

Master's Thesis in Informatics

ORACLE SUPPORT

Can it be made more intelligent?

Fredrik Karlbom and Oscar Tillander

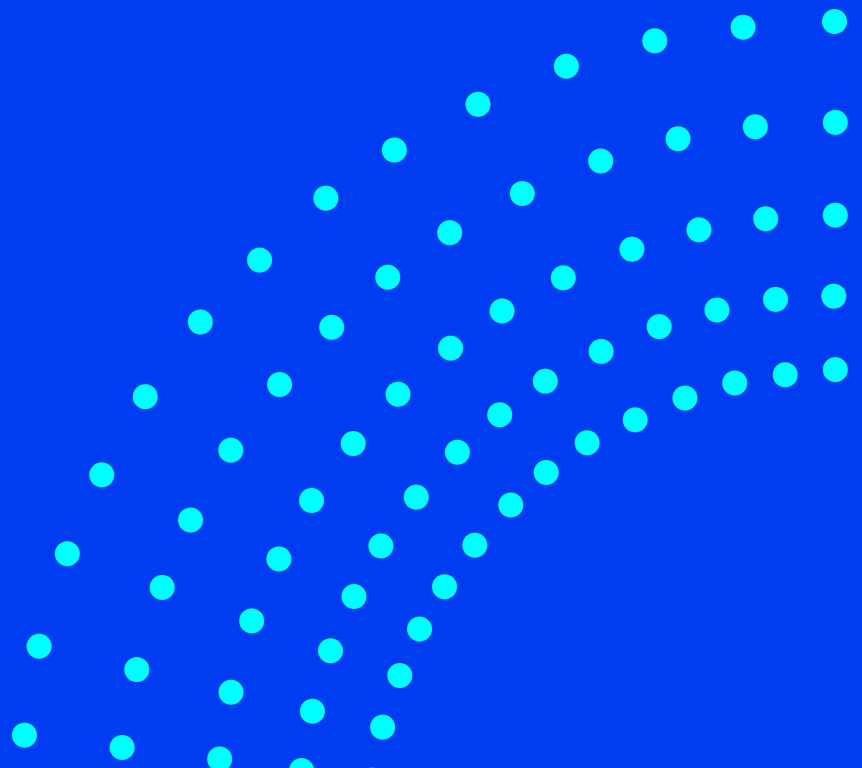
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PREFACE

This master thesis has been completed as a part of the Business Technology studies at the IT-university at the University of Gothenburg and Chalmers Technical University of Gothenburg.

During the completion of this thesis we have received valuable and indispensable assistance from our tutor, Fredric Landqvist. Furthermore, we would like to acknowledge the help that we have received from Stellan Aspenström from Oracle Support. Without their help this thesis would not have been what it is.

Finally we would like to thank all of the interviewees from Oracle Support that have participated in our study despite their lack of time.

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ABSTRACT

Knowledge and accordingly the management of knowledge have been increasingly important to organizations in general and knowledge-intensive organizations in particular. The organization that this thesis is focusing on, the Oracle Support department of Gothenburg is an example of such a knowledge-intensive organization, where the employees' and their knowledge and competence are the central assets. The purpose of this master thesis is to investigate and highlight the potential benefits Information and Communication Technology (ICT) can have on the management of knowledge at Oracle Support. Furthermore, the thesis discusses the related but somewhat different concepts of data, information, and knowledge. In addition various ICT and their influence on an organization's management of knowledge are introduced. Technologies that are discussed are for example knowledge repositories, intranet-related tools and systems, as well as intelligent agents. When creating the interview guideline, we used an ethnographical approach, thus enabling the authors to construct and put the right questions and consequently receive answers of high value and relevance. The research gave the authors valuable insights as well as specific design proposals. The research results as well as the analysis that the five ICT-dimensions from the theoretical chapter resulted in, made it possible for the authors to answer the problem definition, "*are intelligent agents capable of improving the support process at Oracle?*" affirmatively. Consequently two concrete design proposals regarding the implementation of intelligent agents were created based on the sub questions: *where should they be implemented* and *how are they supposed to function?* The first design proposal was to create a customer specific intelligent agent in Metalink, with a filter function. The second proposal was to construct intelligent agent support for the employees, thus facilitating the search and transfer for and of information and knowledge.

Keywords: *Information, knowledge, knowledge management, intelligent agents, ICT, and Oracle Support.*

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1 INTRODUCTION

This introductory chapter gives the back ground of the thesis, furthermore is the problem and purpose of the thesis explained. The chapter will also illustrate the limitations of this paper. A dditionally, a structure will be given in order guide the reader through the paper. The focus of Business Technology, that is the education program that this master thesis is a part of, is to ensure that investments in Information Technology (IT) actually adds value to the organization that implements it. In addition, both authors have similar educational back grounds within the areas finance and business administration. The amalgamation of interest in IT as well as business management has lead to that this thesis emphasis on k nowledge management, and the usage of IT, to enhance the efficiency and business value of k nowledge management. Furthermore, the choice of organization that was a crucial part of this thesis was due to three decisive factors. Firstly, the availability that was based on personal contacts, secondly, the organization is one of the largest IT-companies in the world, and thirdly, the support department of the organization that we focus on is highly dependent on the management of k nowledge.

1.1 BACKGROUND

Clearly, knowledge is nothing new per se. The development of various definitions of this phenomenon has drawn attention from philosophers since the time of ancient Greece. However, due to increased claimed as well as real importance of knowledge in modern organizations in general, and in so called knowledge-intensive organizations in particular, the concept of knowledge management appeared in the beginning of the 1990's. Knowledge management accentuated the significance of knowledge within the company, and managers were recommended to identify, capture, structure, and disseminate knowledge throughout the organization. By doing so, the organization (company) can reach a higher level of efficiency when developing new products and solving problems according to its advocates. Consequently, the company can become more competitive. The introduction of the concept of knowledge management can be derived from many aspects. Partly by the change in the general business climate, where companies more regularly regard knowledge as a strategic resource, but also because of the emergence of knowledge-intensive organizations. In such

organizations, most work is done by highly trained, well educated, and qualified employees. Often are these organizations service companies or R & D (Research and Development) units or support departments, and they are able to produce services or products of high quality. The appearance of knowledge-intensive companies can be derived from the society and organizations where knowledge has been increasingly important. Knowledge is also considered to be the most important input in these organizations. Oracle Support at EMEA (Europe, Middle East, and Africa) is an example of such a knowledge-intensive organization. The Support office in Gothenburg employs seven highly trained professionals.

Additionally, there has been a considerable shift in society from manufacturing businesses to service dittos. The concept of the so called “Knowledge Society” has consequently been widely adopted. Furthermore, knowledge is often highlighted as perhaps the most important asset of any company, regardless if they are manufacturing or service companies.

Nevertheless, knowledge differs in many ways when compared to other assets of a company. The main difference can be derived from the fact that knowledge is not as easy to transfer as other more common resources such as machinery or raw materials. Thus leading to that the focal point is not only on the creation of knowledge, but also on the transfer and accumulation of knowledge. Due to the fact that much of the knowledge in an organization is stored within its employees, this is above all true when discussing knowledge-intensive organizations; it may leave the company when the employee leaves. Here technology-embedded knowledge can prove to be more resistant to deterioration; accordingly can the usage of ICT (Information and Communication Technology) be fruitful in knowledge management initiatives. For example, Artificial Intelligence (AI) in the form of intelligent agents have been claimed to be valuable tools for knowledge management, but also more traditional technologies such as knowledge repositories that store and systematize information and knowledge can be helpful, technologies that Oracle emphasizes.

