Situated Knowledge Management – KM on the borderline between chaos and rigidity

Marc Diefenbruch
ExperTeam AG, Dortmund, Germany
mdb@experteam.de

Marcel Hoffmann, Andrea Misch, Helge Schneider
Informatics and Society,
University of Dortmund, Germany
{hoffmann, misch, schneide}
@iug.cs.uni-dortmund.de

Abstract

Acknowledging the "untidiness of knowledge work", we agree that organizational learning calls for flexible and adaptable IT support. However, recurring situations which generate experience or information needs require appropriate functionality. In this paper we suggest an approach to designing KM applications that complies with situated learning and situated information needs without restraining creativity and flexibility of knowledge processes.

1 Introduction

Knowledge Management (KM) depends on reflective and creative employees who take the initiative to engage in organisational learning spontaneously. Therefore, autonomy has always been considered as one of the most important conditions for KM. However, "grass root approaches" to KM can create "evolving use" [Orl96] and unanticipated successes, but also dysfunctional knowledge development, transfer, and reuse processes, disappointment and a decreasing acceptance and participation at the same time. Dysfunctional behaviour is often ascribed to a lack of commitment and reliability in organisational learning. Starting from these observations, we develop a KM approach that aims at a reconciliation of the strong point in chaos and rigidity. Developing adaptable frameworks of KM processes, the approach provides situated perspectives on an organisational knowledge base that support both making gathered knowledge explicit and the retrieval, re-contextualization and reuse of knowledge.

[DJB96] described knowledge activities like generating/producing, distributing/providing and reusing knowledge as parts of knowledge processes "that exhibit a specific ordering of work activities across time and place, with a beginning and end and clearly identified inputs and outputs". In this respect, knowledge processes are similar to business processes which produce a value to an internal or external customer and support the organization's business goals. Sometimes knowledge processes run in parallel and sometimes orthogonally to business processes, e.g. when they "transfer" experience from one case to later cases (fig. 1).

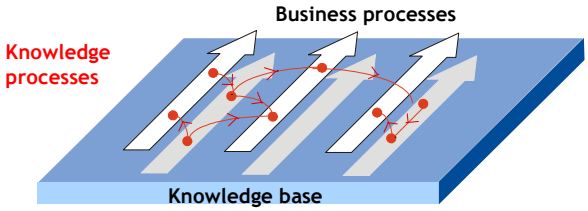

Fig. 1: business and knowledge processes

Analysing business processes for knowledge activities, one can identify activities or tasks where knowledge processes and business processes meet with increased probability. This is either because the activity opens the opportunity to gather new insights, since it creates extraordinary information needs, or because it allows the reuse of previously gathered knowledge. [AGL99] call these activities the information leverage points of business processes. Knowing the preconditions or the subsequent actions that result from information leveraging actions, the actual information requirements and the outcomes of knowledge activities still depend on the user's interpretation of the situation and remain contingent. Yet, we cannot say more about the object the user may direct his inquiry to, about other activities that may benefit from the user's reflection, about resources that may convey relevant information, or about other users who may have experienced similar situations before, unless we have pictured the user's situation in advance.

In this paper we describe our approach to designing KM applications that comply with situated learning and situated information needs, without restraining creativity and flexibility of organisational learning. In section 2 we describe our view of different software systems and make a rough differentiation between software systems that may

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imply more chaotic or more rigid KM applications. Section 3 suggests a solution to reconcile the strong points of both extremes, leading to the explanation and the evaluation of the benefits of our approach. Finally, the paper provides an illustration of our first steps towards realizing our approach in KM modules.

The approach described here was developed through a cooperation between the University of Dortmund, Informatics and Society, and ExperTeam AG, Dortmund in the research project EXPECT (www.expect-project.de). The project develops organisational strategies and instruments for the introduction and the continuous improvement of KM and KM-modules which enhance the functionality of KM products to overcome barriers. We illustrate our approach with a case study which we carried out in a training company, designing a system for trainers to share training materials [Ho*99].

2 IT support for chaos and rigidity

Explaining the objectives of KM, many authors refer to knowledge processes, like for instance Nonaka and Takeuchi's [NoT95] well-known pattern of externalisation, combination, internalisation, and socialization or the building blocks of KM according to [PRR99]. From this perspective KM can be defined as the continuous development, provision and employment of methods and tools to support these organizational knowledge processes. Relying on these definitions, many organisational efforts can be considered as KM efforts, projects, methods or tools. Dedicated KM instruments, methods, products or applications remain obscure.

