In today's business world, the ability to deal with knowledge is the factor that differentiates successful companies from others, e.g. in product development or recognizing market opportunities. Professional Knowledge Management helps to determine knowledge needs, to identify available knowledge and make it transparent to others, to develop or to acquire new knowledge, to distribute knowledge, to apply or to reuse knowledge as well as to measure the value of knowledge. Knowledge Management is a combined set of organizational design, social interventions in business culture, as well as development and application of information technologies. The forth conference Professional Knowledge Management – Experiences and Visions in Potsdam, once again provides a broad and integrated overview on the state of the art of Knowledge Management in science and practice. It is key to the conference to connect scientists from various scientific backgrounds and to share experiences from interdisciplinary perspectives from various applications.

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- Experiences and Visions -

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Prof. Dr.-Ing. Norbert Gronau
University of Potsdam
Chair of Business Information Systems and Electronic Government
August-Bebel-Straße 89
14482 Potsdam
Germany

norbert.gronau@wi.uni-potsdam.de
http://wi.uni-potsdam.de

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Klixstraße 1A, 13403 Berlin, Germany
Phone: +49 30 41 93 83 64, Fax: +49 30 41 93 83 67
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Preface

In today's business world, the ability to deal with knowledge is the factor that differentiates successful companies from others, e.g. in product development or recognizing market opportunities. Professional Knowledge Management helps to determine knowledge needs, to identify available knowledge, and make it transparent to others, to develop or to acquire new knowledge, to distribute knowledge, to apply or to reuse knowledge as well as to measure the value of knowledge. Knowledge Management is a combination of organizational design, social interventions in business culture, as well as development and application of information technologies.

The 4th Conference on Professional Knowledge Management – Experiences and Visions in Potsdam, provides once again a broad and integrated overview on the state of the art of Knowledge Management in science and practice. It is key to the conference to connect scientists from various scientific backgrounds and to share experiences from interdisciplinary perspectives and from various applications.
In the tradition of the preceding three conferences both, knowledge manager from business world as well as scientists will participate at the knowledge market in order to share insights, to discuss current challenges and research and, to learn from one another.

The conference participants can gain a deep foundation on the subject as well as current trends in knowledge management.
The success of this conference is the result of many contributions. Therefore, a big Thank You goes to the keynote speakers and the program committee, the workshop and tutorial organizers and authors as well as all conference speakers. In addition, I thank the organizational team. My special gratitude however goes to the council of the conference Mr. Matthias Platzeck as well as to the sponsors for their support.

Potsdam, March 2007

Norbert Gronau

| Conference Chair

Prof. Dr.-Ing. Norbert Gronau

University of Potsdam
Chair of Business Information Systems and Electronic Government
August-Bebel-Straße 89
14482 Potsdam
Germany

Phone | +49 331 977 3379
Fax | +49 331 977 3406
E-Mail | wm2007@wi.uni-potsdam.de
Web | http://wm-tagung.de

| Organisation

Dipl.-Inform. Jane Fröming, University of Potsdam
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| Co-Organisation and Commercial Management

UP Transfer GmbH
at University of Potsdam
Am Neuen Palais 10 | 14469 Potsdam
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Fax +49 331/977-1143
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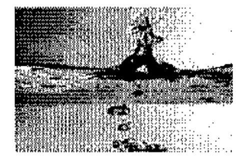
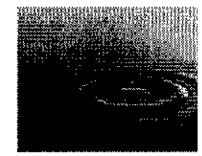

A Knowledge-Driven Model and Architecture to Develop Knowledge Management Systems

Juan Pablo Soto
University of Castilla – La Mancha
Ciudad Real, Spain
jpsoto@proyectos.inf-cr.uclm.es

Javier Portillo
University of Castilla – La Mancha
Ciudad Real, Spain
javier.portillo@alu.uclm.es

Aurora Vizcaíno
University of Castilla – La Mancha
Ciudad Real, Spain
aurora.vizcaino@uclm.es

Mario Piattini
University of Castilla – La Mancha
Ciudad Real, Spain
mario.piattini@uclm.es

