information between participants;
  - coordination is the activity which ensures that different participants work together in achieving the common objectives.

Other authors [26] insist about the creativity in collaboration and on the role of content management. In this respect, content management is the process of creating, updating and publishing content online and can have different meanings according to the interpretation:

- from a business-goal view, content management represents the means to deliver business value covering the processes and tools behind it, as a process it refers to collecting, managing and publishing information;
- from a technical point of view, it represents the combination of hardware and software that comprise the content management system.

In this respect, the collaboration is the intersection of these four domains: cooperation, communication, coordination and content management. It can be remarked that this point of view is a refinement of the 3C paradigm, because the content management can be included in communication. But it needs to be mentioned that in CKMS, the content management has a very important role.

The collaboration can be considered from a theoretical, but also from a practical point of view. In this respect, without study in detail, we consider two taxonomies.

The first taxonomy is based on the background and the role of participants in collaboration from an epistemic point of view [32]:

- employer/employee
- teacher/apprentice
- peer-similar
- peer-different.

A second point of view is a practical one. Combining the time/place communication model [29] with some collaborative technologies [32] results the combinations from Fig. 1.

	Same Time	Different Time
Same Place	Face-to-face Collaboration (Synchronous): • GSS in same room • Web based GSS • Multimedia presentations • White board • Document sharing • Face-to-face lectures in class or on Skype, Chat or messenger in same room	Asynchronous Collaboration • GSS in same room • Web based GSS • Workflow management • Document sharing • E-mail, V-mail using a local net • Video conferencing playback • Home work analysis
Different Place	Distributed Synchronous Collaboration • Web based GSS • Whiteboard • Document sharing • Video and Audio conferencing • Computer conferencing • Online lectures • Contact on Skype, Chat or messenger • E-mail or v-mail	Distributed Asynchronous Collaboration • Web based GSS • Whiteboard • Document sharing • E-mail or v-mail • Workflow management • Video conferencing playback • Video conferencing playback • Computer conferencing with memory • Home work analysis

Fig. 1. Combination of time/place communication models and collaborative technologies

In order to reap the full potential benefits of acquiring, developing, managing, sharing and disseminating knowledge in a dynamic environment some changes regarding collaboration must be done [17].

3. Communication and content management

As it was presented in section 1, the communication is an essential point in collaboration. As it is mentioned in [32] "without communication, there is no collaboration". The communication can be realized in different manners, such as: face-to-face direct communication, e-mail, chat, listservs, newsgroups, bulletin boards, videoconferencing and electronic meeting systems, portals etc.

But in [32], it is mentioned that "Communication primarily transmits information from sender to receiver, but collaboration is much deeper. Collaboration conveys meaning or knowledge among group members". In a wide group, the information is heterogeneous and the necessity of content management results. The content management system (CMS) ensures the acquisition, management and publication of the content. It is composed of different components, but for our interests, the most important parts are represented by document management and Web content management.

The technical aspects of CMS are very interesting, such as different formats of data and document links, like HTML (Hypertext Markup Language), RDF (Resource Description Framework) or XML (eXtended Markup Language). From a Collaborative Knowledge Management System (CKMS) point of view, it may be the most interesting CMS that can be realized by Wiki linkage. The classical Wiki systems collect Web sites via hyperlinks [28]. Among the advantages, the following can be mentioned:

- doesn't require technical abilities like HTML;
- has a rollback mechanism with versions;
- ensures different linking forms;
- ensures uploading of other contents;
- has search functions;
- represents a very strong base for CKMS, because it can ensure a very good heterogeneous CMS.

It can be remarked, that in the last period of time, the classical Wiki was extended by different semantic forms [28].

4. Collaborative Knowledge Management (CKM)

CKM is based on two very important new IT technologies [22], more exactly: Knowledge Management Systems (KMS) and Collaborative Information Systems (CIS).

Knowledge Management (KM) objective consists of gaining the most from the knowledge which all the organizations possess by means of its adequate and explicit management [3]. KM includes tools, strategies and practical experiences used in a productive organization (industrial or services) to identify, develop, represent, distribute and make available different kinds of knowledge [25], accepted as the most important assets of today's organization [31].

