

## **OPERATION OF A KNOWLEDGE MANAGEMENT SYSTEM FOR FINAL DISPOSAL**

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### **ABSTRACT**

In order to manage the available information and knowledge in the field of final disposal, a **knowledge management system** (*kms*) for final disposal issues has been developed in Germany. The system is based on Microsoft *SharePoint* Portal Server. The server is installed at Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) in Garching near Munich. Access to the data is possible by the use of Internet, dedicated lines or the GRS-company network.

The database of *kms* consists of a collection of documents and metadata for each document. The information in *kms* is organized in a three dimensional structure, which allows a convenient and precise data access. The properties of the documents have been supplemented by additional metadata, particularly for evaluation purposes. The standard query form of *SharePoint* has been adapted for an adequate data access supporting the three dimensional structure and the supplemented metadata.

Sources for the documents included in *kms* are the Internet, conferences, publications and professional journals. All documents of *kms* are pdf-formatted. Once a document is stored in *kms*, a set of basis metadata such as title, author etc. is assigned. At a later phase information about categorization and evaluation is added.

The *kms* serves not only for convenient, comprehensive and precise information provision, it also states a useful tool for expert working on the field of final disposal, e.g., as a document repository for the various projects.

### **INTRODUCTION**

In the past a lot of R&D work has been carried out on the field of final disposal. By this a large amount of information has been cumulated, which has to be taken into consideration for a comprehensive planning of a repository for radioactive wastes. These information concern waste management issues, the operation of repositories, concepts for final repositories, set up of

repositories, licensing procedures, post closure phase, politics and disposal concepts, guidelines, site investigations, site characterisations, closure and other questions.

In order to get an optimum use of this information a computer-based knowledge management system (*kms*) for the topics of final disposal issues was developed on the behalf of the German Federal Ministry of Environment, Nature Conservation and Reactor safety (BMU).

The main objective of the *kms* for the customer is the provision of information on short notice. This means, that a summary of information for specific topics, background information and an evaluation of the available information is provided. Another essential objective of the *kms* is know-how preservation for future repository projects.

The system has been installed at March 2003. Within a period of six month a basis pool of app. 4.000 documents has been entered in the system. Following this phase normal operation has been started.

After a short explanation of the *kms* practical experiences with the use of *kms* are described. This concerns three aspects:

1. Information acquisition
2. Use of the knowledge management systems by experts
3. Use of the knowledge management system by decision makers

## **DESCRIPTION OF THE KNOWLEDGE MANAGEMENT SYSTEM**

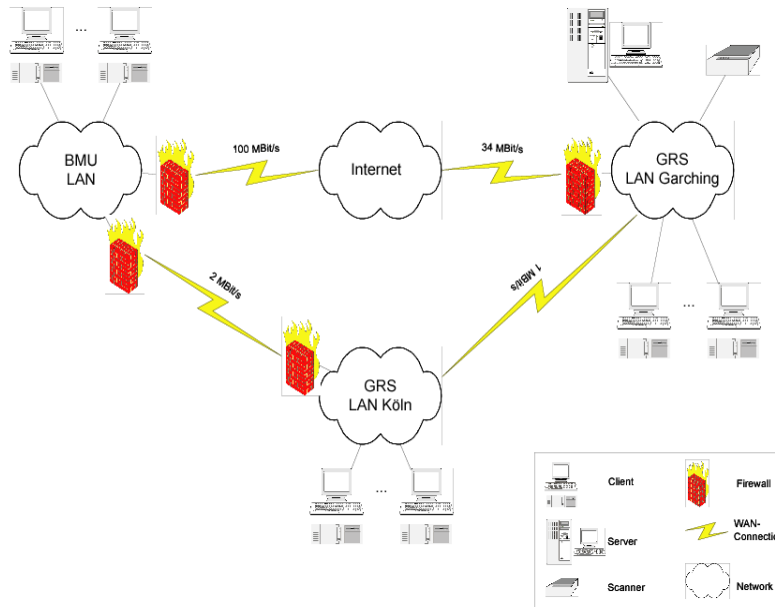
### **Technical Solution**

The *kms* is based on the *Microsoft SharePoint Portal Server*. *SharePoint* is a server-based platform consisting of three basis elements:

- A configurable portal,
- a document management system with a database and
- an indexing and search component.

