Concepts of the Enterprise Knowledge Medium

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Abstract

The fact that knowledge is the most important value generating resource in modern organizations is extensively described and justified in theory as well as accepted in practice. The pace of change, the increasing share of knowledge in products and services, the virtualization of companies and new opportunities provided by information technology are forcing companies to establish a systematic and active management of the knowledge resource. This is done by designing corporate processes and information technology systems.

This paper adopts a process-based view of knowledge work focussing on the corporate planning process as a knowledge-intense process because of the high level of skills and expertise necessary. We present a framework of a Knowledge Management Cycle (KMC) that includes the elements of identifying, building, storing, sharing and applying knowledge in organizations. The KMC is used to determine the requirements of a knowledge management system that supports the executive level in the corporate planning process. Therefore it is important to distinguish two different perspectives: the corporate perspective, which aims at the organization as a whole and the individual perspective, which represents the view of the executive as a knowledge worker. Based on the analysis of requirements, a modular architecture for an Enterprise Knowledge Medium - based on the combination of innovative information technologies - will be introduced. Finally it will be identified in how far the EKM system contributes to solve the problems related to each KMC element.

The paper presents the results of a research project (Competence Center Enterprise Knowledge Medium) that was carried out by the Institute for Media and Communications Management (chair of Prof. B. Schmid) at the University of St. Gallen. The project was set up in cooperation with seven German and Swiss companies for a period of three years. One important result was a prototype that was successfully implemented with one of the partners (Deutsche Bank).

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1 Introduction

As recent as twenty years ago Peter Drucker wrote that „to make knowledge work productively will be the great management task of this century, just as to make manual work productive was the great management task of the last century“ [Drucker 1978]. Authors such as Quinn [Quinn 1992] or Nonaka [Nonaka 1991] hold the opinion that knowledge represents the most important value generating source of modern organizations. Recent studies indicate that the production factor, knowledge, accounts for a larger share of the added value in a company. This has the implication that the topic, management of knowledge, is important and will continue to grow in significance. At the same time, a large gap exists between a company's awareness and action; many companies estimate their efforts in this area to be insufficient [Bullinger et al. 1997].

Spur noted: „Accompanying the transition into the next century is a transformation to knowledge-oriented production. Initiated by a rapid development of information technology, the production factors, knowledge and information, will play a significant role“ [Spur 1997, p. 91,

translated by the authors]. Spur goes on to say: „Knowledge management will determine the future success or failure of a firm [Spur 1997, p. 101, translated by the authors]

What makes the management of the knowledge resource highly relevant and necessary? Was knowledge not always critical for the success of the company? A systematic approach to knowledge management was not necessary in former years since in stabile economic conditions, employees were attached long-term to the firm and thereby could accumulate knowledge over time. Employees were able to acquire knowledge about their company's product and services as well as the market, customers, suppliers and competition. Thereby knowledge was anchored in the processes and culture of the firm.

Today the economic conditions are totally different. Continuous changes lead to quick aging of knowledge such as information about new products, new technologies or new unexpected competitors. These pose both threats and opportunities and depend on the company's knowledge to deal with the new challenges. But not only economic changes are compelling companies to seriously consider the knowledge factor: The increased share of knowledge in products and services, the globalization of markets, the high employee turnover, the virtualization of companies and the opportunities of information technology [for details, see Prusak 1997] are forcing companies to dedicate more effort to knowledge management. The question is not if or how much knowledge is important but rather how to deal with knowledge associated with processes, products and projects within the company.

The importance of managing the knowledge resource was identified very early at the chair of Professor Schmid. It was there that relevant competencies could be acquired through several years of research in the field of knowledge media in which the project team of the authors participated.

In 1995 the Competence Center for Enterprise Knowledge Medium was established. This research project was created in cooperation between the Institute for Information Management at the University of St. Gallen (from which the present Institute for Medium and Communication Management emerged) and the Institute for Information Management at the Technical University of Berlin. In cooperation with seven leading German and Swiss companies, solutions to the management of the knowledge resource were developed by the integration of innovative information and communication technologies. The following enterprises were involved in this project:

Allianz AG (München), Bankgesellschaft Berlin AG (Berlin), Daimler-Benz AG (Berlin), Deutsche Bank AG (Frankfurt), Dornier GmbH (Friedrichshafen), Karstadt AG (Essen), UBS (Zürich).

2 Conceptual Definitions

In this chapter we discuss the basis for understanding the project. The necessary terms will be introduced from the field of knowledge management and knowledge media.

Although the term **knowledge** is defined by many authors in literature and would basically deserve an in-depth study, it is not the purpose of this paper to do so.

