1 Introduction

Data volumes generated by the Internet [Webcraft web server survey] and other IT related systems have grown steadily over the past few years [Gantz et al., 2008]. Recently a threshold has passed so that individuals and enterprises find it hard to cope with the amount of information that is available to them [Janssen & de Poot, 2006].

A number of possible strategies have been introduced from the academic and commercial sectors that attempt to deal with that issue. Technology oriented people declare enterprise search systems as the best method to retrieve information [Riehn, 2008], assuming that the required information is stored within an IT system. However, integration of such a system is usually a serious problem, as argued in Section 2.3.

New technologies for information interchange between IT systems are arising faster and faster. However, what is important here is not the way information is exchanged, but rather the meaning associated with this information.

Data structures and tags may increase the flexibility of data transferred, but they do not really explain the **meaning** – the **semantics**.

Meanwhile, several semantic oriented techniques and standards have been developed. Ontologies enable to model concepts of the real world and standards allow to exchange these models (see Section 2.2). A model of the whole world consisting of millions of smaller sub models that interact with each other might be available in the future. Today, everybody is able to contribute to projects like Wikipedia (an online encyclopaedia). In the future everybody may provide semantic models of topics of individual interest based upon semantic web standards. [Davies et al., 2002]

Considering all the information available, there is still an intense discussion going on in the academic world regarding the following question:

What is Knowledge ?

Two “schools” give contrasting definitions as illustrated in Figure 1-1.

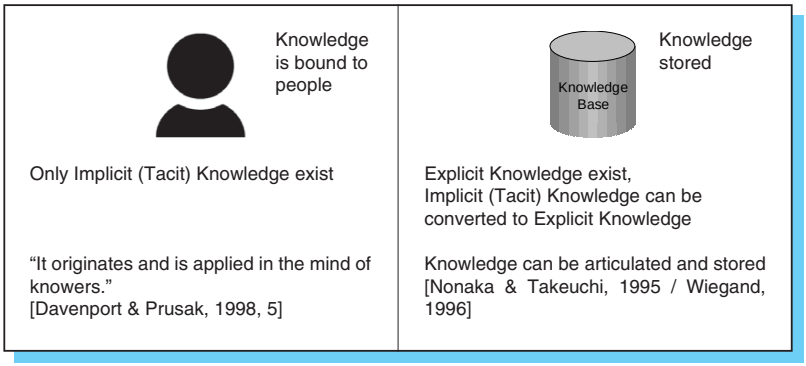

Figure 1-1 Conflicting Concepts of Knowledge

A statement of Rainer Kuhlen, 2004 comes to the point that

> *“Knowledge, an internal cognitive structure of human beings, cannot be managed”*

However, if it is assumed that the “management of knowledge” is impossible then one may ask why write a thesis on the topic of knowledge management?

However the goal of this thesis is to:

> *“make ... knowledge available to the right people at the right time”*
> [Kuhlen, 2004]

Using this statement as basic requirement for this thesis, a new approach will be developed and introduced here.

Research Question

Assuming that knowledge or information that is of value for a problem solution process exists within an organisation, but it is very difficult to find it. As illustrated in Figure 1-2 there are different kinds of sources but they have no real value for the searcher. Searching, interpreting and summarizing these information sources is too complex and time-consuming.

The focus of this thesis is to support a person or a group to get access to the right knowledge and information in an easy to use manner. Therefore details of no interest to the user will be hidden as shown in Figure 1-2.