Since the concept of knowledge management have rendered such a great attention the last ten years, many papers, theses, and articles have discussed topics that can be derived to the knowledge management sector. During the completion of this thesis, several such documents have been discovered by the authors, among them a doctor’s thesis from the Department of Service Management at Chalmers University of Technology by Per-Olof

Sverlinger, dated from 2000. Also, a master thesis from the School of Economics and Commercial Law at Gothenburg University from 2002 by Hanna Janzon has discussed this topic. However, all the theses and papers that the authors have come across discuss knowledge management from a theoretical angle, or focus on the implementation of knowledge management in organizations that not directly is applicable on this thesis's focal point. This thesis is on the contrary focusing on knowledge management in practice. Nevertheless, some of these documents have provided the authors with interesting as well as valuable ideas and topics.

1.2 PROBLEM DISCUSSION

Employees that work within a support organization face, when trying to find information for the best solution of a problem, a massive flow of information daily. This information is generally both structured and unstructured, thus complicating the situation even further. A support organization must provide its clients with satisfactory solutions on their problems. Generally, the clients anticipate these solutions to be provided promptly. Obviously, this puts pressure on the support organization, and consequently the employees within this organization easily become stressed and consider themselves being inadequate in their current job situation. Another obstacle that influences many support units negatively is the fact that they often are treated as “the third wheel” in comparison to e.g. sales and consulting units. This can perhaps be derived from the circumstance that the revenues that a support unit generate often comes in a “lump sum” that is a fixed cost for the client, i.e. the expenditure does not vary depending on usage. In contrast to sales and consulting, the action of a support organization does accordingly not create direct revenues. The conflict of interest between providing qualitative solutions and doing so within a reasonable timeframe is restraining the employees' own knowledge acquisition. This can lead to a deknowledging process among the employees. In addition, the storing and transferring of knowledge acquired is inhibited due to a lack of time. Consequently, the knowledge that each employee within the organization obtains stays embedded and tacit, resulting in for example individual and different techniques in searching for information and knowledge. Therefore, best-practice is not spread and implemented throughout the organization. A support organization

that is geographically dispersed is even more vulnerable to this, since they are more dependent on technological tools and systems in order to be able to diffuse knowledge. This is in contrast to the traditional organizational structure, where co-workers were facilitated within the same physical entity, e.g. in an open-plan office. Hence, enabling new employees to gain knowledge from more experienced colleagues by the old device: “watch-and-learn.”

The combination of an information overload and a restricted amount of time hinders a human individual to sufficiently compute all relevant information that is created as well as sought after by him or her. An automatization of storing, transferring, and applying knowledge might be a part of the solution. Clearly, such an automatization of the knowledge process puts a lot of pressure on any system which is involved in managing knowledge to function with some sort of ICT, such as an intelligent agent, support. Consequently, this leads to our problem definition regarding intelligent agents and the support process at Oracle: *A re intelligent agents capable of improving the support process at Oracle?*

1.3 PROBLEM DEFINITION

Are intelligent agents capable of improving the support process at Oracle?

If this is true:

- Where should they be implemented?
- How are they supposed to function?

1.4 PURPOSE

The purpose of this master thesis is to investigate and highlight the potential benefits Information and Communication Technology (ICT) can have on the management of knowledge at Oracle Support. Furthermore, the thesis aims, if the problem definition is affirmative regarding intelligent agents, to present specific design proposals on how above

mentioned technology can be used to improve the handling of support errands and knowledge management.

1.5 STRUCTURE AND DISPOSITION

Here we give a short description of how this thesis is structured. The introductory chapter gives the background of the thesis, as well as problem, purpose and delimitations. The following chapter, chapter two, aims to describe the methodology that this study is built upon. In chapter three, the theoretical framework is presented, e.g. definition of knowledge and knowledge management. Thereafter, in chapter four, an empirical framework is introduced to enable the reader to fully understand the results of the research, which is presented in chapter five. In the sixth chapter we analyze the results. Finally, the seventh and concluding chapter contains design proposals as well as recommendations for further studies.

1.6 DELIMITATIONS

When the company name Oracle is used, Oracle EMEA (Europe, Middle East, and Africa) is meant, if nothing else is clearly stated. Furthermore, since the concept of artificial intelligence is covering such a vast area and the concept is somewhat dated we have decided not to investigate its overall context any further, but limit our research to the one implementation, intelligent agents, that have sprung from artificial intelligence. The reason for this delimitation is that we consider intelligent agents in particular to be of interest when developing and presenting design proposals that facilitates the support process at Oracle. We have chosen to not use any names when presenting the results from the interviews since we focus on the opinions and way of handling support tasks at a general function level and not on an individual ditto. Due to the limited time frame that this thesis was conducted within, the research that was carried out was qualitative not quantitative since the latter research approach are far more time consuming. During the completion of this thesis reorganization has taken place in the support organization of Oracle. Thus illuminating the fact that an organization not is a stable nor static entity, but rather something that continuously is changing and developing. The reorganization's most recognizable change is that the Triage

function has been terminated. However, the authors believe that the design suggestions that our analysis have resulted in still are applicable to the new organization, since the work assignments that the Triage function used to handle still exist, even though Triage does not.

In the following chapter, the chapter of methods, we will describe how we have carried out the completion of this thesis, as well as the research approaches we have used and the reason why these specific approaches were used.

2 METHOD

This chapter aims to describe the methodology that this study is built upon. The first part of the chapter provides a theoretical discussion on different methods possible for the study. Thereafter follows a detailed discussion on the method chosen. Comments upon why these choices were made and how the practical procedures were carried out are also provided. Finally, an evaluation of the method chosen and the data collection will be presented.

2.1 Theoretical research approaches

According to Zikmund (2000) there are three main categories of designs for research in the business area; *exploratory*, *descriptive* and *casual*. The categories can be described as follows:

- An *exploratory* research approach is appropriate when the knowledge about the problem area is limited, and is often applied when the problem definition is unclear. Therefore the researcher must explore the area of interest to gain knowledge and understanding about the problem. The exploratory research method is characterized by high flexibility and is often used for preparative and/ or investigative purposes.
- The *descriptive* research approach is normally used when a study intends to describe a phenomenon or something of that kind from a basis of a well defined and structured problem. This kind of research approach is often used to describe how different occurrences appear or is associated with each other.
- A *casual* research approach aims to clarify cause-and-effect relationships. The approach uses assumptions regarding cause-and-effect relationships, and is structured to gather evidence on these relationships.

A theoretical distinction can be made between *qualitative* and *quantitative* research models (Wiedersheim-Paul and Eriksson 1991). Quantitative models aims to quantify results, often

in numerical measures, and/ or measure a problem statistically. A qualitative model on the other hand uses variables such as sex, civil status or attitudes and intends to display results in words rather than statistically. Accordingly the differences between the models can be derived from different data collection and analyzing processes. Frequently, elements from both models are used in surveys.

Applied research approach

We have discussed different possible approaches to fulfill the purpose of this thesis. With the theoretical method discussion as a standing-point, our study must be seen as an exploratory study. We examine a problem area that has many angles of incidences, and from this point of view our study must be seen as exploratory.

In our planning process we considered making a complete survey in order to be able to present a more general and broad picture of the way the support process was conducted. After discussions we realized that this would be far too time consuming in relation to our limited time frame. Moreover, our problem definition required some complicated questions to be asked, which is not possible to do in a survey. To sum up, we concluded to do a qualitative study with personal interviews as the primary data-collecting tool.

2.2 Collection of data and sources of information

According to theory of research, collected data can be divided into the two categories; *primary* and *secondary* data (Wiedersheim-Paul and Eriksson 1991). Primary data is data collected for the first time specific for the research. For example, primary data consists of interviews, simulations or observations. On the other hand, secondary data is data already collected and available for the researcher, such as company or library reports, journals, surveys or sites on the Internet. There are reasons to be especially careful when using secondary sources. The first problem with secondary data is that the data may have been collected for studies with different objectives and therefore are not applicable for the study of current interest (Ghauri et al. 1995). Inadequate information about how professional and objective the secondary source is also requires caution (Dahmström 1991). The last problem

concerning secondary data refers to the timeliness problem, i.e. the data might simply be out of date.

2.3 Choice of data collecting method

In the process of completing this thesis we have been using both primary and secondary sources.