KM has also different meanings. Two nearly equivalent meanings are:

- KM consists in the collecting, categorizing and disseminating K in an organization [32].
- KM consists in the practice related acquisition, capture, construction, sharing and use of knowledge [1].

Some authors [14] consider the KMS as specially text or hypertext oriented systems, because they are involved mainly in different format documents management.

KM is focused on the continuous improvement of performance, competitive advantage and innovation by two main issues, namely, Organizational Learning (OL) and Organizational Memory (OM) that is the Knowledge Repository (KR) containing knowledge and best practices. It consist of a strategic asset and a focus on encouraging the sharing of knowledge in organizations.

KM has been studied theoretically and practically since the late 1990s. The KM theory has been gradually moving to an academic maturity.

Similarly, OL has been studied for a long period of time1. The interest is due to the positive effect of OL in storage of organization K in a changing and dynamic environment [30]. It

[1] V.E.Cangelosi and W.R.Dill, Organizational learning observations: toward a theory, Admin. Sci. Quart, 10, 1965, p. 175-203.

ensures the development of new K that can be important in the behavior of the organization. In VO and SN, it increases the need of OL to share and disseminate the information. OL starts with the individual learning and continues with collective learning, that means, groups, teams or organizations level.

The learning abilities include:

- opening to new perspectives;
- consciousness of the personal aptitudes;
- exposition to unfiltered data;
- realistic understanding.

OL can bring the organization solutions in 5 important issues [10]:

- the systematic solution of problems;
- creative experiments;
- learning from the past experiences;
- learning from the best practices of others;
- the rapid and efficient transformation of K in an organization.

OM ensures the capture, representation, store and dissemination of the K in an organization. OM is formed [6] by 4 tips of memories:

- the occupational memory contains explicit referential K, documents, utilities used in a job;
- organization memory is chained to organization's activities and its partners;
- individual memory contains the abilities and competences of the individuals;
- project memory stores the project definition, activities, resources, history of the project and results.

Other taxonomy could be:

- internal memory, containing K and information inside of the organization;
- external memory, containing K and information from environment.

It can be conclude that OL and the OM depend less on the technology and more on the human resources.

To create the K [23] it means:

- to generate new meanings, new ideas, new behaviors;
- joining of explicit and tacit K;
- realization of the K spiral individual/group/organization K.

In [23] there are 4 K creation models:

- socialization – converting the tacit K in new tacit K by social interaction and sharing K between members of VO (for example using instructors);
- externalization – translating tacit K in new explicit K (producing a new learning document in a school);
- internalization – creation of tacit from explicit K (create meanings from written documents or content management);
- combination – creation of new explicit K by: classification, categorization, and systemization (for example, statistical or data mining analysis on different data collections using Knowledge Discovery Query Language (KDQL) like it has been described in [34]).

The K capture consists in search K sources and also usage of the internal K. The K capture can be made without ITC. One classical example is made by the case studies. There are different methods to collect K. One of the most usual is the verbal discourse.

The K capturer can be from individuals or groups.

The main individual K capture techniques are [8]:

- interviews, the most usual, the manager of the interview has an acquiring, maintenance and validation of K;
- direct observation, the expert's activity in recorded video, his documents, data and actions are studied;
- usage of questionnaires;
- analysis of past cases;
- introspection, the expert needs to solve a typical case that overpasses his experience;
- simulation etc.

An interesting question for our problem is [5] "Can work groups be viewed as distributed knowledge systems?" The problem is not very well studied in literature. KM is concentrated on the knowledge integration in groups as merely additive. Also, some authors consider [2] that the distributed KMS are more difficult in VOs.

Generally [22], knowledge networking uses IT to share knowledge and wisdom among individuals, groups and units across the organization and even with external organizations. By our point of view, we are interested in the Knowledge networking across VO and SN.

In this respect, our model for CKMS can be represented as in Figure 2. This model consists of two phases. In the first one, the CKMS is created by a VO, which means the OL, the OM and the collaborative system are created. One of the main elements is the collaborative portal. This portal will chain the CKMS of VO and CKMS of SN.