Abstract. *Knowledge Management Systems (KMS) are of great help to companies since these systems are a means of increasing companies' competitive advantage. However, the developers of this kind of systems frequently focus on technology without taking into account the fundamental knowledge problems that these systems are likely to support. In order to avoid this we propose a model which describes the main knowledge functions that these systems should support. Moreover, the experience of using this model to develop a generic multiagent architecture to develop KMS is explained.*

1. Introduction

Nowadays, knowledge is a critical factor for an organization's competitive advantage; because of this the production environment and infrastructure play a diminishing role and intellectual capital and knowledge management a growing one [8]. Consequently, one way to assess an organization's performance is to determinate how well it manages its critical knowledge. In order to assist organizations to perform this task different systems have been designed. These are called Knowledge Management Systems (KMS), defined by Alavi and Leidner [9] as an IT-based system developed to support/enhance the processes of knowledge creation, storage/retrieval, transfer, and application.

Developing KMS is a difficult task; in fact, there are different approaches towards its accomplishment. For instance, the process/task based approach focuses on the use of knowledge by participants in a project, or the infrastructure/generic system based approach focuses on building a base system to capture and distribute knowledge for use throughout the organization [9]. On the other hand, before developing this kind of systems it is advisable to study what we understand by knowledge and how the transfer of that knowledge is carried out by people in real life.

In this paper we propose a generic model for developing KMS. Therefore, in section two we describe the conceptual model and its phases. Section three, illustrates how the model was used to design a generic multi-agent architecture to develop KMS. Finally, conclusions and lessons learnt are outlined in section four.

2. A Model to Develop a Knowledge Management System

A successful KMS should perform the functions of knowledge creation, storage/retrieval, transfer and application [18]. Taking this fact into account and after reviewing several knowledge cycles considered by many authors (summarized in Table 1), we decided to define a knowledge life cycle that indicates what processes a KMS should support.

The stages of this cycle are **acquisition, storage, use, transfer** and **evolution**. The first three stages are considered in most knowledge life cycles, and the transfer stage is also considered in many cycles. In adapting these models to our necessities we have included the evolution stage to ensure that the knowledge used is always updated. In the following paragraphs each stage of the model is described. At the end of each stage some tips about the technology that can be used to implement that stage in a KMS are given.

Model	Stage1	Stage2	Stage3	Stage4	Stage5	Stage6
Nonaka y Takeuchi [16]	Socialization	Externalization	Combination	Internalization		
Wiig [27]	Creation	Storing/ gathering	Use	Leverage	Sharing	
Davenport y Prusak [3]	Generation	Codify/ Coordinate	Transfer	Knowledge skills		
Tiwana [24]	Acquire	Sharing	Use			
Alavi y Leidner [1]	Creation	Storage/ Retrieval	Transfer	Application		
Rus y Lindvall [21]	Creation/ Acquisition	Organization/ Storage	Distribution	Application		
Nissen [14]	Creation	Organization	Formalize	Distribute	Application	Evolve

Table 1: Knowledge Life Cycles

Knowledge acquisition is a key component of a KMS architecture. This stage includes the elicitation, collection, and analysis of knowledge [20]. During this process, it is vital to determine where the knowledge exists within the organisation and how to capture it. This stage is responsible for collecting the information (data, models, experience, etc) from the different knowledge sources monitoring the information and experiences generated during the interaction between the user and the system or groupware tools (email, consulted web pages, chats, etc.).

From a technological point of view, in order to achieve these tasks there are several tools and techniques that consolidate and transform corporate data into information [7]. They contain:

- Front-end system (i.e. DSS-Decision Support System, EIS-Executive Information System and OLAP-Online analytical processing).
- Back-end system: data warehouse, data mart, and data mining [6].

More sophisticated techniques such as webParser [2] to obtain information from the Web, document classification [17], mailing list management [13], or data mining and neuronal nets can be also used.

Knowledge formalizing/storing is the stage that groups all the activities that focus on organizing, structuring, representing and codifying the knowledge with the purpose of facilitating its use [3].