The primary data consists of information composed from five in-depth interviews, which have played the most central role in the establishment of this study. The respondents have been analysts located in the Oracle Support Gothenburg branch.

In advance it was difficult to determine what number of interviews would be needed to accomplish our purpose for the study in a suitable way. Therefore we aimed to do as many interviews as possible until we felt that further interviews would be of marginal use. However, due to the limited number of interviewees that were available (the Gothenburg office has seven employees) our five in-depth interviews covered the majority of possible respondents. All interviews have been transcribed and then documented to simplify the analyzing process. For minimizing the risk of subjective judgment of the interviews both the authors have been present in every interview occasion.

Secondary sources were mainly used during the process of completing the theoretical and empirical framework, where academic literature, scientific journals as well as whitepapers were the essential sources. To carry out the purpose, especially the theoretical part that provides the foundation for the thesis, an extensive literature research was made. To be able to prepare this frame of references, we made use of databases accessible from the library systems of Gothenburg University, Gunda and Libris. Therefore theory must be seen as an essential part of this thesis. In addition we aimed to provide an empirical background as to support the interviews and theory, where information from Oracle Corporation, such as manuals and websites, have been collected and used.

Ethnographical approach

We constructed our questions by using an ethnographical approach. The ethnographical approach we conducted was influenced by the guidelines stated by Repstad (1993).

The purpose of an ethnographical observation is to see the various situations the observed employee naturally face and how he handles them. We used an open observation where we clearly stated who we were and what our objective was. As our objective was to gather information without preconceived thoughts, we tried to be as passive as possible in our first interview, thus being able to conduct more structured interviews later on based on the ethnographical observation. Our choice of interview subject was based on the notion of the good informant. A good informant means a person that:

- Has a function which ensures that he or she handles the information you aspire
- Are supportive and enthusiastic in sharing information
- Has good ability to share information

Interviews and interview guideline

Our interviews were to some extent standardized in the aspect that we used an interview guideline (Appendices II and III) to help us carry out the interviews in the desired manner and to focus on our problem areas. The interviews were conducted in Swedish and the answers thereof were afterward translated and transcribed into English, thus explaining that there are two interview guideline appendices. The primary reason for using a guideline was to ensure that all respondents encountered similar questions; hence the results should be comparable.

The quality of our interview guideline was one of the most critical factors in order to receive “high value” of collected data. To make this possible we conducted, as already mentioned, an initial ethnographic study at Oracle Support. Great effort was also put into the procedure of having the questions correlated with the essence of the problem analysis. We have tried to disregard preconceived thoughts in the subject of matter. The guideline was supplied to our main respondent ahead of the interview occasion, to give him the possibility to comment the

questions and time to reflect over the problem area. The various input and information that we received by doing so were very valuable to us in our further interview process.

2.4 Evaluation of research

Validity

The concept of *validity* can be defined as: “*How reliable a method approach or a measuring instrument really is, and that these really measure what they are supposed to measure*” (Wiedersheim-Paul and Eriksson 1991). From our point of view, the validity of this study is related to two aspects. *Firstly*, we needed to reach respondents who had the right competence and knowledge about the subject of matter. *Secondly*, we needed to ask those respondents the “accurate” questions, i.e. questions that were well correlated with the purpose and problem definition of the study.

We considered that all respondents had enough familiarity with our problem area to give us accurate information. In this respect we do not think that the validity is insufficient. In the preparation of our interview guideline we put great emphasis on the importance of linking the questions to the problem discussion and theoretical framework. Our tutor has also helped us to revise the questions before the interview process began. According to our judgment there are no signs of deficiencies in the interview guideline that might have caused insufficient validity.

Reliability

The *reliability* of a study is the degree of reliability and stability of the research process that the study is based on, i.e. the investigation’s capacity to resist random distortions in measurement (Kinnear and Taylor 1996). If a high level of reliability would be regarded to exist for a study, an independent researcher should get the same results at a different occasion (Dahmström 1991). When using interviews as a tool to gain information there is always a risk that the interviewer affects the respondent in some way. The interviewer may affect the respondents’ answers either consciously or unconsciously. Even if we are aware of

the risk of controlling behavior that can occur in an interview situation we can not be absolutely sure of our complete neutrality. We have however tried to avoid asking leading questions and thus manipulating the interviewees in any way.

Degree of generalization

Due to our choice of a qualitative research process our results cannot be generalized straight of. Obviously we are not able to statistically draw any conclusions from the research due to the limited number of interviews conducted. However, we regard that the interviewed analysts at the Gothenburg branch solve similar problems for similar customers as other support branches within Oracle do, thereby making it possible to draw general conclusions from the results received that are applicable throughout Oracle Support. In addition it is our hope that this study will bring some additional interest for the problem area and raise questions for further research. We consider the answers provided from our interviews as giving interesting information regarding the usage of ICT in a support environment at a multinational cooperation.

Criticism of the sources

The principal criticism of the collection of primary data is the somewhat limited number of interviews conducted. There is also a risk that we have affected or misinterpreted the analysts interviewed. Nevertheless, we think that the analysts and the team leader we have interviewed are so secure and confident in their profession that they are not so easily affected by students.

Regarding the secondary sources of information, e.g. academic literature and scientific journals, we consider them to be reliable due to where they have been published and by whom they have been produced. It is in the human nature that the authors advocate their own publications and theories; however we think that we have been able to get a profound and broad picture of the theories we have used in this thesis, due to the large amount of academically published material that is included.

3 THEORETICAL FRAMEWORK

In this chapter the theoretical framework of the thesis will be presented. Initially the characteristics as well as distinctions between data, information, and knowledge are introduced. Further, since the thesis is focusing on knowledge rather than data or information, the focal point is put on the former concept, knowledge. After the profound introduction of the concept of knowledge and its various elements, such as tacit and explicit knowledge, the exposition of knowledge elements lead to the introduction of the conception of knowledge management. In addition a presentation of different information and communication technologies (ICT), such as intelligent agents, which can be used for knowledge management purposes, is put forward. Finally, the connection between knowledge management and ICT is concluding the chapter.

3.1 Data, information, and knowledge

To use a distinction between knowledge and information is very common among authors when discussing knowledge management. However, according to Davenport (1997) to operationalize the distinctions between the data, information, and knowledge has proven to be rather difficult. Nonaka and Takeuchi (1995) distinguish the difference between information and knowledge as if information is a flow of messages; knowledge is accordingly what is created by the flow of information, anchored on the beliefs and commitment of its owner. Another distinction is presented by Starbuck (1996): He tries to illuminate the distinction by defining knowledge as a stock of experience, i.e. a stock of experience rather than a flow of information. To exemplify he implies that knowledge relates to information in the same way assets relate to income. Thus the distinction between information and knowledge can be interpreted as the degree to which information is processed and put into a practicable context. Data on the other hand is asserted by Davenport (1997) as simple observations from the environment. Data is consequently easily captured, structured and transferred. Davenport (1997) also suggests that information can be seen as data that is endowed with some sort of relevance and purpose. Furthermore, information demands analytical units as well as consensus on meaning and the interference of humans. Moreover, Davenport (1997) implies that knowledge is derived from valuable information from the

human mind. Hence, it includes reflection, synthesis as well as context. However, it is also considered to be hard to structure, complicated to capture via technology and difficult to transfer. I.e. it is often considered to be tacit. Even though it is considered to be hard to use machines to capture knowledge, Davenport (1997) asserts that knowledge can be embedded in technology, as well as in routines (Argote 1999).

Brown and Duguid (2000) have noticed that the two terms, “knowledge” and “information” often are used interchangeable in knowledge management literature. However, they have also observed three distinctions that they consider to be generally accepted by the terms.

Firstly, they point out that knowledge in general requires a knower. *Secondly*, because of this personal attachment, knowledge seems harder to attach than information. Information in turn is easy to reveal, possess, store in a database, accumulate, and so forth. Accordingly, knowledge is in contrast less easy to pin down. Their *third* and final distinction is that knowledge appears to be something that are digested rather than merely hold/ stored. In addition, they assert that knowledge demands an understanding of the knower as well as some kind of commitment.

