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Abstract

Over the last few years many companies have recognized a need for corporate knowledge management systems. In the meantime various products from the areas of workflow management, document management and project management have become available that are intended to support these companies in the implementation of knowledge management concepts. A comparable assessment of these various approaches and systems, with reference to particular situations of use, has not been possible until now. Now a procedure model was developed and tested which makes it possible to compare heterogeneous system architectures to one another and then make recommendations for use and expansions. This evaluation is designed to help in the differentiation of knowledge management systems.

Keywords: *Information System, Knowledge Management, Evaluation*

1. Objective

The main objective of the procedure model presented here for the evaluation of knowledge management systems is to support companies in their selection of appropriate systems and components. The procedure model should make it possible in particular for various application areas and focal points to compare the use of knowledge management systems that consist of heterogeneous components. In this respect the procedure model can be used primarily for an assessment of use of planned knowledge management systems. A part of the procedure models also suitable for an evaluation of knowledge management systems that are already being used in operational applications. Both methods of the procedure model have already been applied successfully.

2. Concepts

Knowledge is to be defined as all of the information and capabilities that individuals use in arriving at solutions to problems. Thus it can entail theoretical findings, practical every day rules or instructions for action. The availability of data and information is a prerequisite for knowledge. In contrast to this, however, knowledge is always tied to some type of interaction by people [1].

Knowledge management is defined as an operational management task that encompasses a decision-oriented approach. It is the goal of this management task to establish learning processes across all levels of the organization and to develop them consistently. An organizational knowledge base is one possible result of knowledge management in an entrepreneurial context [2].

Since the knowledge of an organization exists in an unstructured and dynamic form, the use of information technology should have the purpose of re-discovering internal and external data and methods and referring them to human experts. Support systems for this application could be called OMIS (Organizational Memory Information Systems) competency or know-how databases [3]. In the following section, the necessary components for a knowledge management system – from the viewpoint of the authors – will be discussed in some detail.

The setup of an knowledge management system separated from other business information systems can be described using an architecture that is divided into six layers (Fig. 1) (in dependence to [4]).

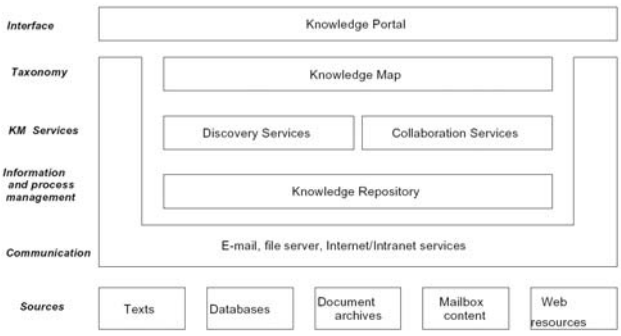

Figure 1 : Architecture of a knowledge management system

- Information and knowledge sources, which in light of the increasing digitalization of contents make up the overwhelming portion of the available information in

organizations, are deemed to be the basis of the knowledge management system

- An infrastructure layer enables the use of communication mechanisms.
- The processing and systematic opening up of information and knowledge sources is done by integration into a Knowledge Repository, which ensures a uniform, logical view of the variety of sources that are integrated into the system.
- The functionality of a knowledge management system is to be considered as a part of the service layer. Here a differentiation between the support of collaborative work and the availability and accessibility of knowledge based on individual inquiries or interest profiles can be achieved. With the Discovery Services a differentiation between the Pull and Push technologies (other sources refer to this as active and passive techniques) can be made:
  - In a Pull situation (or with an active search) the user searches the knowledge management system by inputting a search string. The stimulus for generating the knowledge thus comes from the user.
  - In a Push situation (or a passive search) based on a customized interest profile, the user receives unsolicited and automatically generated documents that have been newly added to the knowledge management system based on his/her interest profile with every usage of the System. The advantage of the Push technology is that no stimulus from the user is needed to generate the output of knowledge. With skillful utilization of the interest profile, other relevant documents are also found, which would not have been retrieved using the traditional Pull technology.
- A structured presentation of the knowledge available in the system that can be used for navigation is made available by the taxonomy layer. Some existing implementations also integrate the Knowledge Repository and Taxonomy into a single component.
- The user interface layer provides a uniform interface for the operation of the system, which may be customizable.