However, the following two definitions should be presented: Steinmüller defines knowledge as "...networking of information in order to efficiently understand a definite purpose under specific rules of context" [Steinmüller 1993, p. 236, translated by authors].

Albrecht defines knowledge as "the result of processing information through consciousness and can be described as 'understood' information" [Albrecht 1993, translated by authors]. For the purpose of this paper, the authors will use the following working definition which is derived from the above-mentioned definitions: Knowledge is information associated with a specified context and is processed by an intelligent component.

As an intelligent component, one can understand this to be a human person or machine. The latter can be thought of as a e.g. simple algorithm which can make independent decisions. In this context, such intelligent components are called **agents**.

Research literature shows several approaches to categorizing knowledge. Fundamental in this regard is the division into implicit and explicit knowledge. Implicit or tacit knowledge is stored in the heads of individual persons and is difficult to transfer or divide and cannot – or only with difficulty – be codified (see Nonaka/Takeuchi 1995, p. 8ff). Explicit knowledge, however, is stored outside the heads of individual persons in the form of words, documents or computer programs. Because it is less context-bound and easier to partition, explicit knowledge is processable, transferable and storable with the help of electronic data processing [Rehäuser/Krcmar 1996, p. 7]. For an extended and in-depth study of knowledge categories, see [von Krogh/Venzin 1995].

Knowledge management [Eck 1997, p. 165] i.e. the management of the knowledge resource, involves the three non-distinguishable areas: production, distribution and utilization (processing) of knowledge.

A **knowledge medium** is understood to be a place for exchanging knowledge between groups [see Brockhaus 1986, p. 120; Lechner/Schmid 1998].

Which problems associated with the information flood, the sinking half-life of knowledge and the new potential of information technology can be identified? Why is it so difficult to manage knowledge as a resource? Several problem areas are classified in the following framework, the so called „Knowledge Management Cycle“ (s. Figure 1).

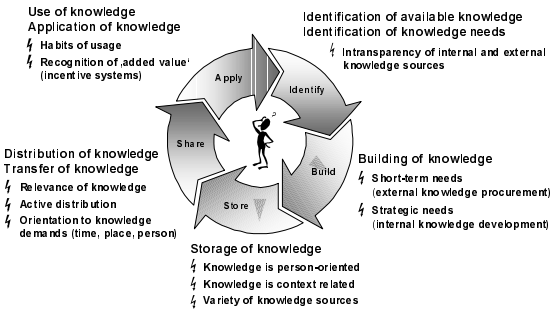

Figure 1: Problem Areas in the Knowledge Management Cycle

How often does it occur that an employee is confronted with a problem which has already been solved by another person in the company? This situation can be described as intransparency of knowledge: „Who knows what?" „Who worked in which project?" or „Who has the required knowledge outside of the company?" are typical questions which when not answered lead possibly to unnecessary use of resources. When the knowledge requirement is identified, the next step is to build up the knowledge. The knowledge can be developed internally (e.g. further education programs) or externally by acquiring personnel and firms. In the case of external knowledge acquisition, the difficulty of integration is not easy to overcome. In order to protect against the loss of available knowledge (e.g. personnel leaving the company), knowledge should be stored. Amongst a number of problems, the externalization of knowledge is of paramount importance. Only when knowledge is distributed in a company, can it induce a multiplication effect. However, difficulties associated with knowledge relevance and the distribution mechanism arise. Even if the knowledge is made available to someone, the problem is how to motivate that person to use it. It cannot be taken for granted that employees will use the available knowledge. Possible reservations exist associated with the quality or the added value sought after.

3 Evaluation of Industry Requirements

Within the scope of the EKM project involving close cooperation with the seven industry partners, the conceptual requirements for an Enterprise Knowledge Medium were defined. The explicit architectural concepts presented in the following chapters were influenced by the following findings:

- Experts interviews with the planners of the participating industry partners

During this project phase, "analysis of current situation", the planning field was analyzed. For this purpose, several expert interviews with the respective planners took place. These interviews provided valuable input about existing and desirable process flows, the development and structuring of relevant information objects as well as the requirements for a system which effectively supports the management of planning knowledge. Thereby it was possible to identify several shortcomings of the previous and nearly completely paper-based planning process. This led to creating a specifications catalogue for the conceptualized platform.

- Analysis of the existing IT-infrastructure

Because of investment considerations such as possible wide-scale implementation, the aim was to use the existing infrastructure of the partner firms to realize feasible practical solutions. This led to the decision, among others, to employ Lotus Notes as the groupware platform since it was being used by all the industry partners.