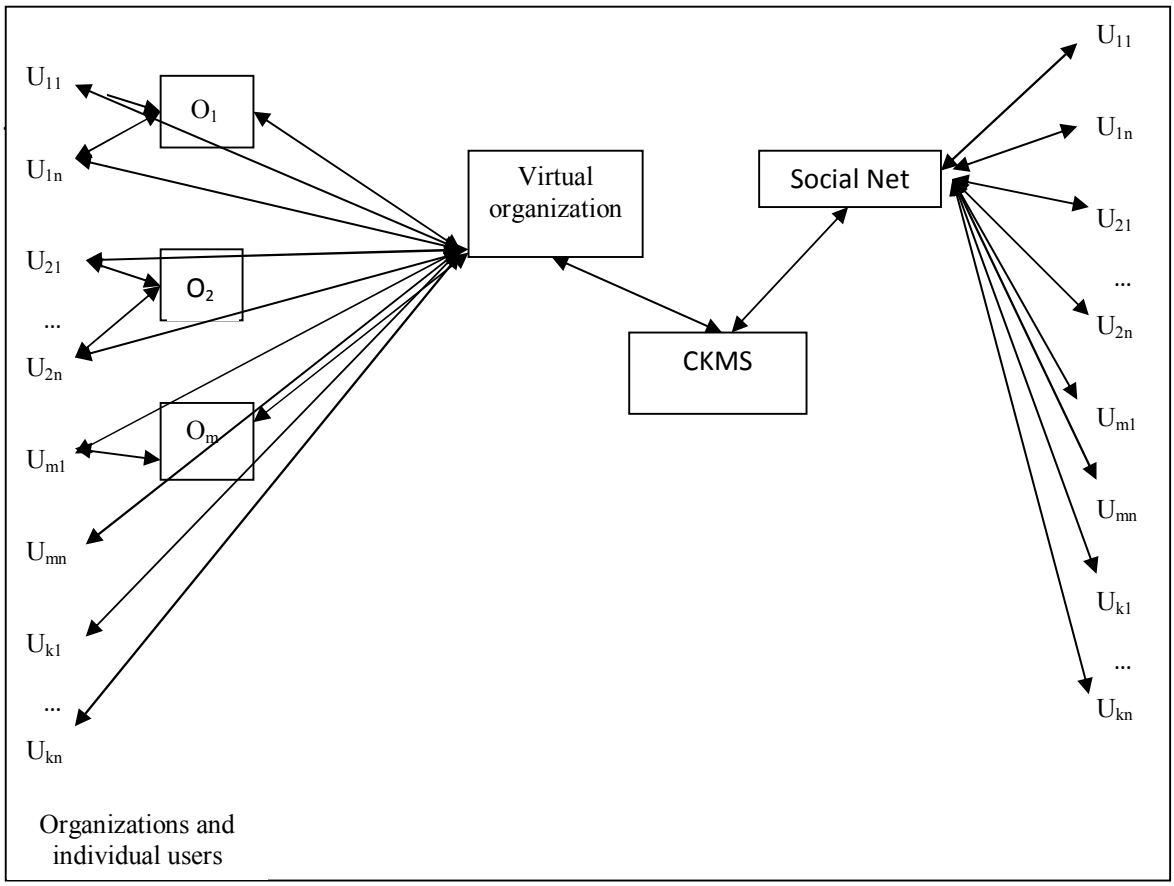

Fig. 2. The general architecture of a 2 phases CKMS

In Fig. 2:

- U_{ij} , with i=1,2,…n, are the users of real organizations O_i; they can communicate with VO directly or intermediated by their organizations. U_{kj}, with j=1,2,…m are individual users which communicate directly with VO.
- O_1, …, O_m are real organization that collaborate.

5. CKMS in VO and SN

VO is a conglomerate of collaborative organizations and people to achieve some common objectives [21]. Coupling VO with ITC has led organizations to extend the boundaries of teams from traditional co-located settings to a dispersal one [16].

The authors realized some VO examples in different grants and studies as case studies:

- the first is formed by some universities, high-schools and individual teachers in a project to improve the economic education in Romanian high schools;
- the second is formed by some universities, research institutes and a company to realize a Technological Transfer Center which will collaborate with other centers;
- the third is formed by different universities and research organizations to collaborate in some research projects;
- the last is generated on a real university to realize by ITC of a collaborative environment for distance learning.