3. Procedure Models for Evaluation of Information Systems

Software or information system evaluation is an old task, which can be differentiated into three main groups of evaluation methods:

- Some methods use criteria catalogs to choose one information system from a list of possible products [5].
- To evaluate the modeling capabilities of systems which map information flows a meta model method is used, e.g. for workflow management systems [6].
- Some methods concentrate on productivity measurement - with uncertain results due to the problem of missing chargeability of positive and negative influences of new information systems [7].

IT evaluation methods were developed in a broad range; an overview is given in [8]. Most investigations of these evaluation methods show that the focus of their usage in practice is in most cases narrow and concentrating on the system itself rather than the intervention as a whole of which the (new) system was just a part. Therefore Farbey recommends to insist more on the social nature of evaluation.

Only a few evaluations of knowledge management systems exist. One example comes from the area of clinical information systems and uses as categories of criteria quality of information, personal impact and organizational impact [9].

4. Description of the assessment procedure

To map the different requirements form the business practice with the diverse knowledge management systems and components a reference model (fig. 1) is used.

The differentiation in components in the reference model helps to compare only comparable components of the knowledge management systems.

In this process the vendor specific terminology will transferred into the product independent terminology of the reference model. Furthermore a first discussion with the vendor's architecture and possibly its modularization can be reached.

In contrast to other software evaluation processes the requirements for the functionality of a knowledge management system is defined by the user itself. Therefore it makes no sense to work only with an external derived criteria catalog. An evaluation of a knowledge management system has rather to measure the fulfillment of the expectation of the user. From that point of view a possible working area for the system can be derived. Knowledge management systems live more than other information systems from the acceptance by its users

This primary evaluation approach is completed by well known and accepted techniques like an ergonomic check derived from EN/ISO 9241 and a classification of the system's components regarding targets and functionality.

The procedure model for evaluation is shown in fig. 2.

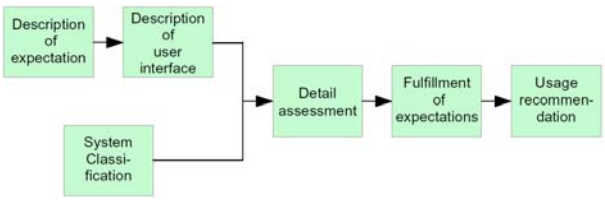

Figure 2: Procedure model for the evaluation of knowledge management systems

4.1 Description of Expectation

In phase 1, the description of expectations, the user first describes the expectations he attaches to a new system that is planned for installation. This step is essential, since quality, efficiency and frequency of use of a knowledge management system depend to a great extent on the system meeting the expectations of the user [10].

The author recommends using the statements about the product provided by the suppliers as basic information for the description of expectations. These should be evaluated by the future user. The different aspects presented in Table 1 have been crystallized as helpful aspects for the description of the expectations.

Hints for the description of expectations
Incorporating into communication and cooperation relationships
Easing of workload and/or increasing efficiency
Fast adaptation and usability
Handling of multiple information sources
Expense of creating meta-knowledge
Use as an instrument of control

Table 1: Hints for the description of expectations

4.2 System classification

According to the description of expectations, which cannot yet be influenced by usage experience if new system components are to be evaluated, a classification of the system components that have been used is undertaken in step 2 of the evaluation procedure. This classification can be done according to the purpose of the knowledge management system, according to its functionality and according to the components of the reference architecture, where the architecture components exist in the system configuration under consideration. The following types can be distinguished based on *purpose*:

- Integrated knowledge management systems that have at their disposal components like libraries, archives, collaboration, meta knowledge and knowledge flow,
- Content management systems for the management of structured and unstructured information,
- Document management systems for automatic recording, ordering and storing of documents and
- Retrieval and search tools.

For a differentiation by functionality, the following basic functions can be distinguished:

- Identification of knowledge: Tools are used to uncover knowledge resources and knowledge deficits and to investigate and analyze business processes according to the aspects of knowledge distribution. In most cases, this category of tools can be described as procedural and is used e.g. by consultants in the introductory phase of knowledge management systems.
- Documentation and management of knowledge: The focus is on storage and filing of documented knowledge. This corresponds to the document management function or, for personalized storage of qualification and experience profiles, the application of skills management systems [11].
- For the distribution of knowledge as a third classification object it must be tested how knowledge and user gets in contact. For this aspect the pull and push technologies are usually differentiated as well.

For the classification according to usage of components of a reference architecture, the knowledge management system to be investigated is characterized to the extent that the components specified in the reference architecture are actually utilized in the investigated configuration. This ensures that for system comparisons only the functions and characteristics of knowledge management systems that fit together are investigated in each instance.