KM projects employ many different IT tools, each supporting certain processes and applications. Sometimes IT is the driving force behind the development of knowledge processes; sometimes it is one of many methods or enablers. Sometimes KM employs already existing technology in the organisation and sometimes it introduces additional software. Recent market-studies of commercial KM products list software coming from different functional backgrounds.The building blocks of most of the current products are Document Management Systems (DMS), Content Management-Systems (CMS) Workflow-Management-Systems (WfMS), Groupware (GW), Search & Retrieval technology (S&RT) and Enterprise Resource Planning (ERP) [FGS99].

"Chaotic" KM solutions are characterized by symmetrical relations between autonomous protagonists and flexible access rights to contents and functionality. The definition of roles (if any) reflects the user's interest and not their position in the hierarchy. Communications, cooperation and coordination are user-initiated and the results of these activities are contingent. Composition and order of activities in cooperative work processes are configured spontaneously and can be specified and adapted by the users. As a consequence, the users themselves regulate system use. They decide for which tasks they employ the system, which results they provide for common access, with whom they cooperate, which information they read, and so on. Therefore chaotic KM solutions support voluntary knowledge work in particular.

GW mechanisms are employed to a great range of situations of communication, coordination and cooperation. Like DMS they tend to imply symmetrical usage and retain different and unanticipated contents. Both systems provide support in chaotic situations.

"Rigid" KM solutions are characterized by detailed specifications of user's duties and rights and by the anticipation of an orderly execution of pre-specified activities with the system. Distribution of labour is enforced through the distribution of access rights to contents and functionality. The system monitors the control-flow. Therefore, it is capable of distributing work-items, triggering necessary activities, and notifying deadlines. Furthermore, the anticipation of certain usage situations allows for extended

Case study:
Knowledge Management in a training company.
The aim of a joint project with a training company which we carried out during 1998/99 was to develop knowledge management by reengineering organizational processes, to educate the trainers in knowledge sharing, and to introduce an embedded KM-Software. When our team entered the company we found more than 50,000 training documents. Trainers were constantly producing new training material and gathering valuable experience which did not find its way into the company's archives. In order to improve the quality and the development of new training services, the training company wanted to increase the knowledge exchange. Documents were stored and retrieved according to numbering-systems. Accordingly, one of the goals of the project was to establish search functionality that allowed trainers to search for training elements for a specific purpose and to find related training elements in the electronic archive. Other goals of the project were the reduction of brain-drain, when trainers leave the company, and the support of new trainers in developing training expertise.
The company offers behaviour training in sales and management business and is one of the leading organizations in this field in Germany. 20 trainers carry out more than 3000 training days each year. They are supported by an administrative team of about 20 employees, including customer service, trainer assistance, seminar conceptionists etc. The central process is the delivery of training services which includes several activities like negotiations with the customers, preparation of a training offer, preparation of training materials, development of new materials, carrying out the training, and debriefing after trainings [He*2000]

support of work activities, automatic selection of relevant knowledge resources or the recommendation of appropriate activities respectively. Rigid KM enhances the reliability of KM processes and guarantees certain results. The performance of the KM system can be evaluated against certain expectations.

WfMS produce best results when applied to frequently executed processes which have little variance and which can be described a priori with a certain degree of correctness and completeness. Like WfMS CMS imply certain roles of users, a small number of authors and editors and a larger number of readers respectively. Both systems are more prevalent in "rigid" applications.

We expect future KM products to combine functionality from different origins even more seamlessly. However, the products will keep their focus. No product will provide optimal conditions in all functional requirements. If the products' heritage stays visible, products will keep implying certain applications while impeding others. To judge whether an application of a software tends to either the first or the second extreme in that continuum, we look at certain indicators. For instance,

- whether the application creates new patterns of interaction, or whether it supports the orderly execution of anticipated processes (flexibility of control flow),
- whether the application is employed to manage various unanticipated contents, or whether it manages predefined contents (flexibility of contents),
- whether the application is used symmetrically or asymmetrically among the users (distribution of labour and access rights), or
- whether the users employ the application for voluntary tasks, or whether the application enforces specified constraints of mandatory tasks (monitoring and control of task execution).

Some of the distinctions we made to classify commercial KM products hold for some research prototypes, too. However, many prototypes transgress our boundaries (cf. section 3.2).