Brown and Duguid (2000) further state that these three distinctions between knowledge and information should be seen as a development that initiate a shift from processes and technology towards people and the assimilating, comprehension and sense making of information. According to the authors, information cannot be converted into knowledge without the human processes of consensual understanding and contextual sense-making.

It can be concluded that knowledge can be transferred either directly between individuals through socialization, or indirectly by delivering information which people can make meaning of and internalize as their personal knowledge. Information, in turn, is data that have been put in context. In chapter 3.3, a more in depth description of how knowledge can be transferred as well as created will be conducted. Information can be categorized into two main classes, *structured* and *unstructured* information.

Structured information

Structured information means information that has been traditionally classed as a report. Data, characteristics, key figures, assignments and other attributes are presented in table or diagram form. These structures enable diverse analyses. Reports do not always have to be created individually - a large proportion of report creation can be carried out automatically. Searching, sorting, filtering, highlighting and exceptions can be used as desired on individual attributes. (Willenborg 2003)

Unstructured information

In contrast, documents that contain, for example, body texts, pictures, films, are unstructured information; it is more human friendly in its character than structured information. They are often stored in different ways and created individually and manually rather than automatically. The search, apart from that of attributes in the document master record or document folders, is usually a free-text search using a text index that has been created with a special indexing program. (Willenborg 2003)

Since the scope of this thesis is foremost related to knowledge rather than data and information, a more thorough presentation of the former term will be conducted.

3.2 Knowledge

There are a bewildering number of different definitions of knowledge. However, there is a common core when defining knowledge; the emphasis that knowledge is seen as a justified, i.e. true, belief. The emphasis on belief indicates that there is a believer and that knowledge is seen as some sort of process, a process that most likely is influenced by humans.

The definition given by the authors Nonaka and Takeuchi (1995) appears to be the definition that foremost influences the concurrent literature on knowledge and knowledge management. This definition and a selection of other definitions are introduced in table 1.

Table 1 Definitions of knowledge.

Author	Definition of Knowledge
Allee (1997)	Experience that can be communicated and shared
Brooking (1996)	Information in context, together with an understanding how to use it
Davenport and Prusak (1998)	A fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information
O'Dell and Grayson (1998)	Information in action
Nonaka and Takeuchi (1995)	A dynamic human process of justifying personal belief toward the truth. Knowledge is created by the flow of information anchored in the beliefs and commitment of its holder. This emphasis that knowledge is essentially related to human action
van der Speek and Spijkervet (1997)	The whole set of insights, experiences, and procedures that are considered correct and true and that therefore guide the thoughts, behaviors, and communication of people
Sveiby (1997)	The capacity to act
Wiig (1993)	Truths and beliefs, perspectives and concepts, judgments and expectations, methodologies and know-how

Among the various definitions of knowledge there are also different classifications, where the most acknowledged is the distinction between *tacit knowledge* and *explicit knowledge* (Polanyi 1966; Nonaka and Takeuchi 1995), but also the distinction between *analogue* and *digital* knowledge Bateson (1972) has rendered attention.

Tacit and explicit knowledge

Michael Polanyi (1966) says that individuals *know more than they can tell*. This specific knowledge is named *tacit knowledge*. Tacit knowledge can be described as follows; we can know things and we can do things without being able to tell anybody how we know or exactly what we are doing. Tacit knowledge, or *informal knowledge* as it also known as, is context specific and therefore difficult to articulate and as well as to communicate. Tacit knowledge is also considered to be personal knowledge that is derived from individual experience and personal beliefs, perspectives, and values.

Polanyi (1966) classifies the opposite form of knowledge as *explicit* or *formal knowledge*. Explicit knowledge is in contrast to tacit knowledge transferable through formal verbal or written language. According to Polanyi (1966) people are able to create knowledge by actively making and organizing experiences. However the knowledge that we can articulate in words and numbers and communicate to others only represents the tip of an iceberg. Nonaka and Takeuchi (1995) further apply distinctions between tacit knowledge and explicit knowledge. According to Nonaka and Takeuchi (1995), knowledge of experience generally tends to be tacit, physical and subjective, while knowledge of rationality tends to be explicit, metaphysical as well as objective.

Analogue and digital knowledge

As stated by Bateson (1972), tacit knowledge is created here and at the present moment in a context that is specific and practical, and entails to what Bateson (1972) refers to as *analogue knowledge*. The relationship between tacit and analogue knowledge is derived from the condition that communication of tacit knowledge between individuals is an analogue process that requires simultaneous handling of the issues shared. In contrast, explicit knowledge is derived from past events and objects, as well as being oriented toward a context-free theory (Bateson 1972). This sort of sequentially theory is named *digital knowledge*. Clearly, the dichotomy of knowledge into tacit and explicit knowledge also refers to the accessibility of knowledge. Generally, tacit knowledge is not considered to be as accessible as explicit knowledge, hence it is accordingly more difficult to transfer.

3.3 Knowledge management

The concept of knowledge management is nothing new, even if it is one of the contemporary “buzzwords.” For hundreds of years, owners of family businesses have passed their commercial insights to the next coming generations, master craftsmen have taught their apprentices the secrets of the trade, and workers have shared ideas and know-how on the job. According to Beckman (1999), the concept was coined at the International Organization Conference of 1986. However, knowledge management has appeared under other names

over the years, but has not until recently (1986) been named knowledge management. Tiwana (2000) points out that the concepts that drive knowledge management are the same that have influenced businesses for a long time. Earlier trends that are predecessors to the concept of knowledge management are PERT (Program Evaluation and Review Technique) in the 1950s, centralization and decentralization in the 1960s, the experience curve in the 1970s, corporate culture in the 1980s, and lastly the learning organization of the 1990s (Tiwana 2000). Clearly, the standpoint of Tiwana (2000) is to dispute the claim that knowledge management is something new and something that has emerged out of nothing, as some consulting firms are trying to have one believe.

Knowledge management gained popularity among leading management consultants in the mid-1990s, most likely because it was profoundly influenced by the concurrent development of IT. Consequently, knowledge management is seen as an attractive amalgamation of features from the TQM-movement (Total Quality Management), Organizational learning, Lean production, as well as Business Process Reengineering (BRP) (Deming 1986; Argyris and Schön 1978; Womack et al. 1990; Hammer 1996). According to Sverlinger (2000) knowledge management also inherit several elements from Information Systems Management (ISM). However, in contrast to ISM that can be derived from the world of mainframe computers, knowledge management has emerged from a world of decentralized and PC-based information technology, the Internet, and more effective telecommunications in general.

Definition of knowledge management

It has proven difficult to find a clear and well-established definition of the concept of knowledge management. This can perhaps be due to the enormous attention from academia as well as industry that knowledge management has received in the last few years. However, according to most writers on knowledge management, it is some sort of process of getting the right knowledge (information)¹ at the right time to the right people, if this is at all possible. In doing so, the greatest possible value for the organization will be obtained. Here

¹ See the distinctions between data, information, and knowledge in chapter 3.1.

we will present some of the various definitions and perspectives that are being used for this multifaceted idea.

Control perspective

According to van der Speek and Spijkevet (1997) knowledge management can be defined as the explicit control and management of knowledge within an organization or company with the objective to achieve company or organizational goals. Correspondingly, Wiig (1997) claims that knowledge management is the systematic, explicit, and intentional building, renewal, and application of knowledge to maximize the returns from all knowledge related assets. Both these perspectives on knowledge management are control-oriented in the sense that they both treat knowledge as an asset. An asset that, if managed correctly, can lead to various beneficial outcomes.