For the collaborative systems the authors proposed a general framework [20] based on DARPA Intelligent Collaboration and Visualization program (IC&V).2 This is a multi-their framework that can be used for CKM in a VO. More exactly, the four tiers of the framework are: requirement tier, conceptual tier, middleware or logical support tier and technological or physical support tier.

In each tier we had specific objects and ontologies.

At requirement tier, four categories of objects exist: work tasks describe the main activities in the collaborative systems, transition tasks, social

[2] http://zing.ncsl.nist.gov/nist-icv/documents/

protocols and group characteristics. The main ontologies are based on natural languages, heterogeneous structures [18], Time Facetted First Order Horn Logic [19], WordNet or a classical Wiki. At this level it can establish the requirement for the collaboration, for content management [26], but also for KM.

At the conceptual level, we have the conceptual images of the objects from the requirement level. The main ontologies are based on AI instruments like, semantic nets and more exactly their standardization or scenarios standardization. But we also have more specific ontologies, as for example, SUMO (Suggested Upper Merged Ontology) And GOLD mapped on SUMO, Cyc, CIDOC CRM (Conceptual Reference Model) and ISO Draft International Standard (ISO/DIS 21127).

The middleware ensures the functionality of various types of services to understand how a given conceptual object and scenarios would be supported. It allows us to compare services to determine which service seems most appropriate given the characteristics of a group, ensures the robustness and the scalability of the system and also can prove the correctness of the CSCW (Computer Supported Collaborative Works). A list of the main components for the various services from this tier can be: E-mail, chat, Internet, intranet or extranet connections, telephone conversation, multicast audio and video, half and full duplex audio, duplex audio, white and black boards, shared workspace and applications, encryption, recording, history mechanism, lists of objects, participants, possible collaborators, version control, simultaneous sessions, collaborative space management and navigation, object repository, object control, import/ export facilities, semantic web facilities etc. To represent the scenarios we can use a frame system from AI or some special languages based on frames KM (Knowledge Machine) of F-Logic (Frame Logic), KIF (Knowledge Interchange Format), OWL (Ontology Web Language), a markup language specified by World Wide Web Consortium (W3C), RDF (Resources Description Framework), also developed by W3C, and other components, these tools make up the Semantic Web project.

Finally we do not insist on the technological level.

By this middleware description we can generate analogous with [13] the basic architecture of a VO or SN and its CMS as in Figure 3.