4.3 Description of user interface

In this phase of the evaluation procedure the user interface is described. There is a representation of how the partitioning of the screen is done, where the navigation elements are located and how information is displayed. A neutral approach is used in this case for coloring, page layout and structure, as well as for icon arrangement in the interface. This step is useful to inform people which are unfamiliar with the investigated system.

4.4 Detail evaluation

In phase 4, there is a detail evaluation of the knowledge management systems that is oriented toward the components of the reference architecture. The evaluation categories and possible criteria are presented in Table 2.

component resp. criteria	factor	grade	sum
Sources			
Support of widely used database standards			
support of the access on unstructured and semi structured text			
Integration approach for multiple components			
Communication			
Possibility to connect up internal modules with existing IT infrastructure			
Possibility to connect up internal modules with existing communication instruments like e-mail or Chat			
Is a private use possible to higher user's acceptance?			
Knowledge Repository			
Are techniques for securing data integrity available?			

component resp. criteria	factor	grade	sum
Is there a consistency check while adding or changing information?			
Is there a division between contents and meta data to avoid redundancies?			
Are meta data to be captured (e.g. author, organizational structure, workflow data)			
Is it possible to capture explicit assessments (e.g. usefulness)?			
Is it possible to capture implicit assessments (e.g. number of accesses)?			
Are different languages possible in the same environment?			
Can entries be added anonymously to rise acceptance?			
Collaboration Services			
Support of Instant Messaging and conference functions			
Provision of Yellow Pages, Blackboards and protected fora			
Provision of multistage and freely configurable workflows			
Integration of multi-authoring functions and other CSCW tools			
Support of resource planning (e.g. group calendar)			
Discovery Services			
Provision of different search functions (e.g. ad-hoc query, longtime query)			
Support of different data types incl. web search			
Integration of different retrieval techniques (e.g. Data Mining, Case Based Reasoning)			
Relevance of search results			
Automatic categorization and contents extraction			
Knowledge Map			
Graphical presentation of existing information (e.g. category map)			
Context presentation of contents			
Knowledge Portal			
Connection with external applications			
Ability to personalize and customize			
Ability of external (mobile) access			
News ticker			
Presentation of knowledge sources on one view			
Technical realization			
Modularization and use of open interfaces (e.g. J2EE)			
High stability of the application			
Avoidance of storage restrictions			
Short response times			
Adequate User and access control management			
Usage of encryption protocols like SSL			
Ergonomic aspects			
Appropriateness			
Self explaining ability			
Controllability			
Conformity with expectations			
Error robustness			
Individualization			
Learning support			
Help functions			

Table 2: Overview of the evaluation criteria

When proceeding in the evaluation, the knowledge and capability of the user for the application of the system as well as the attitude and motivation of the employees must be taken into account. The projected or actual area of application of the knowledge management system must also be considered. In order to be able to indicate various degrees of importance of the individual criteria, a scoring model can be used as an option in the application of the evaluation catalog. The importance of a class of evaluation categories or an individual evaluation category can be shown by assigning weights or points to it. A point system using a method similar to the one shown in Table 3 should be used for assessing the level of fulfillment of the listed criteria.

Points	5	4	3	2	1	0
Level of fulfillment	Totally fulfilled	Mostly fulfilled	Largely fulfilled	Partially fulfilled	Sporadically fulfilled	Not fulfilled

Table 3: Possible levels of fulfillment for each criterion

4.4 Fulfillment of expectations

From the results per category, ranking orders can be established among the knowledge management systems being investigated. It must be pointed out, however, that an interpretation of the interval between the point values of two system configurations is not meaningful.

Following this task, which will surely involve the greatest amount of time during the evaluation, the fulfillment of expectations will be queried in phase 5. If the evaluation was done using the criteria catalog in conjunction with the user, the user will now be in a position to make a judgment as to the fulfillment of his expectations by the system. When doing the comparison with the expectations that were recorded before the detailed evaluation, those items for which the expectations of the user were not fulfilled should be particularly emphasized. Just as the results of the evaluation of the criteria catalog from phase 4, these should be included in a summary recommendation on the use of the knowledge management system. This will include a recommendation on the application of the different knowledge management system components involved.

5. Sample applications

Very briefly, the application of this evaluation procedure on two software products will be demonstrated in this section. A separate Knowledge Management System is used in this case, as well as an Information Portal. Both have been kept anonymous to safeguard the interests of the manufacturer.