Process perspective

An alternative perspective on knowledge management is the process perspective. This view on knowledge management also seems to be the most widely spread. The advocates of this perspective view knowledge management as the process of capturing knowledge, skills, and know-how of the organization wherever this expertise exist: for example in databases, in reports, or in the heads of employees, and thereafter distributing the expertise so it contributes to the biggest payoff (Hibbard 1997). Another process perspective on knowledge management is proposed by O'Dell and Grayson (1998). According to these authors, knowledge management is all systematic approaches in collecting, understanding, and using knowledge with the objective to create value for the organization. Davenport and Prusak (1998) have a similar assumption on the knowledge management process; they suggest that the process consists of creation, codification, and transfer of knowledge. In terms of studying organizations and their business and understanding how they manage their knowledge, it is generally assumed that a process perspective is more rewarding than a control perspective. Most likely is this also the reason why this perspective is the most popular within academic circles and management consulting firms alike. According to Alavi and Leidner (2001) a minimum of four basic knowledge management processes can be identified:

- Creating knowledge (also referred to as constructing)
- Storing and retrieving knowledge
- Transferring knowledge
- Applying knowledge

Creating knowledge

Four different modes of knowledge creation have been introduced by Nonaka (1994). They are: *socialization*, *externalization*, *internalization*, and *combination*. The common denominators of these concepts are that they either take their standing points in tacit knowledge or explicit knowledge and that they discuss how knowledge can be created and shared in an organization. The *first* mode, socialization, concerns how tacit knowledge can be converted to new tacit knowledge through various social interactions and shared experience among for example employees. Socialization can be implemented through e.g. apprenticeships. The *second* mode is externalization; here tacit knowledge is converted to new explicit knowledge by e.g. the articulation of best practices or lessons learned. A *third* mode is the so called internalization of knowledge. New tacit knowledge is created from existing explicit knowledge by for example learning that results from reading or discussion. The *fourth* and last mode is the combination mode. The combination approach converts new explicit knowledge by merging, categorizing, reclassifying, and synthesizing existing explicit knowledge. This can be done via e.g. literature and survey reports. Information technologies that can facilitate the creation of knowledge are for example various data mining and learning tools. These technologies can help the creation process by combining new sources of knowledge as well as implement Just-In-Time (JIT) learning.

Storing knowledge

According to Alavi and Leidner (2001) there are mainly two different forms of memory that influence an organization and the employees of this organization, *individual* and *organizational* memory. These two categories of memory differ in many ways. When individual memory is developed it is based on a person's observations, experiences as well as actions. On the contrary, organizational memory or collective memory as it is also entitled includes a wider

range of content. It includes organizational culture, production processes and work procedures, formal organizational roles, physical work setting as well as internal and external information archives. ICT that supports the storage of knowledge are e.g. knowledge repositories and databases, but also electronic bulletin boards that can be accessed via intranets. The various technologies can enable a support of individual and organizational memory, as well as provide a platform for inter-group knowledge access.

Knowledge transfer

As said by Alavi and Leidner (2001), knowledge can be transferred within an organization at various levels. The fundamental transfer is the one that occurs between networks of individuals. However, individuals are also able to transfer knowledge to explicit sources, generally by providing codified knowledge to a knowledge repository. The transfer of knowledge between individuals to groups as well as between and across is in addition important for a well-functioning organization. In these situations intranets may prove useful, and the tools that the intranet contains, such as discussion forums, electronic bulletin boards, and knowledge directories. It is claimed when using ICT for knowledge transfer, more communication channels become available, and faster access to knowledge sources can be achieved.

Knowledge application

The application and integration of knowledge in an organization to create organizational capability can be accomplished by three different approaches according to Alavi and Leidner (2001). These three approaches or methods depend on for example the complexity of the knowledge that is transferred and should be implemented as well as on the organizational structure of the organization. The three mechanisms are *directives*, *organizational routines*, and *self-contained task teams*.

- *Directives*. Specific set of rules, standards, procedures, and instructions developed through the conversion of specialists' tacit knowledge to explicit and integrated knowledge for efficient communication to non-specialists.

- *Organizational routines.* Coordination patterns, interaction protocols, and process specifications that allow individuals to apply their knowledge without the need to communicate what they know to others.
- *Self-contained task teams.* When task uncertainty and complexity prevent the specification of directives and organizational routines, teams of individuals with prerequisite knowledge and specialty are formed for problem solving.

When integrating and applying knowledge throughout an organization, expert as well as workflow systems can facilitate these processes, hence, knowledge can be applied to many locations, and a more rapid application of knowledge can be obtained through workflow automation.

3.4 Organizational structures

Traditionally, the organizational structures of foremost companies have been dominated by divisions and functions that can be derived from their geographical location. However, the introduction of knowledge-intensive organizations as well as the development of efficient IT has made other organizational compositions possible, structures that are more appropriate and tailored for their ever-changing environment. This thesis will introduce two of these new structures that the authors consider important to be somewhat familiar with: *Communities of practice* and *Electronic networks of practice*. Both of these organizational functions possess traits from the mechanism of self-contained task teams (Alavi and Leidner 2001).

Communities of practice

The other organizational function that the authors have decided to include is the community of practice. A community of practice can be described to have five different levels regarding its relationship to an “official” organization (Wenger 2000):

- *Unrecognized.* Invisible to the organization and sometimes even to members themselves. Challenges are the lack of reflexivity, awareness of value and of limitation.
- *Bootlegged.* Only visible informally to a circle of people in the know. Challenges are getting resources, having an impact and keeping hidden.
- *Legitimized.* Officially sanctioned as a valuable entity. Challenges are broader visibility, rapid growth, new demands and expectations.
- *Supported.* Provided with direct resources from the organization. Challenges are scrutiny, accountability for use of resources, effort and time and short-term pressures.
- *Institutionalized.* Given an official status and function in the organization. Challenges are fixed definition, over management and living beyond its usefulness.

Communities of practice differ from typical organizations that it is not built upon forms regarding how information is supposed to be distributed. As the purpose is to develop knowledge it is based on the notion of collegiality. This does not imply that there are no differences in power among members, but differences are rather based on level of expertise and his or hers ability to add knowledge then on official authority. A community of practice differs from teams, since mutual interest and shared learning is what keeps it together unlike official teams which are bound to specific task, goals and work plans. A community of practice exists as long as the members feel they are provided with knowledge that are of value to them not by a set date as project teams. Furthermore, communities of practice differ from networks as they are built upon a specific topic or interest, not just as a set of relationships. It does not exist merely on the relationship among the members but on the common will to share knowledge in a specific field. The common goal can naturally result in individual relationships among the members, but it is not the fabric upon which the community is built. The creation of a community of practice is founded around the need of knowledge, neither on production requirements nor formal units. It can, when it functions at its best, work as a channel which distributes best practices, tips, lessons learned or feedback.

Meaning that a community of practice provides the arena where information translates into knowledge.

Electronic networks of practice

When trying to replicate communities of practice online, organizations focus in IT that are able to create intra-organizational electronic networks, i.e. electronic networks of practice. These electronic networks' main function is to create electronic "bridging ties" between the geographically dispersed organizational members, thus providing a communication arena where individuals working on similar problems are able to promptly inquire other participants for help on task-related problems (Teigland 2004).

The fundamental characteristics of electronic network of practice are that the primary communication channel, obviously, is computer-mediated, with a one to all communication. The membership of the electronic network of practice is open, and the membership is based on shared interest in practice. Due to the lack of face-to-face interaction there are low levels of shared identity, language, norms as well as values. The shared knowledge within an electronic network of practice is generally public good, and explicit, thus being highly non-redundant. In addition, electronic networks of practice demonstrate a lower level of efficiency in comparison to communities of practice, but a higher level of creativity (Teigland 2004).

3.5 Knowledge management approaches, strategies, and initiatives

People-centered and technology-centered knowledge management approaches

The idea of *people-centered* and *technology-centered* approaches to knowledge management was introduced by Poneis and Fairer-Wessel (1998). These two opposite approaches are, as revealed by their names, focusing on either people or technology.

People-centered knowledge management approaches are focusing on human resource issues, and primarily involve assessing, changing and improving individual skills and behavior of the employees of the firm.