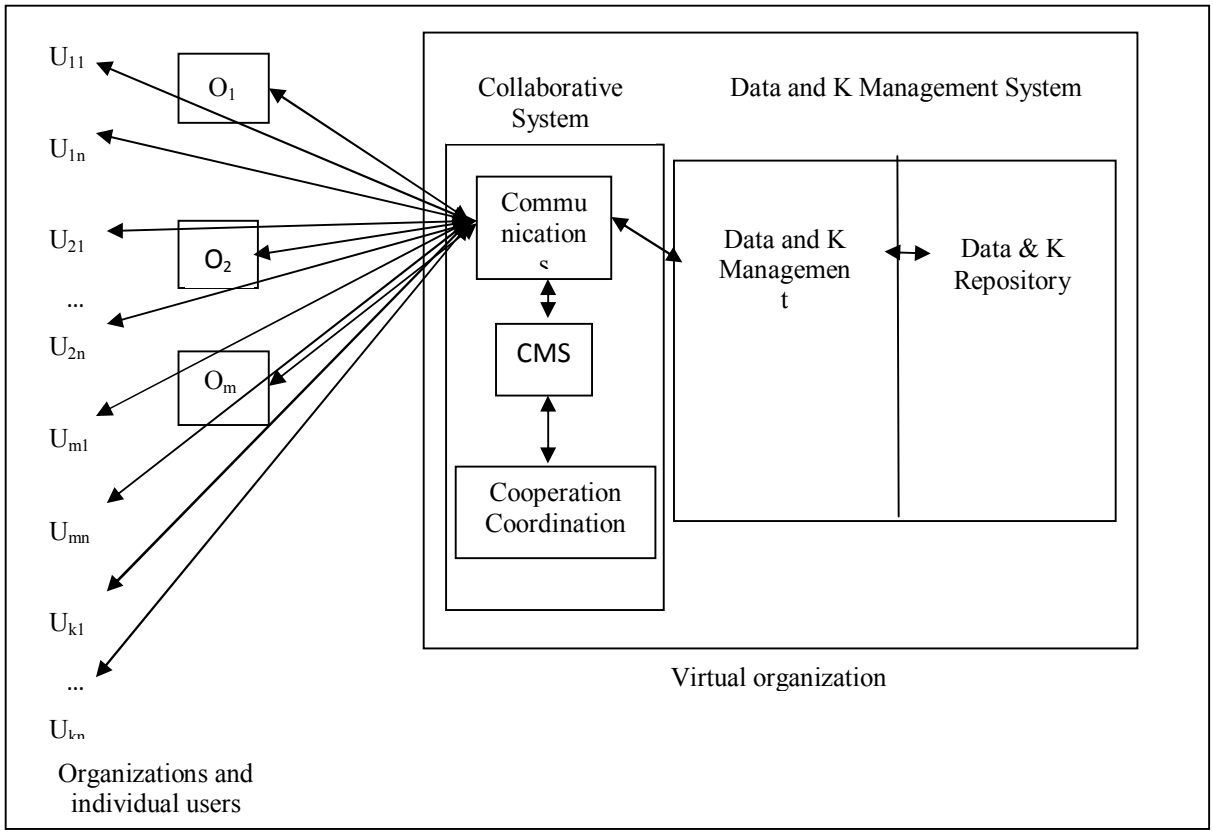

Fig. 3. The general architecture of a VO or SN CMS

In Fig. 3:

- U_{ij} , with i=1,2,…n, are the users of real organizations O_i; they can communicate with VO directly or intermediated by their organizations. U_{kj}, with j=1,2,…m are individual users which communicate directly with VO.
- tthe collaborative can be realized in different manners: directly, face-to-face or electronic as it can be seen from the middleware.
- Data and Knowledge Repository is formed by databases data warehouses, data marts or data marts. The knowledge repository is formed by knowledge bases and a repository with the best practices.
- Data and Knowledge Management Systems enable the management of these elements.

SN can be represented [14] by mathematical models of dynamic networks in which the nodes represent people and the links between them represent some kind of a relationship (e.g., friendship, advice, supervisor/subordinate). As it is mentioned [14] the Knowledge Network (KN) is a special SN, where the links represents the knowledge and the main differences between the two are, SNs represent “who knows who", then KNs represent "who knows what". The most important element of SN is the fact that the relations are between persons.

6. Case study - Economic Education in Romanian High Schools Project

6.1. General presentation of the project.

The case study presents a project supported by the EU3. The main objective is: to improve at a national level the competences of the professors involved in teaching economic disciplines in Romanian high schools. From this main objective, other, more specific ones, are derived.

In the first phase, the project is based on a VO formed by:

- Babes-Bolyai University Cluj-Napoca, coordinator, Academy of Economic Studies, Bucharest, University “Al. Ioan Cuza” Iasi, West University Timisoara and Learn&Vision Ltd., Cluj-Napoca.
- 76 trainers, selected from among partners’ professors , but also from among teachers from different high schools.
- 1250 trained teachers from different high schools that participate as individuals.

Within this project, 8 training programs are designed for the main economic disciplines in Romanian high schools: Design, organization and evaluation of didactic activities – ECON (P1), Didactics of economy (P2), Didactics of entrepreneurship education (P3), Didactics of accounting (P4), Didactics of management (P5), Didactics of marketing (P6), Didactics elements of simulated companies (P7), ITC-ECON (intermediate level) (P8).

The main schedule is (whole time period is 36 months from October 2010 until September 2013):

- 1-st activity, Octomber 2010 - February 2011, consist in the selection of the trainers and the organization of lectures for them;
- 2-nd activity, Octomber 2010 – March 2011, consist in the elaboration of the questionnaires, for teachers and for pupils, the application of them and the analysis of the results concerning the learning needs in economic disciplines;
- 3-rd activity: November 2010 – September 2013, consist in developing a virtual organization;
- 4-th activity, January - September 2011 consist in developing the Design, organization and evaluation of didactic activities – ECON program;
- 5-th activity, January - September 2011 consist in developing the Didactics of economy (P2), Didactics of entrepreneurship education (P3), Didactics of accounting (P4), Didactics of management (P5), Didactics of marketing (P6), Didactics elements of simulated companies (P7) programs;
- 6-th activity, January - September 2011 consist in developing the ITC-ECON (intermediate level) (P8) program;
- 7-th activity, August 2011 – February 2012 consist in approval of the developed programs by the Romianian Ministry of Education, Research, Youth and Sports;
- 8-th activity, Octomber 2011 - February 2012, consist in the selection of the trainers and the organization of lectures for them;