The portal serves as a common entrance for user accessing the knowledge management system by the use of an Internet browser. The document management system contains the document database with version control and access management. The indexing and search component can index local and external data sources and consists of full-text search, the search for Meta data and the search in categories. Any Meta data can be defined for specific search purposes. All elements have been adapted to the requirements of the *kms*.

Figure 1 shows the network infrastructure of the knowledge management system schematically, in which server and clients are embedded.

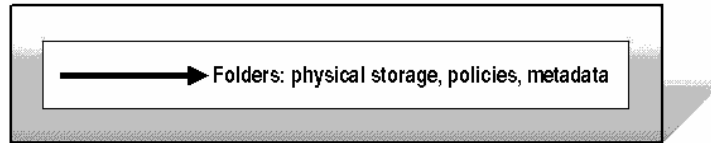


**Fig. 1. Network infrastructure of the knowledge management system**

The *SharePoint Portal Server* with the document database is installed on a server located at GRS Garching, Germany. Authorized experts of GRS at the various GRS-locations enter the system by the use of the company network. The main customer (BMU) has access to the *kms* by the use of both the Internet and a dedicated line. On demand of the BMU other users may get access over internet.

### Organization of the Information

In contrast to the usual organization of documents in an one-dimensional folder structure the *kms* allows a three dimensional structure of the documents, cf. Figure 2.



The storage of documents follows a logical structure. In the *kms* the structure is as follows:

All documents are structured as a tree structure. The origin of the document is the most level of the tree structure.

1. proceedings
2. periodicicals
3. publications
4. reports

*Proceedings* consist of *proceedings* is further divided into subcategories. Other essential information about the structure, too.

In the main directory structure. The directory *publications* contains domestic or international results of scientific activities. The way as described above.

The second structure is assigned to one or more categories used in our

Windows directory structure. The directory structure is as follows:

The web folder is structured according to type and content. The subcategories represent the upper

symposia. The folder *WM* or *DisTec*, etc. is derived from the directory structure.

Publications are collected. The directory structure, particularly from *reports*. *Reports* contains subdirectories is arranged as follows:

Documents stored in the *kms* is organized into subcategories. The

The bold categories are the main categories, the indented categories are subcategories. All aspects regarding the development of a sustainable disposal strategy are covered by this categorization from the German point of view.

**Table I. Categories used in *kms***

<p><b>Waste</b></p> <ul style="list-style-type: none"> <li>- Waste streams</li> <li>- Waste treatment and quality control</li> <li>- Waste characterization</li> <li>- R&amp;D-work</li> <li>- Clearance and exemption</li> <li>- more...</li> </ul> <p><b>Operation</b></p> <ul style="list-style-type: none"> <li>- Operational experience</li> <li>- Operational safety, safety analysis</li> <li>- Storage technology</li> <li>- R&amp;D-costs</li> <li>- costs</li> <li>- more...</li> </ul> <p><b>Repository concepts</b></p> <ul style="list-style-type: none"> <li>- Barrier-concept</li> <li>- Package- and container-concept</li> <li>- Disposal-concept</li> <li>- R&amp;D-works</li> <li>- Costs</li> <li>- more...</li> </ul> <p><b>Set-up</b></p> <ul style="list-style-type: none"> <li>- R&amp;D-costs</li> <li>- Drift</li> <li>- Costs</li> <li>- Aboveground facilities</li> <li>- Planning and design</li> <li>- more...</li> </ul>	<p><b>Licensing Procedures</b></p> <ul style="list-style-type: none"> <li>- licensing flow</li> <li>- Participation of the public</li> <li>- Participation of authorities</li> <li>- R&amp;D-work</li> <li>- Licenses</li> <li>- more...</li> </ul> <p><b>Post operation</b></p> <ul style="list-style-type: none"> <li>- R&amp;D-work</li> <li>- Institutional control</li> <li>- Costs</li> <li>- Long terms safety analysis</li> <li>- Monitoring</li> </ul> <p><b>Politics and Disposal concepts</b></p> <ul style="list-style-type: none"> <li>- R&amp;D-work</li> <li>- Social conditions (ethic aspects)</li> <li>- Domestic and international strategies</li> <li>- Political and legal boundary conditions</li> <li>- more</li> </ul> <p><b>Rules and Regulations</b></p> <ul style="list-style-type: none"> <li>- legal rules and regulations</li> <li>- Technical rules and regulations</li> </ul>	<p><b>Site selection and Exploration</b></p> <ul style="list-style-type: none"> <li>- Selection criteria</li> <li>- Selection procedures</li> <li>- R&amp;D-work</li> <li>- Costs</li> <li>- Aboveground explorations</li> <li>- more...</li> </ul> <p><b>Site Description</b></p> <ul style="list-style-type: none"> <li>- R&amp;D-work</li> <li>- Costs</li> <li>- Long term development (climate etc)</li> <li>- Site characterization</li> <li>- Underground laboratory</li> </ul> <p><b>Decommissioning and Closure</b></p> <ul style="list-style-type: none"> <li>- R&amp;D-work</li> <li>- Costs</li> <li>- Closure and backfill materials</li> <li>- Procedure</li> </ul> <p><b>Superior Aspects</b></p>
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The documents assigned to a distinct category give an overview of all relevant subjects and are a useful collection of the knowledge of the respective issue as well. The number of documents in the distinct categories represents an indicator of the available knowledge in the respective process. Only few or even no documents in a category can be an announcement for further information to be collected or for the necessity for additional work in the considered field.