Technology-centered approaches are on the contrary primarily involved in the construction of information management systems, AI/ intelligent agents² and implementing groupware solutions. However, Ponelis and Fairer-Wessel (1998) stress that a combination of the two approaches is the optimal approach when striving to have a successful knowledge management implementation. To solely focus on either of the approaches will most likely, according to the authors, lead to the failure of the knowledge management initiative. A balance between the two approaches are, according to Ponelis and Fairer-Wessel (1998), needed, because even when people hold knowledge, they also need some sort of technology to store, retrieve, and share it.

Codification and personalization knowledge management strategies

Another division of the conception of knowledge management was introduced by Hansen et al. (1999). They established two different knowledge management strategies: *The codification strategy* and *the personalization strategy*.³ The codification strategy is based on the implication that information is coded and stored electronically, the coding and storing of the information is consequently independent of the person that developed it. The personalization strategy on the other hand is instead focusing on communication between individuals. It is therefore based on learning by recording knowledge of the individuals and it approaches accordingly these individuals directly. When using a personalization strategy for knowledge management, tacit knowledge is also captured; this is a clear distinction to the codification strategy. Furthermore, emphasizing the wrong approach, or trying to pursue both at the same time at the same degree can rapidly damage your business (Hansen et al. 1999).

Above stated strategies have many similarities to the people-centered and technology-centered knowledge management approaches that were discussed previously. When

² Intelligent agents and related technology will be more thoroughly introduced in chapter 3.6.

³ A more thorough exposition of the codification and personalization strategies will be made in chapter 3.8.

comparing these strategies, it can be found that the codification strategy is similar to the technology-centered approach. The personalization strategy can, similarly, be paired with the people-centered approach.

Knowledge management initiatives

Ponelis and Fairer-Wessel (1998) as already stated, as well as Hansen et al. (1999) suggest that a balanced combination between the strategies or approaches is the most suitable way of working. Furthermore, strategies and approaches such as these also are realized through different initiatives that support the idea of seeing knowledge management from a process perspective rather than from a control perspective. Not surprisingly is a categorization of such initiatives developed (De Long et al. 1997).

- Capturing and reusing structured knowledge
- Capturing and sharing lessons learned from practice
- Identifying sources and networks of expertise
- Structuring and mapping knowledge needed to enhance performance
- Measuring and managing the economic value of knowledge
- Synthesizing and sharing knowledge from external sources
- Embedding knowledge in products and processes

3.6 Technologies for knowledge management

Knowledge management technology is not a single technology, but rather a wide spectrum of technologies that need to be implemented and integrated when managing knowledge in an organization. Many of these technologies are not new, for example those that can be derived from AI. Furthermore, some of the technologies can be used to manage data and information as well, as is true of intranets and the Internet.

Davenport and Völpel (2001) classifies the different knowledge management technologies into three categories:

- Repository and access technology
- Structured knowledge representation tools
- Knowledge management e-commerce tools

Repository and access technology

As the most common type of knowledge management projects involves building repositories of codified knowledge, i.e. when having a technology-centered knowledge management approach, not surprisingly the most common technologies are those that make it possible for organizations to build repositories, provide extensive access, and allow people to find the knowledge objects that meet their needs. According to Davenport and Völpel (2001) there are three basic “backbones” for knowledge repository systems and access environments: Lotus Notes, Web-based intranets, and Microsoft Exchange. Earlier, Lotus Notes was the dominating technology for these kinds of knowledge management activities; however, in recent years foremost Web-based intranets have grown considerably faster. That use of Web-based intranet are outgrowing especially Lotus Notes, but also to some degree Microsoft Exchange, is quite obvious when you consider that these intranets are being developed by a large number of firms and therefore are more versatile, instead of being developed by one single company. Accordingly, this thesis will present intranets more thoroughly than the other knowledge management “backbones.”

Intranets

Intranets are in many aspects similar to the Internet, but distinguishes it self from the latter due to some unique characteristics. Whereas the Internet appeared from the ARPANET of the 1960's, intranets started to develop when more and more companies started to run TCP/ IP on their internal networks during the 1990's (Stenmark 2003). The features that intranets have in common with the Internet are they both are: *hyperlinked*, *networked*, and *flexible*. However, intranets differ from the Internet by being *organizationally bound*.

- *Hyperlinked.* Both intranets and the Internet have the ability to create hyperlinks, thus allowing people to collaborate, as well as to exchange and communicate information in a transparent way. Due to the fact that both intranets and the Internet are hyperlinked, easy access to documents are allowed. In fact, any object anywhere on the web/ intranet may be easily addressed and accordingly accessed (Baecker 1993). According to Turoff and Hiltz (1998), this “super connectivity” does enable individuals as well as large organizations to distribute knowledge just as easy.
- *Networked.* According to Stenmark (2003) the Internet can be considered to be highly networked in the sense that it is distributed in both a physical way as well as in authority. Since information can be located anywhere within the network, the actual physical location of data is transparent to the user. In addition, due to the fact that the Internet has neither central management nor predefined structure, anyone can publish anything. Hence, web users can be information providers just as easy as information consumers.
- *Flexible.* Since the web is a bottom-up driven technology that can be derived from open standards, it enables anyone to develop add-ons, thus guaranteeing that both formats that are in use as well as types that not yet exist can be accessed and adapted to. In addition, according to Damsgaard and Scheepers (1999), web technology is a multi-purpose technology contrasting for example other IT-solutions such as a payroll system. Furthermore, Scott (1998), suggest that e.g. the open standards and the free-to-use software for both clients and servers make the intranet not just a flexible but also a relatively economical implementation.
- *Organizationally bound.* The intranet can be seen as a subset of the Internet and shares the above characteristics as we already have mentioned. However, one important characteristic that distinguish intranets from the Internet is that intranets are organizationally bounded and only accessible by users that are employed within their own organization. Seen from a knowledge management perspective is this factor of crucial importance due to the fact that it enables the organization to share information that is not intended for competitors more freely. In addition, users that

belong to the same organization also, to a higher degree, share the same company objectives as well as subscribe to the same set of values and beliefs (Stenmark 2003).

Above stated knowledge management backbones are generally complemented by other fundamental tools for repository and access management:

- Search engines of different varieties
- Document creation and management tools
- Automated tools for editing and trimming knowledge bases
- Tools for capturing and managing expert biographies

Today, repository and search technologies are already quite capable to handle structured textual information and knowledge. However, to be even more functional, future tools will have to be able to search and retrieve all kinds of information formats in one query, regardless if the information is summarized data, textual information or information that can be derived from audio or video sources. As said by Davenport and Völpe (2001) companies are already beginning to construct various Web-based portals that are able to provide access to multiple types of knowledge.

Search engines

A search engine generally composes of three parts. *Firstly* the spider which searches the Internet and gather sites, *secondly* the indexation function that searches and indexes the site content and *thirdly* a search module which searches the index. (Dalianis 2002)

- *Keyword based search.* The fundamental approach in operating keyword based search engines, when you use more than a single key word, is to use Boolean operators as AND, OR and NOT. Thus making the search exact, but not weighing the importance, only stating if the word exists in the document or not. Merely to state that words exists or not does not weigh, obviously, if the content is of relevance or not (Stolpe 2003). With the rapid growth of sites to index, you are obligated to be more exact in your search by using more elaborated search questions. Nevertheless,

users tend to use less than three words in their search, and if there are more than ten hits they only regard the first ten hits anyway as relevant, which illuminate a negative aspect in none content driven search engines (Spink and Xu 2000).