3 Finding the path

Purely self-regulated approaches call for continuous social negotiations of conventions and rules that provide organisational guidance to using the system, otherwise they run the risk of slipping into chaos. On the other hand, closely specified systems will lose acceptance and become rigid, if the organisation fails to provide a participatory process for continuous improvement and fulfil changed user requirements immediately. Of course, "chaos" and "rigidity" are both negative terms to designate modes of KM applications. However, both extremes show considerable benefits and advantages. Therefore, the central challenge in designing KM solutions is in reconciling chaos and rigidity, self-regulation and reliability, emergence and control and creating KM-systems that are both creative and value adding.

3.1 Requirements

KM solutions have to reconcile emergent KM with the execution of predetermined knowledge processes, symmetrical relations between users with special functionality to support certain services, and mandatory business process tasks with voluntary participation in organizational learning. Evaluating available systems in the context of a KM project in a training company, we observed deficits and requirements for improvement in three aspects.

3.1.1 Information overload / deviations and gaps in classifying and routing information

Since chaotic KM applications provide few mechanisms for convergence, they tend to manage poorly structured and classified volumes of data that a single user cannot filter for his/her information needs. As a consequence, valuable information is not reused. On the other hand, fixed information structures and information distribution processes fail to record innovations and to adapt to rapidly changing information needs. Full-text retrieval mechanisms provide indispensable benefits, but sometimes change agents push information at the wrong time and search engines deliver too much irrelevant information. Additional metadata, like for instance a document's history or references to related resources, can bear extra benefits. Therefore, most systems manage information on a document's age, origin, and so on.

In the training company we found that information needs vary according to the problems users were working on. Preparing trainings for automobile sales agents, for instance, trainers reviewed materials from previous training sessions in the automobile industry, previous sales training sessions and previous training with the actual customer. Some trainers maintained several versions of the same training element for different situations. Conventional DMS, GW-systems and current knowledge portals do not reflect such transitions of the user's information needs and his/her situation.

Requirements are:

- Additional, helpful metadata for filtering documents
- Information suitable for user's information needs and current situation

3.1.2 Lack of reliability, commitment, and prospect awareness in knowledge processes

In most organisations the execution of organizational learning processes differs from the business process execution. In business processes the division of labour, the rules for sequencing the activities, the requirements on the activities' results, and the deadlines are constrained more explicitly than in knowledge processes. However, it is a

mistake to believe that organisational learning processes require less commitment, reliability, or control. Engaging in knowledge processes, workers build expectations on the consequences of their activity and need feedback just as in business processes.

In the training company, trainers agreed that recording experiences after training sessions was an important means of improving the reuse of training materials. However, when we found out that experiences were recorded sporadically only, the trainers explained that they felt more obliged to work for their customers than for other trainers. Furthermore, trainers complained that they did not know whether another trainer was going to reuse a training element. Accordingly, they were not aware of the benefits of providing extra information. Suggestions to set up obligations to fill in review forms after training sessions or to discuss training elements in an electronic discussion space were rejected, although it was agreed that the lack of commitment and reliability in the knowledge processes was a major deficit.

Requirements are:

- Reliability and control of organisational learning processes without strict control mechanisms
- Supporting awareness of prospects of participation in knowledge processes

3.1.3 Fractures and friction between personal and social KM

Current KM solutions are not sensitive to a user's situated information needs and most of his personal characteristics. Since users are commonly modelled in terms of access rights only, the IT-support does not match the individual interests, preferences and social relations.

In the training company individual preference did not only influence the work process but also determined the interpretation of training knowledge. Even though there was a central archive of training documents, all the trainers kept a personal archive. The personal archives included personal versions of common documents, links between documents and were structured according to individual needs. When trainers used shared material, they created their personal versions of training elements. Moreover we observed that trainers who were working in the same business area built communities to share experiences.

Requirements are:

- Configurable interests, preferences, and social relations
- Intertwining personal and shared workspaces
- Community membership must add extra value to the personal environment

3.2 Situated KM – Integrated Approach

To reconcile chaos and rigidity we suggest combining personalization with a business process oriented organization of the knowledge base in a concept we call *situated KM*. Depending on the domain, **personalization** provides personal bookmarks, bookshelves, saved queries, interest profiles, community membership and so on. The general idea is to record data about a user's preferences to provide individually customized services or functionality. **Business process oriented organization of KM** captures, stores and presents contents regarding their relation to business categories, for instance business objects (customers, products, services, documents, ...), business processes and subordinate workflows, and roles. [GoH2000] list several business related aspects which can be modelled as contents metadata. **Situated KM** is the contextualization of knowledge processes. A situation is the context of a user at a specific time. In business situations, it consists of the user, the tasks the user has to perform, and the information explicitly available in documents and systems, and the environment the person is working in.