In this stage an appropriate electronic format is given to the experiences obtained so that they can be stored in a knowledgebase to aid retrieval. Storing knowledge helps to reduce dependency on key employees because at least some of their expert knowledge has been retained or made explicit. In addition, when knowledge is stored, it is made available to all employees, providing them with a reference as to how processes must be performed, and how they have been performed in the past.

Moreover, in this stage it is convenient to compare the new information with old knowledge that has been stored previously and decide whether to delete it and add new knowledge or to combine both of them. In this way, the combination process of the SECI model (proposed in [15]) is carried out, producing new knowledge resulting in the merging of explicit knowledge plus new explicit knowledge.

Different techniques exist to store knowledge and the technique used is frequently narrowly related to the retrieval method used. Therefore, if a case-based reasoning is going to be used the knowledge will be stored as “cases”.

Knowledge use is one of the main stages, since knowledge is helpful when it is used and/or reused. The main enemy of knowledge reuse is ignorance. Employers often complain that employees do not consult knowledge sources and do not take advantage of the knowledge capital that the company has. KMS should offer the possibility of searching for information; they can even give recommendations or suggestions with the goal of helping users to perform their tasks by reusing lessons already learnt, as well as previous experiences.

Different techniques are currently used to search for knowledge. Many of them are based on the use of the position and frequency of keywords [12] or on information retrieval techniques [5]. Other authors such as [23] mix several techniques such as data mining and case-based reasoning to develop a recommender system.

Knowledge transfer is the most investigated stage in knowledge management [19]. This stage is in charge of transferring tacit and explicit knowledge. Tacit knowledge can be transferred if it has been previously stored in shared means, for example: repositories, organizational memories, databases, etc. The transfer stage can be carried out by using mechanisms to inform people about the new knowledge that has been added.

In this stage we must detect the group of people, or communities who generate and use similar information: for example, in the software domain, the people who maintain the same product or those who use the same programming language. An appropriate knowledge management linked to communities of practice helps to improve the organization's performance [10]. Disseminated information may be of different types; it may be information linked to the company's philosophy or specific information about a determined process.

Comparing this stage with the SECI model we can say that this stage fosters the socialization process since it puts people who demand similar knowledge in touch and once in contact they can share their experience, thus increasing their tacit knowledge.

Knowledge Evolution. This stage is responsible for monitoring the knowledge that evolves daily. The main purpose of this stage is to keep the knowledge stored in the knowledgebase updated.

3. Applying the model with Agents

In order to evaluate our model, we have developed a KMS by using Intelligent Agents. We have chosen this technology because it is proving to be quite useful in this area [25]. Agent technology can monitor and coordinate events or meetings and disseminate information [28]. Furthermore, agents are proactive in the sense that they can take the initiative and achieve their own goals. The autonomous behavior of the agents is critical to the goal of this research since it can reduce the amount of work that employees have to perform when using a KM system. For example, knowledge acquisition costs increase dramatically if the system development process requires a great deal of an expert's valuable time and knowledge base maintenance costs may dominate system life cycle costs, particularly in situations where the knowledge is highly volatile [4]. Intelligent agents could help to reduce these costs. Another important issue is that agents can learn from their own experience. Consequently, agent systems are expected to become more efficient with time since the agents learn from their previous mistakes and successes [11].

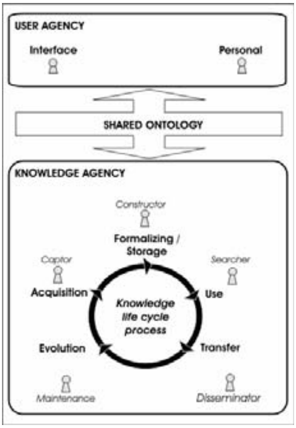

Figure 1: Agents Distribution

As can be seen in Figure 1, our architecture has two Agent Agencies. The first one is the User Agency that includes the Interface and the Personal Agent. The Interface Agent works like a bridge between agents and users showing the information to the users. The Personal Agent is in charge of obtaining the user's profile in order to know the user's preferences with the goal of adapting the representation of the knowledge to each user's preference.