5.1 Evaluation of a Knowledge Management System (KMS1)

1) Description of expectations

According to the product description, this system creates the expectation that it is an intranet-based software for supporting knowledge management in the company. With a component-type structure of knowledge sources, flexibility is to be created and the user is to be supported in his work. In addition, the user's work area should be provided with knowledge-specific information in context. Expectations are for ease of use by means of intuitive operation.

2) Classification of the system

The System can be mapped almost completely to the reference architecture, however, the collaboration services are only available in part (only a discussion area is available).

3) Description of system interface

Coloring is limited to three colors for the presentation of the user interface. The menu and navigation bars are arranged horizontally and vertically (Fig. 3).

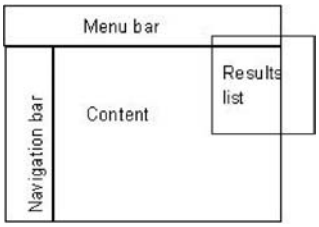

Figure 3: User Interface of KMS1

4) Detail evaluation

The execution of the evaluation procedure led to an assessment of "sufficiently fulfilled". The information and knowledge sources do not indicate that an integration of several knowledge management systems is possible. A representation of the communication mechanisms extending beyond the actual activities is not available (e.g. using a workflow). Verifiability of input and recording of frequency of use is not provided in the knowledge repository. With the discovery services there is no opportunity for the user to do a search on the web. Finally, the ergonomic configuration does not allow for any individuality.

5) Fulfillment of expectations

The above results in comparison with the listed expectations led to the realizations that the system is goal-directed in the support of the management of knowledge. Other criteria that were fulfilled include ease of use, a short period of time until the system may first be used as well as easy upkeep. The expected use for any company with heterogeneous requirements, however, is not possible without some limitations, since the desired collaborative functions are not represented. Thus the use of this system presupposes the use of additional software.

6) Recommendation for use

In giving a recommendation for use of the evaluated software, it could be recommended as suitable for company-wide usage with limitations. A mid-sized company with primarily domestic activities, which has identified deficits in its knowledge management and already has an appropriate IT infrastructure in place will be able to use the tool with significant results in the management of knowledge. The missing groupware features need to be supplemented with other solutions after installation of the knowledge management system.

5.2 Evaluation of an Internet Portal (IP1)

1) Description of expectations

The software description introduces an internet based portal for project work and a solution for cooperative knowledge management. Efficient usage through a uniform method of functioning is anticipated. Database functions are made available for project work for calling up required documents, tables and graphs. Preparation of data that is not available in the system is to be done by search engines or search functions, which will provide the necessary information either from the internet or the company network. By way of implemented safety and security functions, possible loss of knowledge is expected to be minimal. A fast adaptation to the handling of the system is expected to minimize the need for additional training.

2) Classification of the System

When checking for agreement with the layers of the reference architecture it was clear that the architecture had been reproduced for the most part. There are no collaboration services available.

3) Description of System interface

After logging on, the base color of the system is white. The menu bar is represented with blue writing on a green base color. Two thirds of the user window is partitioned into a matrix field, which is sub-divided into 3 x 3 fields with shades of various tones of blue (Fig. 4)

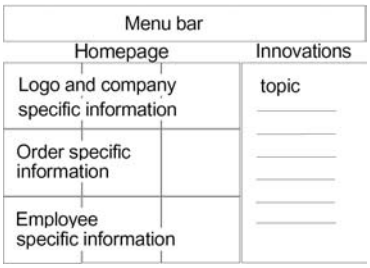

Figure 4: User interface of IP1

4) Detailed evaluation

Carrying out the evaluation resulted in a satisfactory assessment. One item which went into the evaluation was the lack of a functional area for private usage of the System. Verification of input as well as a recording of frequency of use is not provided in the knowledge repository. The information located within the system cannot be evaluated in writing. The discovery services do not provide an option for the user to do a search on the web.

5) Fulfillment of expectations

With the available information on the product, the improvements to be derived from the product description for process quality, productivity and innovation are not immediately evident.

6) Recommendation for use

In particular based on the fact that an existing knowledge management system was acquired with a focus, among other things, on saving time and creating free space for creative activities, the use of the IPI must be recommended with reservations. It should be mentioned here that the manufacturer has already arrived at similar conclusions and has discontinued the product line out for strategic reasons.

6. Summary

The evaluation model described in this paper can be used in cases, where knowledge management systems should be introduced in an existing IT environment. The main goal of this evaluation is to determine where to add functionality and where not. It is now possible to compare different systems with another. Furthermore some of the criteria can be used to evaluate existing knowledge management environments.

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