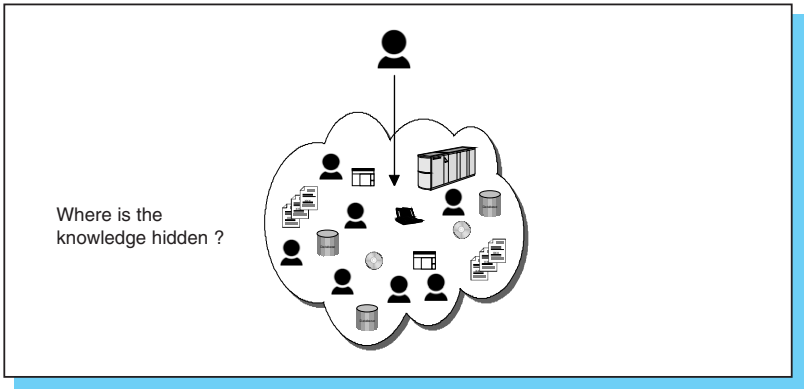

Figure 1-2 Knowledge and Information Sources

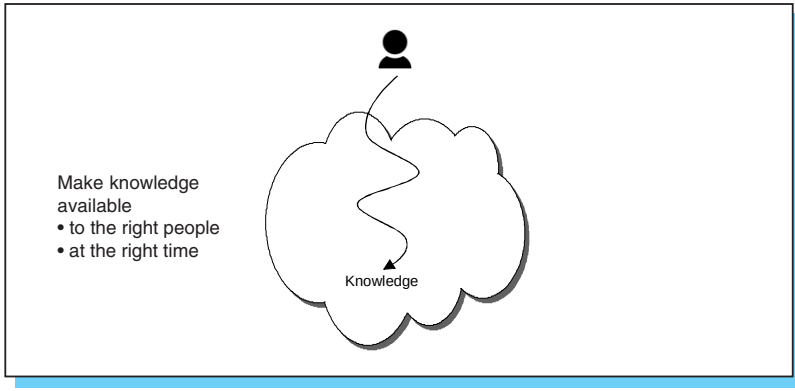

Figure 1-3 How Knowledge should be provided

IT systems are not able to solve that problem but they are used to support people during the problem soultion process (see Figure 1-4).

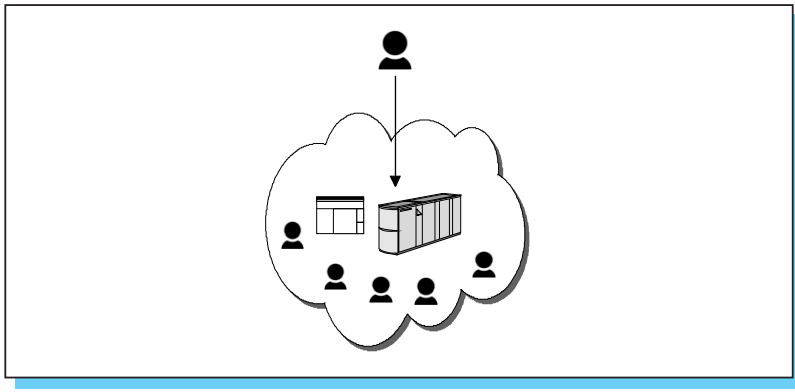

Figure 1-4 The use of IT Systems

Thesis Structure

Chapter 2 deals with Knowledge Management (KM), and tries to give answers to the question “what is knowledge?” Several ways of how knowledge can be perceived are described. Furthermore, the basic concepts of data and information with knowledge management are combined and the different types of knowledge are discussed.

Further, the chapter gives an overview of knowledge management concepts like semantic networks and ontologies. Also KM standards and search and retrieval methods are introduced.

Existing technologies and applications used within a company are basic elements of a KMS. Section 2.3 concentrates on problems concerning the integration of these elements. This is followed by a review of some knowledge management systems.

Chapter 3 discusses issues in company internal knowledge management. Trends in KM based on several studies developed between 2000 and 2005 shows that the focus changed from storage oriented knowledge management to collaboration.

An investigation of some contact and knowledge exchange platforms as an alternative KM approach is introduced.

Experiences of different kinds of users with knowledge management and their requirements for a KMS are described. The respondents of the surveys conducted in this research project have been asked how they proceed when searching for information. The results of the user research have been the basis for the design of the planned system described in Chapter 4.

Problems of KM found in literature are described in Section 3.4 and concluded in Section 3.5: Lessons Learned and Requirements for KM Success.

The novel Knowledge Broker Network (KBN) approach described in Chapter 4 has been developed based upon the findings and conclusions made in Chapter 3.

The principles and strategies of the KBN approach are presented in Section 4.1 with a scenario for using the KBN and a description of people potentially qualified for the role “Knowledge Broker”. The acceptance of the KB approach (see Section 3.3) shows that the majority of users appreciated ideas and layout of the system, although there were limits in the survey sample size.

The KMS approach is based on man-machine-cooperation, a hybrid system combining automated functionality and people as described in Section 4.2 in detail.