[3] www.educatieeconomica.ro

- 9-th activity, October 2011 – September 2013, consist in delivery of the developed programs to high schools teachers;
- 10-th activity, June – July 2011, consisting in organizing of a conference for promoting the project.

6.2. The VO and the KM in the actual project

Considering the general architecture from Figures 2 and 3, we will analyze the elements of the VO and the CKM.

6.2.1. Users

As it was mentioned, the users are trainers, professors from different universities, teachers from high schools, technical support and administrators, other persons that are interested in the project. The community of the users is a large one.

6.2.2. Communication

The communication is ensured in different manners:

- face-to-face, that means the program for trainers were made in this manner. For teachers, the training programs will be delivered face-to-face (partially), very near to their schools. Each group of trained teachers consists of 9 to 14 persons. A part of the training process is carried out on-line. In addition, some workshops and seminars are envisaged between the partners, and in Jully 2011 a conference was organized, with more than 200 participants interested in the project.
- on-line through e-mails, Skype or through the project site.
- by a collaborative portal[4] which will contain all materials and other information elaborated within the project and which could be accessed based on username and password. This portal will be a basic communication instrument in the VO, but it will also be the link in the SN and KN generated by the project.

[4] http://82.79.151.101/educol/learning/login/index.php?lang=ro_utf8

6.2.3. Coordination

The coordination of the VO is a difficult management issue due to the heterogeneity and the large number of participants. In our VO, the coordination is ensured at an administrative level by:

- central coordinator, it means the Babes-Bolyai University management team. This team ensures the general coordination, the resources for all the participants, relations with Education Ministry and other authorities etc.
- each partner has a manager, an assistant manager and a financial manager which coordinates their local problems and also the relationships with the general coordinator.

At a professional level, each partner coordinates 1 or 2 programs. In each program, there are the following involved:

- a program coordinator, which coordinates the activity in the program.
- some experts from different universities that are involved in the elaboration of the materials and in the training of the teachers.
- an evaluator that needs to evaluate all teaching materials.

6.2.4. Knowledge

K about the educational needs was obtained, as it was mentioned, in the second activity, by a social analysis. In this respect, from the 1494 high schools that exist in Romania, 193 schools were selected randomly from all regions. The K was captured by questionnaires. The questionnaires for teacherscontained 38 items and the one for pupils, 18 items. From each school were selected from 1 to 5 teachers and the pupils from the class where they had lessons. In this manner, answers from 322 teachers and 6329 pupils were obtained. To create the collective K a combination method was used. The answers were analyzed in a 42-page report using different criteria, and brainstorming sessions were organized in each workshop from the beginning of the 3-rd activity in order to help elaborate the teaching materials connected with the needs. Some programs made their own analysis.

To create K of the trainers, externalization and socialization methods were used. These methods were applied by organizing special face-to-face lectures. At the end, the participants were tested

by a theoretical and a practical exam and they were certified as trainers.

The K for teachers is captured from the materials elaborated by the trainers. To create the internalization of K by teachers, the programs are divided in modules; each module has subjects and each subject has a number of lectures. Generally 1/3 of the lectures are theoretical and 2/3 are practical. Moreover, as it was previously mentioned, the lectures are organized face-to-face as well ason-line. The lectures follow the training principles.

6.3. CKM

Our VO containing many different people and organizations, it is clear that the organizational cultures and OL are different. This heterogeneous OL needs to be homogenized. An important step in achieving this is the training of trainers, where the teaching methods are established. Another important step represents the analysis of seminars and workshops where the participants are from different organizations. In this respect, we have two steps:

- in the first step the trainer creates explicit K by externalization;
- in the second step the trainee creates their tacit K by internalization.

The administrative information is much more simple to manage because the central coordinator establishes and implements its' rules and structures. The participants have their own structures and rules and thus different interfaces in this federative database system need to be created.