On the other hand, there is a Knowledge Agency to support the activities described in each stage of the knowledge model.

Therefore, we have defined a Captor Agent that must extract information from different knowledge sources previously defined in an ontology. The Captor agent also decides what new knowledge should be stored in the knowledgebase. Then, this agent sends a message to another agent called the Constructor Agent which is in charge of giving the suitable electronic format to the new knowledge. In order to foster the reuse of knowledge, when new knowledge is stored, the Constructor Agent warns the Disseminator Agent about the new arrival. Then, after evaluating the users' profiles and preferences, this agent decides who may be interested in the new knowledge and sends a message (through the users' personal agents) giving information about the existence of this knowledge in the knowledgebase. After that, each user can decide whether to consult it or not. According to the model, another function that a KMS should support is Knowledge Use, and because of this our architecture has a Searcher Agent to search in the knowledge base for the knowledge that may be useful to each user. To do this, the Personal Agents monitor users' actions and ask the Searcher Agent for knowledge related to their users' tasks. From a technical point of view, we would like to clarify that in order to support this function we are using position and frequency of keywords and based-case reasoning [26].

With the goal of updating knowledge, we use a Maintenance Agent which evaluates which knowledge is most frequently used and which should be deleted because it has become obsolete or is inconsistent with the new knowledge.

The diagrams that describe the roles and goals of each agent have been omitted due to space limitations (for more information see [22]).

The third component of this architecture is the *Shared Ontology* which provides a conceptualization of the knowledge domain. The Shared Ontology is used for the consistent communication of the agencies.

4. Conclusions and Lessons Learnt

The agent architecture has been developed following the model described in this paper. The lessons learnt after applying the model are the following: the model helped us to determinate what functions a KMS should support. Moreover, in our particular case the model has had an influence upon determining the roles that each agent should play and how they should communicate with each other in order to attain their goals. Therefore, the multi-agent architecture has been designed by considering technology aspects (agent technology) but also by taking into account knowledge aspects, thus avoiding the weak spot of some KMS that focus mainly on technology and forget about the knowledge tasks that they should support [28]. On the other hand, the model described is partially based on the SECI model which is one of the main models to ensure the creation and dissemination of knowledge.

Besides the model, a generic multi-agent architecture has been described. This architecture can be used as a starting point to develop other KMS. In order to accomplish this it is only necessary to modify the ontologies and implement how the agents are going to represent the knowledge and how it is going to be searched for (if the implementers wish to use other techniques which are different to those that we are using).

To summarize, in this paper we have proposed a model to be taken into account by KMS developers in order to avoid a deficiency which, according to literature, many KMS have (ie a strong technological focus and a weak knowledge focus). Moreover, a general multi-agent architecture (developed following the proposed model) for KMS has been also described. Therefore, with our contributions we are attempting to assist KMS engineers to develop better systems from a point of view of knowledge, in both an easy and a systematic way.

References

1. Alavi, M., and Leidner, D. E., *Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues.* MIS Quarterly, Vol. 25, nº 1, pp: 107-136, 2001.
2. Camacho, D., R. Aler, and J. Cuadrado, *Rule-Based Parsing for Web Data Extraction*, In Intelligent Agents for Data Mining and Information Retrieval, M. Mohammadian, Editor. Idea Group, pp: 65-87, 2004.
3. Davenport, T.H. and Prusak, L., *Working Knowledge: How Organizations Manage What They Know*. Boston, Massachusetts: Project Management Institute. Harvard Business School Press. 1997.
4. F. Hayes-Roth, N.J., *The state of knowledge based systems.* Communications of the ACM, 1994.
5. Frakes, W.B. and R. Baeza-Yates, *Information Retrieval Data Structures and Algorithms*. Englewood Cliffs, NJ: Prentice Hall. 1992.
6. Giannella, C., R. Bhargava, and K. H. *Multi-Agent Systems and Distributed Data Mining*. In Cooperative Information Agents VIII: 8th International Workshop (CIA'04). Erfurt (Germany), Springer-Verlag. 2004.
7. Houari, N. and B. Homayoun Far. *Application of Intelligent Agent Technology for Knowledge Management Integration*. In Third IEEE International Conference on Cognitive Informatics (ICCI'04). 2004.
8. Kautz, H.a. *Knowledge Mapping: A Technique for Identifying Knowledge Flows in SoftWare Organizations*. In EuroSPI. 2004.
9. Leidner, M.A.a.D.E. *Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues*. In MIS Quarterly, 2001.
10. Lesser, E.L. and J. Storck, *Communities of practice and organizational performance.* IBM Systems Journal, Vol. 40, nº 4, pp: 831-841, 2001.
11. Maes, P., *Agents that reduce work and information overload.* Communications of the ACM, Vol. 37, nº 7, pp: 31-40, 1994.
12. Mohammadian, M. and R. Jentzsch, *Computational Intelligence Techniques Driven Intelligent Agents for Web Data Mining and Information Retrieval*, In