- Implementation of Market Observations

The essential goal of the research team which was composed of researchers from the University of St. Gallen and the Technical University of Berlin was to create a producer-independent generic solution which would be realized through the use of state-of-the-art technologies. During the entire project duration, commercially available solutions were evaluated to assess existing technologies. It wouldn't have made sense to re-implement already market-successful solutions, especially in the areas of groupware systems and process modeling tools. The main innovation of the system is the concept of an integral and, simultaneously, a modular (building block) architecture for the management of knowledge and the realization of corresponding software interfaces.

4 Architecture

The architecture of the EKM is specifically designed to systematically support the management of the knowledge resource. The following components, to be described forthcoming, are specifically designed for the requirements of the EKM.

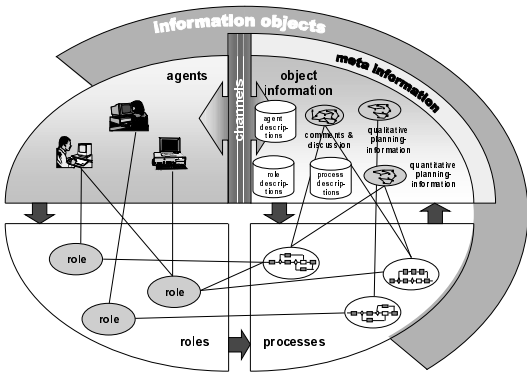

Figure 2: Architecture of the EKM

4.1 Agents

The active components in the EKM are called *agents.* They generate, work with, use and store the information of the EKM. For the groups of agents, the EKM represents a medium in the form of an organized communication system. The meaning of *agent* is a system containing its own more or less intelligent *controlling* component. In general, agents can be human actors as well as inter-

operating hard and software components. In the information medium for *planning,* the planner is the essential human agent. He has the corresponding knowledge of the diverse areas in need of planning and generates *new knowledge* with the help of the information present in the EKM pertaining to implementing planning processes. In a concrete case, the planner has the information about the marketing potential of the diverse products in his planning field. During the implementation of the planning process he generates new information which he incorporates into the EKM by defining concrete goals, measures and quantitative planning values. To guarantee high quality of planning results, it is necessary that the planner has additional information available about implementation of the planning process, besides his own knowledge in the field of planning. The planner should be informed, for instance, about the economic environment, his competitors as well as new products, in order to implement the planning process on a well-grounded basis. This information is readily available from the EKM.

A further group of agents in the EKM consists of planning databases or workflow management systems. Like the human actors, these EKM elements also have their own "intelligence" which enables them, for instance, to carry out independent processes. Example: In response to an inquiry by a human agent, a planning database supplies the desired elements (i.e. electronic documents, etc.) which correspond with the desired search criteria. The workflow management system directs the flow of the process and transmits electronic documents to the workers thereby automatically carrying out individual processing steps in coordination with information logistics. To be able to do this, the workflow management system must understand how the planning process operates.

4.2 Roles and Processes

Roles and processes form the organizational component of the EKM. The *roles* reflect in this case the organizational set-up. They define the rights and obligations of the agents who assume the applicable role. Roles represent the interface between agents and processes. By assuming a certain role, an agent accepts the role's rights and obligations. Thereby a certain role specifies which processes are to be undertaken and indirectly describes what kind of results/output an agent has to produce when assuming that role. A role therefore defines concretely which agent produces what steps of the planning process and what objects of information he is to work on. However, a role also gives its agent corresponding rights, i.e. the access to relevant information needed to complete a certain process. Within this context, a role can derive certain system technical rights about information in the EKM.

Having the planning application field in mind, the "planner's" role for the implementation of the planning process in the different planning fields of a company is defined. Besides this role, there is also a "coordinator" role needed. His obligation is to direct and supervise the process of planning. If necessary, this role can be handled by a mechanical agent (workflow management system), who controls, for instance, the date of completion and supervises the work on the information objects by monitoring and when necessary sending reminders automatically via email concerning lacking output or delayed delivery.

Processes represent the second element in the component of organization. They describe the organizing of the work flow. Here we distinguish between the company-based processes and the processes needed to organize the work flow in the Information medium. In the realm of company-based processes, the agents carry out all activities with regard to planning. It is here that the relevant information for planning is collected.

To facilitate the goal-oriented supply of necessary information (via push principle) to the processes and agents (by using roles), the relevant input as well as output of information objects are made available to the processes. Thereby expensive activities to gather information for company-based processes are eliminated.