- *Catalog search.* Web catalogs are another approach towards searching the Internet/ intranets. They are mainly built upon a human categorizer which contains three main search steps. *Firstly* a manual navigation thru the website, *secondly* the extraction of important information that summarizes site contents, and *thirdly* a categorization of the website within the existing category structure. Thus making it possible to navigate to a specific topic and reducing amount of hits which makes gathered information possible to handle. (Stolpe 2003)
- *Semantic search.* Here the search engine is constructed to understand the meaning behind different words or phrases, since specific words and phrases can have various meanings depending on the overall context (Lervik 2003).
- *Peer-to-peer.* Peer-to-peer (P2P) search means that you by running specific software on each user's computer can obtain a list of available content to download. P2P search uses the Internet mainly as a transport mechanism. (Collier and Arnold 2003)
- *Content search.* A content search engine is based on Claude Shannon's information theory from 1949 which states that information could be stated as a quantifiable value in communications. Natural languages contain a high degree of redundancy. A conversation in a noisy room can be understood even when some of the words cannot be heard; the essence of a news article can be obtained by skimming over the text. The theory that the less frequently a unit of communication occurs, the more information it conveys. Therefore, ideas, which are rarer within the context of a communication, tend to be more indicative of its meaning. This enables the software to determine the most important concepts within a document. (www.autonomy.com)

Structured knowledge representation tools

Companies that intend to use knowledge in real-time as well for mission-critical applications, have to construct the knowledge base so it allows immediate and precise access. To search the Web, and get hundreds of documents as a result will not be sufficient when e.g. a customer awaits an answer over the telephone. Here, the usage of AI in the form of e.g. intelligent agents can be beneficial. AI can be applied to construct both *rule-based systems*, and more commonly, *case-based systems*. These systems are employed to capture and make customer service problem resolution, legal knowledge, new product development knowledge, and a variety of other types, accessible. Even though it can be complicated, labor-intensive, as well as costly to create a structured knowledge base, the undertaking can result in terms of more rapid responses to customers/ clients, a better cost to knowledge transaction ratio, and reduced requirements for expert personnel with extensive experience (Davenport and Völpel 2001).

Intelligent agents

The criteria of intelligent agents are that they should be intelligent, adaptive, and computational. Agents are *intelligent* if, in order to respond to a stimulus, they must engage in cognitive activity acting upon a body of information. One characteristic of cognitive activity is that it takes longer than programmed reflexes. Agents are *adaptive* if they change their behavior in response to changes in the flow of information. Agents are *computational* if they have the ability to do any of the following: acquire process, store, interpret, or communicate information and the connections among pieces of information. (Carley 2002)

In addition, an intelligent agent with a high level of functionality should be able to cluster topics and contexts automatically (www.autonomy.com).

There are various kinds of intelligent agents and they can be summarized in the following categories: (Steinke 1998)

- *User agents*. These operate on behalf of a human user and may act on a user's behalf without a direct user command. In this category we find agents that are supposed to learn the user's preferences and seek out additional information that may interest the user. The agent can also function as a classifier of the user thus enabling an

automatic linking to other users. In this category we also find concept agents whose purpose are to recognize whether a document contains a specific concept or not.

- *Broker agents.* Act as a directory service matching requests with resources without accessing the resources themselves. Broker agents may also be set up in networks where one broker agent directs a request to another more appropriate broker agent.
- *Ontology agents.* An ontology agent is an agreed upon concept of domain specific knowledge. Ontology agents allow agents to formulate meta-knowledge in a way that can be understood by other agents.
- *Task execution agents.* Task execution agents specialize in the execution of complex tasks which allows merging of results from multiple sources.

In our thesis we will put emphasis on user agents, as they can provide a tool for more effective combination of structured and unstructured information.

Knowledge management e-commerce tools

Until recently, knowledge management has mainly been focusing on internal issues inside companies. However, due to the increasing interest in electronic commerce globally, corporations are forced to require tools that are allowing them to distribute knowledge throughout the organization to private as well as to public networks (Davenport and Völpel 2001). The authors will however not proceed in any further discussions regarding these tools.

3.7 Information and communication technology (ICT) and its relation to knowledge management

The usage and role of information and communication technology (ICT) in knowledge management have caused considerable controversy among users and researches. On the one

hand, many authors on knowledge management see great opportunities and benefits from the usage of ICT in knowledge management (Hendriks 2001). Some of the advocating authors have stressed that information technology has acted as a catalyst for knowledge management, but they have also put emphasis on the fact that it “can not deliver knowledge management” (McDermott 1999) nor can make an organization more “knowledgeable” (Davenport and Prusak 1998) even though it clearly is being a part of knowledge management. The criticism of ICTs can mainly be derived from the fact that they restrain knowledge processes in organizations. According to the critics, usage of ICT can easily lead to the commodification and depersonalization of knowledge, in addition to promote an erroneous view of knowledge as objects that can exist independent of knowing objects (Tsoukas and Vladimirou 2000). Furthermore, the promoters of an ICT-driven knowledge management are blamed for emphasizing only the codifiable and explicit sides to knowledge, while overlooking the personalization and tacit sides (Tsoukas 1996).

The most frequently used argument given by the supporters of the ICT-friendly position refers to the claimed benefits of ICTs for knowledge processes. With the aim of identifying the impending role of ICT for knowledge management, numerous authors have constructed lists of what they believe to be relevant applications. For example, Ware and DeGoe (1998) brought up work flow tools for knowledge distribution, databases for knowledge storage, and search engines for knowledge interpretation etcetera. Laudon and Laudon (1997) included word processors for knowledge distribution, computer-aided design (CAD) systems for knowledge creation, as well as groupware and intranets for knowledge sharing. Furthermore, Ruggles (1997) mentioned mind mapping tools as means for knowledge creation and synthesis, and intranet-based forums for knowledge transfer. Davenport and Prusak (1998) mentioned the Internet as a knowledge repository as well as data and knowledge mining applications for knowledge discovery. All of these authors are convinced that ICT are able to support, enhance or, as asserted by some authors, even enable such processes as knowledge acquisition, knowledge transfer and distribution as well as knowledge storage and creation (Hendriks 2001).

The following figure presents a framework for knowledge management within an organization. The figure contains two comprehensive sides, the *reflection side* and the *action side*

of knowledge management. These sides contain, in turn, a number of elements. These elements/ dimensions are elaborated in five dimensions.

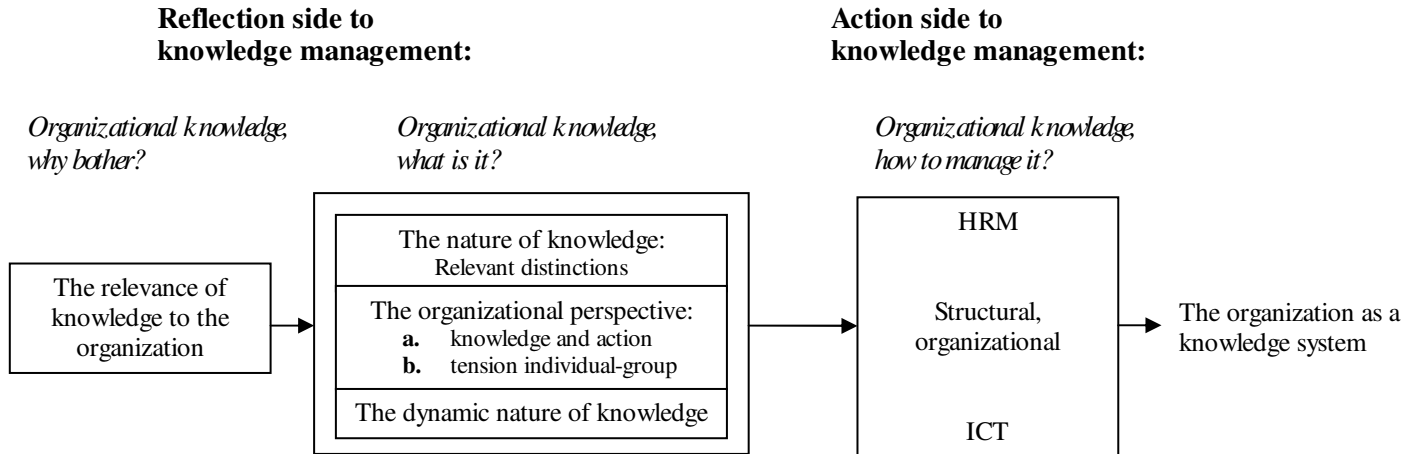


Figure 1 Framework for knowledge management (Hendriks 2001).