The dimension of the information structure refers to the profiles of the stored documents. A profile consists of various properties (metadata). In addition to common metadata, such as title and author, a set of metadata is provided regarding the evaluation of the respective documents. I. a. this affects information about users of the documents, their (subjective) evaluation of and comments about the document and, last but not least, about the usefulness.

### **Information Retrieval**

Microsoft *SharePoint* Portal Server provides a powerful full-text-search engine. However, part of the standard *SharePoint* search engine out of the box is to gain a maximum benefit of each dimension of the information structure. To achieve optimum benefit of the information of *kms*, particularly considering the three-dimensional information structure, the search engine and the search form has to be adapted adequately. The advanced Google-look-and -feel form were chosen to consider user-friendliness, cf. to Figure 3.

All fields of the query form may be part of a query, either unique or in combination. The returning result set consists of a document list with document titles, author lists and various selected properties. After choosing an item out of the list, the document is downloaded and can be examined by the use of the respective tools of the opening application.

The screenshot shows the 'Advanced Query Form of the kms'. It features a search bar at the top with a dropdown menu set to 'this site' and a 'Suchen' button. Below this is a 'Einfache Suche' link. The 'full text' section has four radio button options: 'with at least one of the words', 'with all of the words', 'with the exact phrase', and 'without the words'. The 'properties' section lists various fields with dropdown menus for operators and input boxes for values. The 'category' dropdown is open, showing a list of waste-related categories. The 'Datum' section has radio button options for 'all documents', 'documents published in the last [ ] months', and 'documents published from [ ] to [ ]'. A checkbox for 'Unterкатегorien automatisch mit auswählen' is checked.

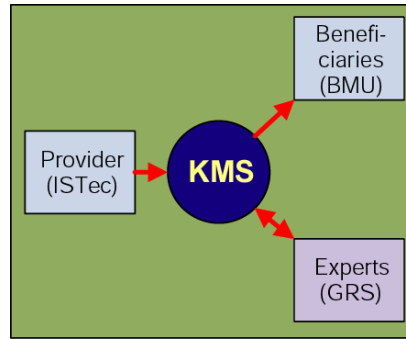
Fig. 3. Advanced Query Form of the kms

## OPERATIONAL EXPERIENCE

As described above the kms in its first version (β-version) was implemented in March 2003. In the following phase kms was systematically fed with information. Because of the large amount of available documents it was decided to consider only documents not older than 1995. In the first six months, approximately 4000 documents were entered in the kms. Entering the kms at this stage means that documents are converted to a readable form and that basis metadata are added.