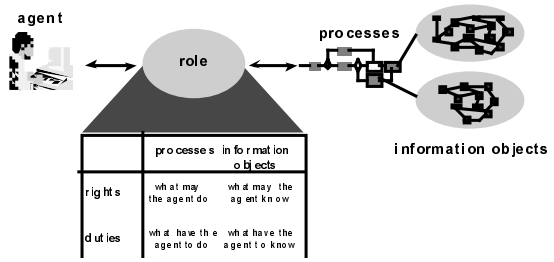

Figure 3: Teamwork between Role and Agent

The processes necessary to organize the work flow in the EKM define, for instance, how the process of planning is initiated in the workflow management system.

4.3 Information Objects

The component "object information" contains all information of the selected application field. For planning purposes, this is mainly planning information. A new feature is the integration of qualitative and quantitative planning information which was up to now separately stored in the information systems (e.g. SAP R/3 and document management systems) and had to be combined by the user. Furthermore, these components include comments, discussions, etc. This information is especially significant for the knowledge exchange between human agents.

Objects relating to the real world (agents, roles and processes) are likewise depicted as information in the EKM and are, in the form of agent descriptors, role descriptors and process descriptors, equally assigned to object information. In addition to the actual planning information, the EKM contains information (role and process descriptors) in the form of an electronic handbook of operative organization planning as well as information regarding the EKM organization itself. An agent

has thereby information available at any time regarding how it can operate or must operate (based on role responsibilities) within a company or knowledge medium and with which agents it can interact with.
The meta information component contains information about the object information. Based on the meta information, a detailed description of object information takes place. Meta information for object information can be the following:

- Type of information (e.g. operative plan, strategic plan or on a detailed basis, premises, goals, measures)
- Author (e.g. “John Doe”)
- Time information (e.g. „date of creation“, „date of change (history)“, „date of last application“, „valid from“, „valid to“)
- Status (e.g. „unprocessed“, „in preparation“, „finished“, „to be decided“, „in revision“, „approved“, „being audited“, „removed“)

4.4 Information Objects

Object information and meta information are imbedded in information objects. They thereby integrate object and meta information. The structure of the information object is recursive. The complex structure of a document which e.g. consists of texts, graphics and tables with corresponding values is depicted with the help of combined information objects. An information object document, for example, consists of various text, graphic and table objects. A table itself is made up of different information objects in the form of numerical values.

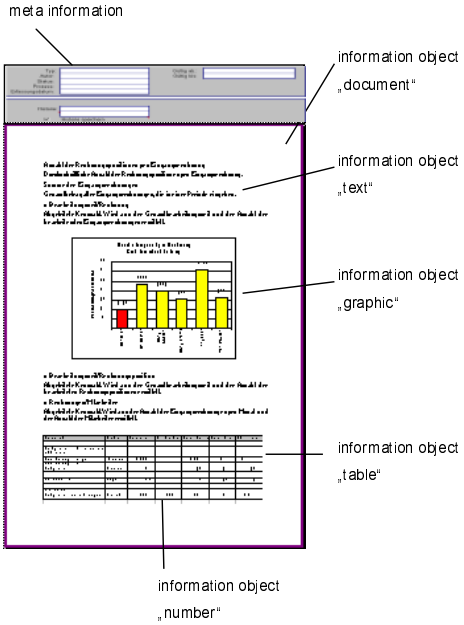

Figure 4: Information Object

A significant distinguishing criterion between EKM and conventional information systems is the availability of interactive information objects. These interactive information objects are simultaneously usable by the agents and able to actively communicate with other agents or other objects according to pre-arranged rules. This active component of information objects can be realized since specific functionality arises by the automated implementation of processes and is available via the linking with agents. For example, after a planner (human agent) has worked on a planning document, it will be forwarded to the next employee via a workflow management system (machine agent). In completing the processing, the planner triggers the active component of the information object in which the planning document is contained. This information object interacts with the agent - workflow management system - which contains knowledge about the structure of the planning process as well as the roles. The workflow management system also passes the planning document to the correct employee, thereby providing an inference service. This interactive component of the information object in the EKM can be of course provided with any combination of functionality.
Channels
The agents in the EKM exchange their knowledge by using different channels. A channel is responsible for the storage and transport of information objects. An EKM consists mainly of databases in which information is stored as well as channels such as LANs and WANs with which information is transferred. In the target process at Deutsche Bank, explicit meetings are also involved. In this case, the planners communicate directly with each other so that the voices of the planners function as a channel for the transfer of information. Important information is often printed for these meetings. These paper-based documents are likewise channels since they store information and can be used to transfer information to other planners.
The above-described components can be realized using an innovative framework. Figure 5 illustrates the individual components of this framework which will be described in the following sections.