Concerning the organizational memory, it is formed from databases and from the Knowledge Repository. KR consists of different teaching materials that form the knowledge base. It is created by externalization by trainers. The second part is formed by the best practices and feedbacks from trained teachers. This part is created by the teaching materials, but also by debates from the workshops, at different lectures, remarks on the collaborative portal or on the site of VO, analyses of the questionnaires and also in the conference organized in July 2011.

7. Conclusions

In the present paper the authors developed a general CKM architecture developed in two phases based on a collaborative framework. In the first phase, a CKMS for a VO is built and in the second phase, the realized CKMS is developed for a collaborative community organized as a SN. The theoretical results are applied on a case study.

In the present case study it is illustrated how the theory can be applied to an education project. We selected this case because it involves many people and organizations from a large geographic area, with different cultures, structures and OLs and OMs. It also involves many people from different high schools situated in different places in Romania.

8. References

[1] Akoumiakakis D., Distributed Knowledge Management in Virtrual Organizations: the 'Social' Experience Factory, The Electronic Journal of Knowledge Management, Volume 6, Issue 1, 2008, pp.13-32.

[2] Alavi, M. and A. Tiwana, A. Knowledge integration in virtual teams: The potential role of KMS. Journal of the American Society for Information Science and Technology, 53(12), 2002, 1029-1037.

[3] Andrade J., Ares J., García R., Rodríguez S., Suárez S., A Knowledge-Based System for Knowledge Management Capability Assessment Model Evaluation, WSEAS Transactions on Computers, Issue 5, Volume 9, 2010, pp. 506 – 515.

[4] Bartlang U, Architecture and Methods for Flexible Content Management in Peer-to-Peer Systems, 1st ed., A. W. Ute Wrasmann, Ed. Wiesbaden, Germany: Vieweg+Teubner, 2010.

[5] Berryman R., Knowledge management in virtual organizations: A study of a best practices knowledge transfer model, Dissertation Prepared for the Degree of PhD., University of North Texas, May 2005.

[6] Bosch-Sijtsema P.M., Knowledge Management in Virtual Organizations: Interorganizational and interproject knowledge transfer, Organizational Knowledge, Learning and Capabilities conference 2002, http://www2.warwick.ac.uk/fac/soc/wbs/conf/olkc/archive/oklc3/papers/id191.pdf

[7] Camarinha-Matos L.M. and H. Afsarmanesh, Collaborative Networks: Reference Modeling. Springer US, 2008, ch. Collaboration forms.