Following this phase experts started using kms, particularly as an easily available library. While using the system by experts further metadata were supplemented. These metadata mainly concerned categorization, evaluation and summarizing. Of course, the input of documents with basis metadata continued simultaneously. This phase lasted for 15 month. At the end of this phase 6000 documents had been included, of which app. 10 % were categorized.

After these two phases kms was implemented in the customer's system for the intended use. In accordance to the implementation phases three user groups have to be differed, cf. Figure 4.



**Fig. 4. User groups of the kms**

The *provider* searches for available information, feeds the system and adds basis metadata. This work is carried out by ISTec (Institute for Safety Technology), the developer of the system. The *experts* use and review the information of *kms* and add professional metadata as well, such as categorization and evaluation. It is intended that the *beneficiaries* only use the reviewed information; however they have access to the complete data stock, too.

The following description of the operational experiences addresses the work of the user groups *provider* and *experts*. An analysis of the experience of the *beneficiaries* will be carried out after an adequate period of operation.

### **Information Acquisition**

There are four major sources of information, which are scanned continuously for new publications in the field of final disposal. These are:

1. The internet
2. Announcement of conferences
3. List of publications and annual reports of selected organizations
4. Professional journals and newspapers

Documents which were chosen for *kms* have to be prepared adequately. Paper documents have to be scanned followed by a character recognition procedure. Because every OCR-software causes errors, a manual correction would be desirable. However, the expenditures in terms of time and money are so high that a manual correction is not justified. Tests have shown that, at an error rate of less than 0.5 %, the search capability is not shortened in a remarkable way.

Documents existing in digital form are of course more advantageous. Due to many reasons we have decided only to include documents in pdf-format. Therefore many of the electronically documents have to be reformatted.

Once a document exists as pdf-document, it will be stored in *kms* and basis metadata are added. These are:

- title of the document
- author



- day of publication
- type of document
- country of origin

The work described above doesn't need highly qualified expertise. Therefore the expenditures for acquisition and for the processing of documents are that low that a further automation will not remunerate.

### **Processing of the Knowledge Management Systems by Experts**

The assignment of advanced metadata such as categories and evaluation to the documents requires professional skills and is rather time-consuming. The complete supplement of all metadata for all documents would take some man-years, which would considerably burden the budget. Therefore the categorization is carried out only for a selection of documents of app. 10 to 20 % of the whole document stock, and only a selection of the categorized documents will be evaluated and commented.

Criterion for categorization is the importance of the document regarding the German disposal policy. The importance is automatically assumed for documents used for the expert's daily work. Of course, the importance may arise as a result of specific queries to the *kms* or of reviewing distinct documents.

For the daily work of experts *kms* serves not only as a comprehensive library but is used as a comfortable repository for project relevant documents, too. This use states another valuable source for documents, because all of these documents are important and categorized.

A special problem is the evaluation of documents. In the first phase it was intended to use a grading system from 1 (excellent) to 6 (bad). However, due to many reasons, this grading system could not be realized. Today we only evaluate the benefit of a document (useful, useless) and we have the possibility to give comments on it.

Another important task of the expert is the summarization of categories in so called fact sheets, which represent the recent state of the scientific and technical knowledge. These fact sheets are included in *kms*, too, and can be retrieved by the standard *kms*-tools.

### **Use of the Knowledge Management System by the Customer**

The *kms* as it exist today offers many convenient and powerful possibilities for an effective and precise information retrieval. The three-dimensional data structure allows information retrieval from various points of view. Effective filtering options disable unintentional documents. For short, but comprehensive information the fact sheets provides specific information on selected fields of interest.

### **CONCLUSION**

An effective disposal policy requires the consideration of a wide range of information. Taking into account the multitude of information published in numerous documents a knowledge management system is necessary for an precise and specific information access. Such a *kms* was developed by ISTec and is operated by GRS.

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After a labour-intensive phase for data acquisition and categorization the normal operation of the system is implemented in daily work and requires only relative low expenses.

The benefit of *kms* is the convenient and effective provision of recent information under various aspects. In addition *kms* states a useful tool for the work of experts in the field of final disposal.

## **REFERENCES**

- [1] D. Gruendler et. al., “Knowledge Management for Final Disposal,” WM'04, Tucson, 2004