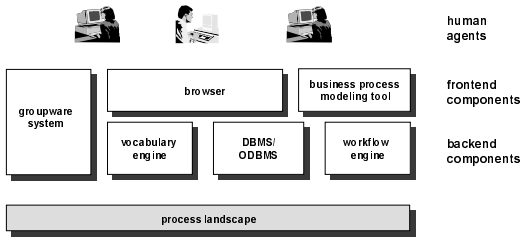

Figure 5: Architecture of the EKM

The framework can be subdivided into frontend and backend components which serve to illustrate the individual information objects and object information of an EKM as well as the realization of the necessary functionality. The end user as a human agent interacts thereby with the system via the front-end components. This can occur via correspondingly web-based user interfaces (e.g. browser) or via client components of a groupware system embedded in the architecture framework. In addition, the possibility exists to graphically

illustrate the business processes using an attached modeling instrument.
The groupware system provides the EKM with important functions such as Email service, access mechanisms, text search engine, discussion forums and above all solutions to team-based and distributed document management.
In addition to the groupware system, the back end of the architecture framework consists of a workflow engine, an object-oriented (relational-oriented) database management system (ODBMS or DBMS) and a vocabulary engine.
The workflow engine supports the automated electronic processing and provides functions such as, process monitoring, exception handling and automated forwarding to the next worker. The necessary process information is taken from the process models.
Besides the meta information, the architecture of an EKM contains an interface to the integrated vocabulary components enabling the attribution of information objects. This vocabulary engine realizes the function of the vocabulary integrated in the EKM.

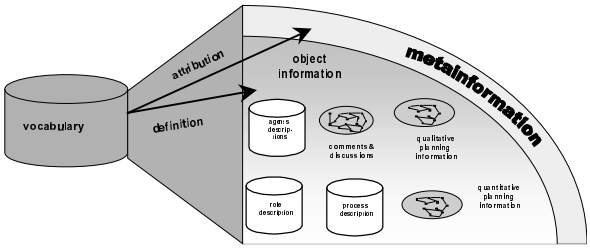

Figure 6: Integrated Vocabulary

In this context, vocabulary is understood to be a model for the representation of knowledge of a certain subject area. The use of vocabulary
permits the representation of quantitative and qualitative information. Thereby, it is possible to implement a semantic (i.e. meaning related) search. This concept enables the depiction of context-logical relationships between individual terms. The relevant frontend components enable a semantic building of cross-references based on the vocabulary. This permits a more focused and more accurate search than is the case with a purely syntax retrieval functionality found in existing search technologies (e.g. full text search). On the one hand, using the front-end components of the search modules, the specification of a search request is possible following certain criteria according to the defined meta information (e.g. Author = „Smith“ with creation date „01 January 1998“). On the other hand, this is possible via the building of cross-references based on the vocabulary. Should certain requests lead to an empty result set, the search will continue in the sense of an „intelligent search“ on the next logical abstraction level.
Interest profiles - as a component of the search module - serve as a management-related parameterization of search requests which enable, in the background, an active provision of relevant information objects. Using an interest profile, management defines their individual interests relating to the desired information supply.
An interest profile – which itself again fundamentally represents an information object – can be logically divided into two sections: Parameter groups for the description of internal information objects and parameter groups for the description of external information objects. The latter enable the definition of search criteria which prepare the classical information retrieval and the automated provision of information (e.g. local storage of continuously updated information of certain providers from the WWW or usegroups as well as filtering of full text). Preferences for the internal information objects, however, can be more precisely specified: By using the above-described vocabulary interface, it is possible to realize an extensively more-focused information procurement in the corresponding vocabulary cross-referenced domain of the intra-organizational network (Intranet). Fundamentally, the above-described parameterization of external objects can also be applied to a company’s Intranet.

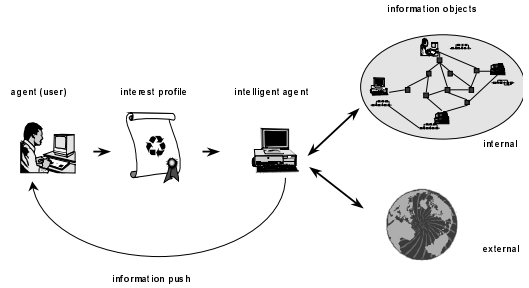

Figure 7: Concept of Interest Profiles

Figure 7 illustrates the above-made explanation. User-specific defined parameters on basis of the interest profiles are converted into search and retrieval requests using intelligent agents. The results are presented to the user in a suitable form (e.g. as a collection of hypertext links which relate to the information objects). The update intervals can be defined flexibly. In addition to the pure search and provision of information, these agents are also, to some extent, in a position to initiate the pre-processing of the search as relevant identified information objects (e.g. an extraction of pure text elements having no diagrams or tables). The provision of information can take place in different ways. As a general rule, the presentation will occur using the Electronic Management Folder metaphor. It is however imaginable to forward important information objects or excerpts from them via corresponding gateways to external value-added services e.g. mobile telephones using the GSM standard (e.g. short message) or a paging service.
The provision of information takes place according to the push paradigm i.e. no active pull of information stemming from time-intensive searching of the user occurs. On the one hand, the object (relational) database management systems provide an archiving alternative to the document-