Intelligent Agents for Data Mining and Information Retrieval, M. Mohammadian (Editor), Idea Group, 2004.

13. Moreale, E. and S. Watt. *An Agent-Based Approach to Mailing List Knowledge Management*. In Agent-Mediated Knowledge Management, 2003.
14. Nissen, M.E., *An Extended Model of Knowledge-Flow Dynamics.* Communications of the Association for Information Systems, Vol. 8, pp: 251-266, 2002.
15. Nonaka, I., *A Dynamic Theory of Organizational Knowledge Creation.* Organization Science, Vol. 5, pp: 14-37, 1994
16. Nonaka, I., Takeuchi, H., *The Knowledge Creation Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press. 1995.
17. Novak, J., et al. *Discovering, Visualizing and Sharing Knowledge through Personalized Learning Knowledge Maps*. In Agent-Mediated Knowledge Management. Standford (USA), 2003
18. Olfman, M.J.a.L., *A Model of Knowledge Management System Success.* International Journal of Knowledge Management, pp: 51-68. 2006.
19. Peachey, T. and D. Hall. *Knowledge Management and the Leading IS Journals: An Analysis of Trends and Gaps in Published Research.* In 38th Hawaii International Conference on System Sciences (HICSS'05) - Track 8, pp: 1-10, 2005.
20. Rhem, A.J., *UML for Developing Knowledge Management Systems.* New York: Auerbach Publications, 2006.
21. Rus, I., Lindvall, M., *Knowledge Management in Software Engineering.* IEEE Software, Vol. 19, pp: 26-38, 2002.
22. Soto, J.P., Vizcaíno, A., Piattini, M., *Towards a Multi-agent Architecture to Process Knowledge.* IADIS International Conference on WWW/Internet (ICWI'06), 2006.
23. Sung Kim, J., *Customized Recommendation Mechanism Based on Web Data Mining and Case-Based Reasoning*, In Intelligent Agents for Data Mining and Information Retrieval, M. Mohammadian, Editor. 2004.
24. Tiwana, A., *The Knowledge Management Toolkit: Practical Techniques for Building Knowledge Management Systems*. USA: Prentice-Hall, 2000.
25. van Elst, L., V. Dignum, and A. Abecker. *Agent-Mediated Knowledge Management*. In Agent-Mediated Knowledge Management. Standford (USA) 2003.
26. Vizcaíno, A., Ruiz,F., Piattini, M., García, F. *Using REFSENO to Represent Knowledge in the Software Maintenance Process*. In 5th International Workshop on Theory and Applications of Knowledge Management. Zaragoza, Spain: Proceedings DEXA 2004, pp: 488-493, IEEE Press, 2004. .
27. Wiig, K.M., *Knowledge Management: Where did it come from and where will it go?*, Expert Systems with Applications, Vol. 13, pp: 1-14, 1997.
28. Wooldridge, M. and N.R. Jennings, *Intelligent Agents: Theory and Practice.* The Knowledge Engineering Review, Vol. 10, nº2, pp: 115-152. 1995.