A personalisation concept within the KBN Portal is presented in Section 4.3.

Communities are a key concept of the KBN approach, that is described in detail in Section 4.4.

The so-called Search Assistance Algorithm (SAA), a new technique for calculating additional hints is shown in Section 4.5. It proposes how personalised knowledge retrieval may work.

How external resources can be used within the KBN approach is illustrated in Section 4.6.

Section 4.7 introduces the KBN Privacy Concept that extend the privacy functionality usually offered by Knowledge Management Systems.

The KB network that may be used for connecting KMS islands is described in Section 4.8.

A prototype of the KBN Portal (based on a real KMS) is presented in Section 4.9. A strategy for the integration of company-internal communication systems into the KBN Portal offers the last part of Section 4.9.

Section 4.10 demonstrates how an infrastructure of different SAA variants should work. The infrastructure developed allows different SAAs to be made available and the

provisioning of new SAAs at runtime. A simplified prototype that demonstrates the SAA principle is shown here. Because of the dependency on the structure of used knowledge networks it did not made sense to develop a complex SAA variant such as introduced in Section 3.5.

An idea, who is qualified for the role “Knowledge Broker” is given in Section 4.11 follwed by a summary of Chapter 4.

The man-machine co-operation principle introduced in Section 4.2 may be used for other applications as well as application domains. Chapter 5 presents three possible applications:

- IT Assistance for small and medium enterprises offering a portal combined with a network of brokers helping SMEs to identify how the use of IT systems might support their day-to-day business.
- The Personal Assistance Network (PAN), that may be implemented within companies to share a pool / network of personal assistants within the company.
- An Information Broker Network (IBN) where information professionals offer their professional information and research services to the public.

The Information Broker prototype in section 5.4 focuses on how an LDAP-based directory service containing Information Broker data may be developed.

This thesis focuses on internal knowledge management for companies or similar types of organisations. The strategies described here can be extended to support networks of partners also. Applications for the public are also able to benefit from the approach described here, as shown in Chapter 5.

Chapter 6 gives the overall conclusions and an outlook to interesting further research questions.

Research Methods

To ensure that the main topics of the research are practice-oriented and accepted by the scientific community all parts have been presented at several conferences / workshops as a **Proof by Demonstration** and published in a book chapter and several journals continuously during the PhD research period.

A mix of several research methods has been used. Within the area of knowledge management a **literature review** shows:

a) the concepts of knowledge management,
b) status of knowledge management initiatives in companies, and
c) trends in knowledge management.

First the man-machine co-operation principle (see 4.2) was developed and introduced with different applications (see Chapter 5) to several potential interested parties followed by **interviews**. The most interesting interview partners were:

- Information Professionals; in means of the KBN approach (see 4.1) because of their know how on developing knowledge representative structures and in means of the "Information Broker Network" (see 5.3) because of their day-to-day work as so-called "Infobrokers".
- Members of higher hierarchical levels of companies; because of their need for assistance in day-to-day tasks by the "Personal Assistance Network" (see 5.2) and support for searching and customising information by Knowledge Brokers within the KBN.
- Specialists for knowledge management system architectures and developer of such systems.

Some of the interviews were followed by a **scenario analysis** to define i.e. the Information Broker Network workflow (see Figure 5.3.4).

Also the **Historical Method** and **Lessons-learned** Method [Zelkowitz & Wallace, 1997] have been used during intensive information exchange with KMS specialists that supported several KM projects within big companies.

How beginners are able to work with a KMS was examined during several **Laboratory Studies**.

A Proof of Concept of all described applications of the man-machine co-operation concept has been done using several prototypes (for a selection of prototypes see Sections 4.9, 4.10 and 5.4). Some **Prototype Experiments** in combination of **End-user studies** have been made using the KBN prototype.

Some requirements concerning functional design and user interface design were found within some **Focus Group** sessions with experts of the German knowledge-media-design forum.

The examination of Contact- and Knowledge Platforms (see 3.2) has been done by a **Heuristic Evaluation**.

The user research “Knowledge Management Experiences and Needs” (see 3.3) uses the **Exploratory Survey** Method with a mix of quantitative and qualitative methods.

A short description of the methods described here can be found in [Holz et al., 2006].