oriented filing structure of integrated groupware systems for relational high volume data. On the other hand, they enable the possibility for the administration of object information as well as meta information which have been cross-referenced with the vocabulary. Thereby process models which have been created using business process modeling tools can, as an alternative to dependence on specific applied technologies, be stored as document-oriented as well as object-oriented (relational-oriented) items.
The individual architecture components are combined via interfaces according to the concept of the Electronic Management Folder. This enables a user-specific configuration of the individual components as well as end-user friendly navigation within the knowledge medium. The Electronic Management Folder represents an innovative front-end concept which as a central steering mechanism bundles all relevant system functions for all the human agents.
The presented architecture framework is distinguished by high modularity and generic features. Based on the realization of different interfaces, high flexibility in the selection of concrete solutions (e.g. individual building blocks) is guaranteed. This modular concept ensures long-term investment success and enables a flexible configuration into the companies‘ existing heterogeneous IT architectures.

5 EKM Solutions in the Knowledge Management Cycle

Solutions of an Enterprise Knowledge Medium related to the phases of the Knowledge Management Cycle are presented in the following section.

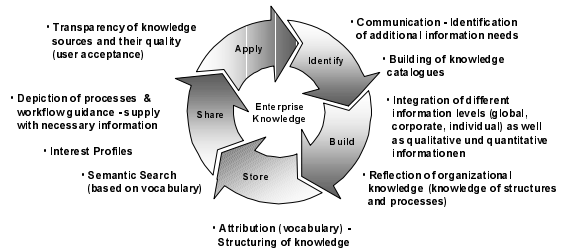

Figure 8: Solutions of an Enterprise Knowledge Medium within the phases of the Knowledge Management Cycle

In order to understand the different solution approaches on a conceptual basis, the conceptual background and the individual building blocks will be described in the following:

1. Identification-Phase
Based on the integration of groupware components and the thereby resulting company-wide **communication,** two significant functions are realized which are necessary for knowledge management. Firstly, the opportunity for every employee must exist to articulate possibly arising knowledge needs so that the build-up of the necessary knowledge can be initiated. Secondly, company-wide communication serves as a basis for the development and problem-free exchange of information between employees i.e. variable and independent of possible defined processes.
In order to answer the central question „Which knowledge components already exist in the company?“, so-called knowledge catalogues have been implemented at the CC EKM which provide structuring and visualization of information objects. The knowledge which is contained in an EKM is structured and presented using a hypertext-based table of contents. An additional advantage is the possibility of selecting different views from the knowledge catalogue. These are defined through the selection of individual structuring characteristics (attributes of the vocabulary e.g. author, s. 4.3).
Another identification mechanism used for implicit knowledge and exceeding the functionality of normal knowledge maps (only identification of explicit knowledge) is enabled. This is achieved with the specific EKM architecture (Figure 8) and by constructing the following causal relation via the process-role-agent relationship. Each process will be assigned roles (rights and liabilities from agents) whereby it is assumed, in relationship to the requirements (To-do’s) which arise from the individual process steps, an agent will be assigned a requirement as well as be made responsible for it. This agent is expected to be able to handle the task due to its ability and experience. Thereby it is possible via this causal chain to identify employees in companies using the requirement profile.

2. Build-up Phase
By accessing external information as is the case in an EKM, functions for knowledge management are prepared in the fields, „identify“ and „build up“. On the one hand, an overview and insight relating to the external knowledge environment is made possible (EKM NewsStand, EKM WebPool). On the other hand, after identification of relevant external company knowledge, this information can be used in the building of intra-company knowledge by transfering it into own information system. Thereby quantitative and qualitative information is processed for the intra-firm, extra-firm and personnel-related levels.
A further strength of the EKM system is its ability to organize the *organizational knowledge* of a company. This term is understood to be knowledge which is stored in the structure and work flow of a firm. In this context, this knowledge is independent of specific employees (e.g. the knowledge of how to best structure the process xy under certain circumstances or which form of organization is best suited for market yz). By integrating modeling components into the EKM, it is possible to organize processes, objects of information and set-up structures within the module, process management.