Business process oriented KM reduces the information offered to the subset which is relevant for a user working on a certain task. Personalization reduces the amount of information to a subset that is in some way relevant to users and adds user specific contents. Combining both approaches, situated KM provides information that is relevant for this user in a given context not unconditional for the user in general. Thus, situated knowledge management enables the user to take quick and effective action as part of a certain business case. To make situated KM work, we employ different mechanisms, so-called "perspectives", metadata based categorization of contents according to a business process related framework, and preference based filtering and completion.

To organize the contents, we adopt the perspectives model developed by [StH99]. Perspectives are a means to distribute contents in hierarchically organized workspaces, each workspace determining a certain perspective. Subordinate perspectives inherit contents from higher perspectives. With these mechanisms, information that is recognized to be of more general relevance can be propagated into subordinate perspectives where it is completed by more specialized information. Stahl and Herrmann applied the perspectives mechanisms to support teams in gathering information on one subject from multiple viewpoints and to control multidisciplinary and multithreaded discussions. They define three fundamental types of perspectives. Team perspectives contain contents relevant to all members of a team, e.g. users who share a certain information needs. Individual perspectives (IPs) inherit the contents of team perspectives and contain personal contributions and contents of other perspectives which the user linked into her/his IP. Finally, the comparison perspectives summarizes contents from different perspectives. Descending the hierarchy, the volume of information grows due to the inheritance mechanisms. To separate specific information

needs, perspectives can be divided or additional perspectives can be introduced.

The perspectives model provides generative mechanisms which can be used to support situated KM. Instead of personal and team perspectives, we suggest to create perspectives for meaningful units or concepts of the business, like processes, activities, objects, documents, or roles which define business tasks. Any perspectives can be utilized by a user or a group of users to collect and communicate information related to a certain aspects of the organization's business. Perspectives that inherits contents from two or more higher perspectives are similar to the comparison perspectives. They provide functions to show the union set of the inherited contents and to filter or highlight the intersection set between perspectives. To separate special information needs (e.g. information relevant in tasks that are concerned with certain customers) and to provide more general information in different situations, contents can be linked to abstract business objects, abstract workflows or business processes, or abstract roles (for an example cf. section 3.3). Figure 2 shows how contents can be distributed among perspectives that derive from business process related categories. The hierarchy on the left side of the figure contains perspectives for business objects, business processes and subordinate workflows, and roles. Alternatively, perspectives can collect data related to other aspects of the business, too (e.g. tools, meetings and groups). The business task portals (BTPs) collect contents which is related to certain business tasks.

To link contents to perspectives, information in the knowledge base has to be categorized. Documents or information in general have properties, which put them in relation to business objects, workflows, roles, persons or business tasks. In addition, there are a lot of properties for each document, which originate from the document's use history, including the author of the document, the access list (access times, permission, etc.) and the version history. Moreover, documents may be related to each other, e.g. through a part-of-relation or different semantic relations. A task creates a selection of information in the organisation knowledge base with regard to a certain business situation.

Suggesting shared business related perspectives our approach establishes places for building communities of practice. However, these "team perspectives" do not provide for personalization. Therefore we suggest to integrate personalization by so-called preference profiles that can be applied to all perspectives. Figure 2 shows how profiles personalize a business task oriented information portal (BTP) to create a situated portal (SP). The situated portal provides mechanisms for selecting different subsets of the contents, filtering and ordering according to preferences gathered from the users preference profile for contributing information to the BTP or to other perspectives and for navigation between different SPs, BTPS, or per-