[8] Dieng-Kuntz R. et all., Methodes et outils pour la gestion des connaisances, Une approche pluridisciplinaire du Knowledge Management, Dunod, Paris, 2-nd Edition, 2001.
[9] Fuks H., et al. The 3C Collaboration Model, 2008, pp. 637-644.
[10] Garvin D.A., Building a learning organization, Harvard Business Review, 1993, July/August.
[11] Giboin A., Dieng R., Karsenty L., De Michelis G., Designing Cooperative Systems, The Use of Theories and Models, Proc. Of 5-th Int. Conf. on the Design of Coop. Syst. (COOP'20000), IOS Perss 2000.
[12] Grosz B., 1996, AAAI-94 President Address Collaborative Systems, AAAAI Magazine, summer, 1996, p. 67-85.
[13] Hollsaple C.W., DSS architecture and types, in F.Burstein and C.W. Holsapple (eds), Handbook on Decision Support Systems,,Springer, 2008, vol. 1, p. 171-173
[14] Jones P.M., Collaborative Knowledge Management, Social Networks and Organizational Learning, NASA Ames Research Center, Human Factors Research and Technology Division, 210.212.115.113:81/.../Collaboration%20A.
[15] Mamcenko J., Beleviciute I. (2007), Data Mining for Knowledge Management in Technology Enhanced Learning. In proceedings of the 6th WSEAS International Conference on Applications of Electrical Engineering, Istanbul, Turkey, May 27-29, 2007
[16] Massey A.P., Collaborative Technologies, in BURSTEIN F and C.W.HOLSAPPLE (Eds.), Handbook on Decision Support Systems, 1, Basic Themes, Springer, 2008, p. 341-354.
[17] Muntean, M., Târnăveanu, A. (2009), Information Technology & Organizational Knowledge Management, Proceedings of the 13th WSEAS International Conference on COMPUTERS, WSEAS Press, ISBN 979-960-474-099-4, pp. 335-339
[18] Nitţchi S.I. and R. Avram-Nitţchi R., On the Paradigm of Collaborative Systems, Proceedings of the International Workshop, Collaborative Support Systems in Business and Education, 28-29 October, 2005, Cluj-Napoca, Risoprint, p. 274-292.
[19] Nitţchi S.I., A.Mihăilă, About The KM in a Heterogeneous Collaborative Projects Management, proposed to KM-Conference, ASE Bucharest, November 2006.
[20] Nitţchi S.I. R. Avram-Nitţchi, A. Mihăilă, Some Remarks on Collaborative Systems Framework, Informatica Economică (B+), 3/.2007, p. 10-14.
[21] Nitţchi S.I., A.Mihăilă, C. Mihăilă, Some Remerks on Knowlegdege Management in Virtual Organizations, 1st CEE Symposium on Business Informatics, Viena, februarie 2009, Oestrische Computer Gessellschaft, Austrian Computer Society, Wi09, ISBN 987-3, 85403, 242-7, p. 207-218.
[22] Nunamaker J.F., Romano N.C., Bricks R.O., A Framework for Collaboration and Knowledge Management, Proceedings of the 34th Hawaii International Conference on System Sciences – 2001, citeseerx.ist.psu.edu/.../download?doi...
[23] Nonaka I., A dynamic Theory of Organizational Knowledge Creation, , Organization Science, Vol.5, No.1, February.
[24] Osher D.M., Creating Comprehensive and Collaborative Systems, Journal of Child & Family Studies, vol. 11, no. 1, p. 91-99, 2002.
[25] Paladini E.P., de Carvalho F.G., New Standards for Competitive Distinctions: A Practical Model, WSEAS Transactions on Computers, Issue 2, Volume 10, 2011, pp. 21 – 50.
[26] Podean, M.I., Content Management in Colaborative Systems, PhD Thesis, 2011.
[27] Rose P., Knowledge Management System Architecture For Organizational Learning With Collaborative Environment, Proceedings of the Postgraduate Annual Research Seminar 2005, Malayesia
[28] Scaffert S., IkeWiki: A SemanticWiki for Collaborative Knowledge Management, Salzburg Research Forschungsgesellschaft/Salzburg New Media Lab, citeseerx.ist.psu.edu/.../download?doi
[29] Thagard P., 1997, Collaborative Knowledge, http://cogsci.uwaterloo.ca/Articles/Pages/Collab.html
[30] Tomblin M.S., Group and Organizational Learning Effects from Multiparticipant DSS Usage, in BURSTEIN F and C.W.HOLSAPPLE (Eds.), Handbook on Decision Support Systems, 1, Basic Themes, Springer, 2008, p. 813-133.
[31] Tučková Z., Strouhal J., Knowledge-Intensive Services: New Leader of

Production Stages?, WSEAS Transactions on Systems, Issue 4, Volume 9, 2010, pp. 432 - 441.

[32] Turban E., J.A. Aronson, L. Ting-Peng, Decisions Support Systems and Intelligent Systems, Seventh Edition, Prentice Hall, 2005.

[33] Weider D. Yu., Collaborative Framework for Problem-Based Learning Environment http://66.249.93.104/search?=cache:xuwUvx KQvB8J: ie.engrng.pitt.edu/ fie2005/ apers/ 1449.pdf+%22Collaborative+ framework%22&hl=ro&gl=ro&ct=clnk&cd= 20.

[34] Zakaria Suliman Zubi. 2008. Knowledge discovery query language (KDQL). In Proceedings of the 12th WSEAS international conference on Computers (ICCOMP'08), N. E. Mastorakis, V. Mladenov, Z. Bojkovic, D. Simian, S. Kartalopoulos, A. Varonides, C. Udriste, E. Kindler, S. Narayanan, J. Lloret Mauri, H. Parsiani, and Ka Lok Man (Eds.). World Scientific and Engineering Academy and Society (WSEAS), Stevens Point, Wisconsin, USA, 497-519