3. Store-Phase
In order to prevent the loss of knowledge due to downsizing or to human „forgetfulness“, it is necessary to store collective, individual and organizational knowledge (see above). The kind of knowledge will determine the possibilities and degrees of difficulty encountered in storing it (explicit knowledge is considerably easier to store than the implicit kind). Since the context of the information must be taken into consideration, simple storage like in a database will not be suitable. It is necessary therefore to characterize and define objects of information in order to structure them in the vocabulary (for details see 4.3). Thereby "knowledge over knowledge", so-called meta-knowledge will be incorporated in the EKM.

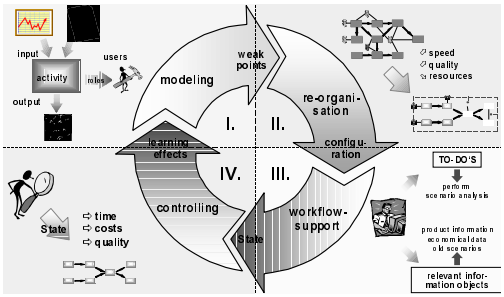

Figure 9: Process Management in the EKM

4. Share-Phase
To participate in the sharing of knowledge in a company, each employee has the possibility to create an interest profile. In this profile, it is possible to specify individual preferences for information through the listing and evaluation of topic areas (e.g. individual company domains, products, markets). The desired information will then be actively made available to the employee through the regular use of push technologies. The EKM-System makes it also possible to systematically conduct a semantic search for information available from the pool of knowledge of a company. The concept of a semantic or significance-related search is based on the design of the vocabulary.
This enables a search based on the context-logical relationship between different information (e.g. tree structure). The result is, that a search will not produce all documents which contain a certain word (full text search) but rather an answer that contains the context-logical related words. Example: In the planning process, one searches for the expression "southern Germany“ (region). As a result all documents *directly* related to the planning process for this region will be listed; in addition the result will also list the documents of the *sub-regions* (i.e. Bavaria, Baden-Würtemberg, etc.) which are part of southern Germany.
The search functionalities produce, in addition, an "intelligent component" in case the search should have negative results; therefore, if no documents are found, a search on the next higher category level will try to bring a positive result. Besides the search functionality, the architecture of the EKM-System as described in chapter 4 fulfills the Paradigm *"the right information - at the right time - at the right place*. Desired knowledge can be made available as needed through the system-technical realization of the relationship "Agent-Role-Process-Information Object".

5. Apply-Phase
The most difficult phase of the Knowledge Management Cycle which requires support of information technology is the phase of Knowledge Application because this is where the company culture plays a special role. To overcome employee concerns regarding the quality of the available knowledge, the EKM has two approaches available. In the framework of Attribution *for* Information Objects the attribute "Author" allows one to identify the actual source of information. This attribute "Author” gives a future user as much an indication about quality as the attribute "Quality" does which is estimated by the respective user. Further concepts regarding evaluation of quality will be dealt with in the next phase of the CC EKM. The possibility to comment about Information Objects (e.g. planning premises) allows us to express to others our intention regarding specific facts. This enables them to gain an insight into the evaluation by other employees and encourages them to perhaps make their own comments.

6 Benefits of an EKM

During the project, the industry partners decided to conduct a pilot phase at Deutsche Bank. The pilot phase began April 1996 and continued to March 1998 (project end). The pilot phase can be subdivided into several sub-phases. [see Figure 10].

Figure 10: Sub-phases of the pilot phase at Deutsche Bank

The process- and information-object-analysis-phase was followed by the redesign of the processes and information objects. Afterwards, a design of the prototype took place (concepts and software modules). After the „live“ tests during a pretest- and a test phase, the gained know-how was transferred back to the University and helped to validate and critically reflect the concepts of the knowledge medium.
During the Deutsche Bank pilot phase, innovative solutions were conceived and implemented with the goal of realizing a platform for integral knowledge management for operative company planning. The designed EKM contains a series of **innovative architectural characteristics** [s. Schwan et al. 1998]:

- A new approach to realizing process structures

With the use of EKMs, one is in a position to completely restructure the planning process. By using Workflow components, process steps can take place simultaneously. Furthermore, one is able to realize a novel approach in which the planner of two adjacent company levels can harmonize planned values with each other. This can lead to significant time savings since the corresponding subprocess was previously realized as a top-down process. In the case of denial, an n-multiple processing of the relevant hierarchy levels is the result. [see Schwan et al. 1997, p. 13 ff.]

- General and active information procurement for tasks

The best possible information procurement for the planner in all process phases are the focus of attention: i) the automated guidance of processes and ii) the automation of individual process steps. The availability of all information objects at anytime in the medium and the possibility of creating and processing interactive information objects (e.g. comments) intensifies the communication between the planners and thereby promotes knowledge transfer. The increased degree of structuring and the transparency of processes make it possible to supply defined process steps with information and knowledge by connecting them to information objects. Costly information procurement processes disappear to a large extent. During the proactive supply of information objects, the respective company planners receive exactly the contextual information objects which are necessary for the completion of his/her task.