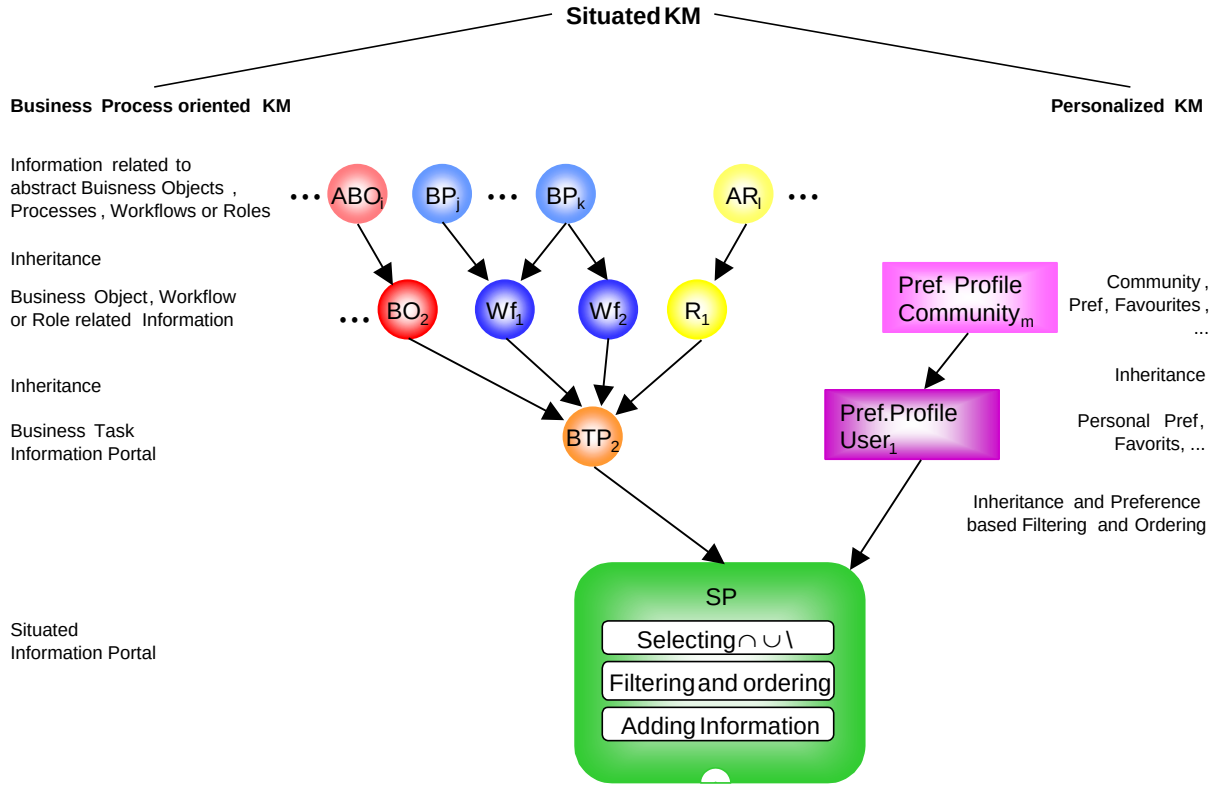

Fig. 2: Distribution and Propagation of the contents of the organizational knowledge base among perspectives and information portals

spectives. A preference profile contains any information about a user that can be applied to filter contents or to add complementing contents to a certain perspective according to the user's skills, interests, or experience. Accordingly the preference profile can include

- Interests, specified in terms of keywords, predefined interest categories, the user's change agents, or natural language expressions
- Usage data, e.g. saved queries
- Skill profile
- Personal favourites
- Positive or negative preferences of contributions, specified in terms of keywords, or in terms of metadata
- Access rights
- Community membership
- …

Comparing different sources for personalization is a complex task. Any kind of preference information must be matched with the hierarchy of business related perspectives. This can be accomplished by specifying preferences with reference to perspectives, e.g. describing interest in terms of a controlled vocabulary that reflects the perspectives hierarchy) or by assigning preference information to certain perspectives (e.g. linking personal favourites to BTPs they match with). However, in practice more advanced mechanisms that provide conceptual comparisons of preference information with the perspectives' contents may be required. Inheriting preferences from community preference profiles provides a basis to build communities of interest. Furthermore, community preference profiles support novice users who can inherit initial configuration from community profiles.

Visiting this business task information portal the user describes his/her information need to the system. In combination with the profile of the user this selection creates a situational portal. The offered information depends on the profile of the user. On the other hand, the information that is offered for a second task (e.g. *briefing after training*) varies from the first situation because the business task information portal changes.

The perspectives hierarchy is not filled by automated analysis of contents or automated comparisons to any given structure of concepts or ontology. Contents are assigned to perspectives on account of user decisions or on account of monitoring user behaviours. As a consequence, the rationale behind the hierarchy does not necessarily reflect one ordering-strategy and does not guarantee semantic consistence, it may even be contradictory in some parts. In contrast to concept based approaches (e.g. [VNJ99]) the perspectives reflect the user's view on the relevance of different business objects, processes and roles in specific business situations. The hierarchy provides an environment for process centered collection, linking, and development of knowledge resources. In this way it integrates "process-centered" and "product-centered" views on KM [Be*99].