- Integration of quantitative and qualitative information objects in company planning

The aspired general strategic and operative planning requires the integration of quantitative and qualitative information. The focus on solely quantitative data - as usually is the case with planning tools - is overcome. Thereby new possibilities arise to enrich the active supply of the knowledge resource to the business decision maker.

In addition, the EKM supports a systematic and above all a comprehensive management of the knowledge resource via the possibilities of automated identification, extraction, dissemination, categorization, networking and maintenance of information pertaining to business processes. From these functionalities, the following **potential benefits** can be derived:

- Shortening of the planning process

While the original planning process needed six months to be run through (end of March until end of September), one is now in the position to significantly shorten the process with assistance of the EKM. In the future, the process should only have a duration from July until September.

- More time for the actual planning as well as the improvement of the planning quality

A depiction of the planning process with the EKM enables an increase in the planning quality as well as a significant decrease in the planning gap. Thanks to electronic illustrations and guidance of process steps, planners are able to concentrate on their actual planning tasks and are freed from administrative activities. By electronically depicting all documents relating to planning, the planning contents are integrated and consistent since the document flow can be optimized with regard to the new process model. Thereby on the operative level, changes of the media type can be avoided and significant time advantages can be realized.

Besides a reduction of the planning time using the electronic illustrations of process steps, an additional time savings can be achieved by the new process structures. These (e.g. parallel processing and application of the so-called „Gegenstromverfahren“) enable the planner more time for planning activities which leads to improved planning quality.

- Explicit planning responsibility creates better process transparency

Especially using Workflow components, the new system concepts allow for a transparent and, above all, explicit planning responsibility. The EKM enables a person-related and task-related tracking of process states which thereby makes it possible to continuously access the current status of the planning process, to identify bottle-necks and when necessary to intervene. As a result of the automated guidance of the planning process, a better time harmonization of the individual activities is possible. Thereby the planning time horizon can be reduced.

- Efficient modification of design and process organization

A significant advantage of the new conception is the flexible and dynamic adaptive organization and process model which enables the quick restructuring of the company organization without having to incur large costs. This has high strategic importance in the banking sector.

- Promotion of communication is an aid in the development of knowledge

The „Gegenstromverfahren“ for supporting management processes is characterized by a high harmonization intensity. The EKM architecture especially takes into account the communication aspect in the provision of relevant functionalities. Only when the possibility of very easy and efficient communication exists, can concepts such as the „Gegenstromverfahren„ be effectively and efficiently implemented. By putting special emphasis on the communication (e.g. the possibility of freely making comments to individual documents, planning information which is available anytime, etc.) the further development of knowledge can be supported.

The above-made statements were confirmed by empirical research. In the fall of 1997 and spring of 1998, test phases were carried out with a total of 19 end-users at the Deutsche Bank headquarters in Frankfurt. Since the tests with the EKM prototype

were successful, it was decided afterwards that this system should be professionally implemented for the 1400 users. This realization will be supported by a consulting company affiliated with the MCM Institute which will ensure a relevant transfer of know-how.

7 Concluding Remarks and Further Work

The EKM enables the ubiquitous and timeless supply of information and knowledge. Using modern information and communication technologies, the active supply of relevant knowledge to the planning processes can be realized. With the use of new media an electronic and interactive knowledge pool can be created which enables an efficient and effective knowledge management. The EKM builds the technical basis for the development of a structured knowledge pool which makes knowledge electronically available anytime and independent of the user. This enables knowledge that is available in a company to be applied efficiently and effectively without time delay. The modular and flexible architecture enables a cyclic dynamic process redesign as well as integration into the heterogeneous IT-landscape of the industry partners by the application of platform-independent products.

After a three-year duration, the EKM project was successfully completed as planned on 31 March 1998. The next project phase – also organized as a competence center – will be based on the first project phase and was commenced likewise a three-year project duration on 1 May 1998.
The second project phase takes a more general approach than is the case with the EKM described in detail in this paper. The "EKM2" incorporates a three-item view, based on the observation, that in order to achieve a certain set of output factors, a project (usually in R&D) is set up implicitly or explicitly, which leads to a product or forms a basis for e.g. an evaluation of technology potential. In order to be developed, the product itself is built upon a range of processes that have to be gone through in order to get the desired output. The concepts of this new EKM will consider intra-organizational as well as inter-organizational aspects in order to answer highly relevant questions of such as how to support the exchange of knowledge between two partners that form a virtual enterprise with different organizational and/or cultural backgrounds.

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