3.2 Applications and Benefits

Implementing situated KM for the process of *delivery of training services* [Ho*99] perspectives for subordinated workflows (Wf) like the *preparation of training folders* or the *debriefing after training* will inherit all information stored in the more abstract perspective. In a given situation like "preparing a training folder for sale agents of the automobile customer A", the user would select a business task information portal (BTP) which inherits contents from

a) the business object perspective of *customer A* (as subordinated perspective of the abstract business object *automobile customers*),

b) the workflow perspective *preparing a training folder*, and

c) role perspective *preparing trainer* (as subordinated perspective of the abstract role *trainer*).

Navigation: The selection of the portal requires awareness of the overall structure of perspectives.Since the hierarchy is composed of elements like customers, documents, or activities which are part of the user's everyday experience, we expect that users will find it easier to navigate in this structure than in an abstract concept space. However, user will not acquire the ownership of the knowledge structure unless they can influence the structure itself. **Evolutionary Knowledge Management:** Since the situated KM approach imposes little constraints for the creation of new information portals, users can be allowed to create information portals on all levels.

When users describe their information need by selecting a predefined information portal the user's task situation becomes traceable to a certain extent. Recognizing a user's situation can be a great advantage to enhancing control, commitment and reliability in knowledge processes. **Automated categorization:** The information about the user's situation can be used to generate metadata automatically, e.g. user when a user accesses a certain document or adds a comment into a customer profile the document or the customer profile can be linked to the situation and can be presented in the BTP. In this way the explication and categorization of knowledge is facilitated. Moreover, knowing about the users situation can be used to control distributed knowledge processes more effectively. **Pushing information in the right moment:** Generally acknowledged CSCW systems for KM need to combine pull and push mechanisms. However, pushed request meet the user at the wrong time. Linking knowledge workflows to visitors of situated information portals one can expect that questions or request to contribute information meet the user in the right moment.

Supporting Reuse: The KM activities could be user or system driven. An example of a system driven design is a dialogue which asks the user while storing a document if the document is relevant for a more abstract perspective. If the user identifies the document as relevant e.g. for all tasks related to an automobile customer the system will store the document in a more abstract perspective. All subordinated perspectives inherit this document. In this way the reuse of knowledge is supported.

Community support: The preferences profiles of the users facilitate individual and social knowledge management. The upper class *community profile* builds communities of interest as communities of shared pre intertwining communities of practice, communities of interest and social communities. The users themselves decide a membership of a certain community. Depending on the chosen community the situational portal which depends on the current user profile offers the information about other members of the communities. In this way we facilitate the exchange of experiences among the users. On the other hand the personalized KM allows users to store their personal versions of documents, their own links between documents or a structure of documents according to individual needs.

4 Conclusion and further research

Based on experiences which we gathered in the research project MOVE (http://www.do.isst.fhg.de/move) we have recently suggested a specific concept to integrate KM functionality into workflow management systems [GoH2000]. In this paper we added a second approach, to support business related knowledge processes. Situated KM combines personalization and business process oriented structuring of knowledge resources. We outlined our approach and described some benefits (for long version of this paper see http://iundg.informatik.uni-dortmund.de/pubs_and_sources/publications/inhalt/).

Building prototypes and applying them to different use cases we are presently experimenting with the basic mechanisms of our approach. The *PRomisE* tool supports the creation of organizational memory information systems on the basis of metadata management, flexible semantic relations and linking contents to configurable activities (http://www.expect-project.de/). As a sample application, the system's HTTP-interface provides relevant resources for several activities in scholarly publishing. *ActivePerspective* applies the perspective and negotiation mechanisms to support collaboration in a multi user databases of bibliographical references. The prototype was tested in an experimental negotiation of the classification of 12 documents according to a keyword list witch included about 200 CSCW and HCI related keywords recently. In order to evaluate situated KM we plan to build a prototype of dynamic situated information portals based on the commercial KM software Livelink. Combining personal portals, project portals and workflow mechanisms, Livelink provides good conditions for a user-friendly implementation of the mechanisms. Currently we are selecting an appropriate business area in a consulting company for introducing the prototype and configuring the perspectives hierarchy to specific business process related information leverage points.

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