Five dimensions for linking ICT to knowledge management

Hendriks (2001) have established five dimensions for relating ICT to knowledge management.

- Dimension 1: Relationships between ICT and knowledge management strategy, and position of ICT in overall knowledge management policy
- Dimension 2: Relationships between ICT and all aspects of knowledge that are related to relevant distinctions and definitions of knowledge
- Dimension 3: Relationships between ICT and organizational perspective on knowledge:
 - a. relationships between ICT and action side of knowledge
 - b. relationships between ICT and individual/ group work
- Dimension 4: Relationships between ICT and various dynamic characters of knowledge, e.g. knowledge processes and flows
- Dimension 5: Relationships between ICT and other knowledge management measures (HRM, organizational)

Figure 2 Five dimensions for linking ICT to knowledge management (Hendriks 2001).

These five dimensions are revealed when a closer examination of the model of knowledge management that was presented in figure 2 is conducted. According to Hendriks (2001) are above dimensions essential when assessing the potential value of ICT applications for knowledge management. We will first give a short introduction to the five dimensions, before we penetrate each dimension more profoundly.

The first dimension discusses how to position ICT tools in a way that is in line with the overall knowledge management strategy and knowledge management policy. This first dimension can be seen as a general backbone of the dimensions, and it sets the criteria of the other four dimensions. Discussion of the concept of organizational knowledge stipulates that ICT should be linked to knowledge (dimension 2) as an action-related, institutional or group resource (dimension 3) characterized by its dynamic nature (dimension 4). The fifth and last dimension concerns the position of ICT as a device for knowledge management and the relationship between ICT and other knowledge management measures.

As said by Hendriks (2001) any approach aimed at establishing the value of ICT will have to establish a way of dealing with these dimensions individually as well as set. All of these dimensions cover a number of questions that address the problems and challenges in the relationship between ICT and knowledge management. Each of the five dimensions will now be addressed in a more detailed way.

3.8 Elaborating the dimensions

Dimension 1: Relationships between ICT and organizational relevance of knowledge

Clearly, knowledge is not relevant for an organization per se, but becomes relevant whenever an organization recognizes its relevance. According to Hendriks (2001), the vision, mission, and competitive strategy of the organization, when translated into a knowledge management policy, should provide the conditions for assessing the organizational relevance of knowledge. Simultaneously, the organization's self-perception of its organizational knowledge could influence how it constructs the mental models of its vision, mission, as well

as strategies. To be able to assess the role of ICT in knowledge management, its relationship with these issues regarding the organizational importance of knowledge ought to be established. Obviously the question to be asked then is how ICT relates to the knowledge management strategy that is adopted by the organization. Earlier in this master thesis, we introduced Hansen et al. (1999) and their division of different knowledge management strategies into two different categories, codification and personalization. ICT, according to Hansen et al. (1999), are more compatible with a knowledge management strategy aimed at codification, i.e. storing structured knowledge for the purpose of reusability. The suggestion by Hansen et al. (1999) that the opinion of ICT as a knowledge management tool will vary according to the suitable knowledge management strategy is much likely to be endorsable. Nevertheless, some reservation might be appropriate as to the completeness and general applicability of their elaboration of the concept. This reservation can partly be derived to the arbitrary contribution of structured information within the codification knowledge management strategy.

According to Hendriks (2001), two questions are appropriate for the evaluation of ICT and related systems as knowledge management means at both strategic and policy levels.

- Firstly, which perception of a knowledge management strategy is appropriate in the context of an organization?
- Secondly, how are ICT systems applicable in this strategy?

An example of how the choice of ICT strategy depends upon the recognition of the organizational relevance is presented here. Consider a management consulting firm that is aiming to sell its solutions it has provided to one customer to many other customers. This firm believes that the knowledge it sells has generic qualities that are applicable for one particular customer's situation. To avoid reinventing the wheel every single time, such an organization might consider capturing these generic qualities in knowledge repositories (Hansen et al. 1999). On the contrary, a firm that aims to sell unique and exclusive solutions would regard knowledge repositories to be more or less useless. Instead, such a company is more likely to use ICT for facilitating employees finding each other, e.g. via electronic yellow pages, expertise data bases (Skillsbank), curricula vitae, etcetera (Hansen et al. 1999). Hansen

et al. (1999) as well as Hendriks (2001) emphasize the importance of choosing the right knowledge management strategy. Hendriks (2001) also accentuate that it might be even worse to completely disregard of a knowledge management strategy, because this could indicate that a concrete basis for connecting ICT to knowledge management is lacking.

Dimension 2: Relationships between ICT and knowledge categories

When examining the relationship between ICT and knowledge categories it is important to be attentive to the differences between data, information, and knowledge.⁴ These differences influence the way ICT affects knowledge. ICT which facilitates the dispatch of data as well as information does not therefore influence knowledge in a direct and complete sense. At best it can affect how characteristics or elements of knowledge are receiving attention. This is also the case when discussing intelligent, knowledge-based systems (Hendriks 2001). Even though these intelligent systems have higher information content than more conventional information systems, they also depend on their users for transforming data and information into knowledge.

Finding a characterization of knowledge that is both rich and functional for identifying the starting points for relating it with ICT have proven to be challenging. One common approach to dealing with this challenge involves the opinion that knowledge consist of both a tacit as well as an explicit side.⁵ According to Junnarkar and Brown (1997) the relevance of tacit knowledge for the creation of knowledge provides the basis for both the value and the limitations of ICT as a knowledge management tool. This is due to the fact that all ICT seems to assume the articulation of knowledge. Besides the tacit and explicit sides of knowledge that we already have introduced, Hendriks (2001) also introduces two alternative distinctions that he considers to be of equal importance. One of these distinctions is concerning *generic* and *situated* knowledge. This distinction is based upon the fact that knowledge engages applications of generic rules within a specific situation. A related distinction is the distinction between *mimeomorphic* and *polymorphic* knowledge and actions (Collins and Kusch 1998). As said by Collins and Kusch (1998) mimeomorphic actions are

⁴ These differences are discussed in chapter 3.1.

⁵ Tacit and explicit knowledge are discussed in chapter 3.2.

those that can be limited to a set of rules (e.g. swinging a golf club is a mimeomorphic action). The opposite, polymorphic, actions demand an understanding of their environment to be valued (e.g. understanding jokes is a polymorphic knowledge, as it depends on the contextual culture to be understood and appreciated – culture is clearly a relevant contextual factor for understanding a joke). Hendriks (2001) suggests that most ICT applications are focusing on the generic/ mimeomorphic aspects at the expense of aspects related to situated/ polymorphic knowledge.

Dimension 3: Relationships between ICT and the organizational perspective on knowledge

Questions relating to the relationship between the use of ICT and organizational actions that are the result from knowledge are critical to knowledge management. According to Hendriks (2001) does this mean that recognizing the value of an organization's knowledge management is not about changes that are brought about in the cognitive capacities of the organization but rather the organization's ability to act based on its cognitive capacity. Distributing knowledge throughout an organization via e.g. an intranet is obviously not relevant as such, but will only become relevant and valuable if it facilitates people to bring about new innovative ideas that are in turn translated into operations or if it lead to the rewarding reapplication of existing knowledge that are stored in some sort of repository. I.e. ICT for knowledge distribution is relevant for knowledge management only if the ICT supported distribution of knowledge leads to action. However, implementing ICT that are supposed to enhance the knowledge base and/ or knowledge processes of the organization does not by default lead to improved knowledge-based proceedings. Actually, according to Davenport and Prusak (1998) introducing an ICT-component might lead to what they called "deknowledging." This deknowledging can be derived to the fact that ICT generally emphasizes the information part. As said by Davenport and Prusak (1998), deknowledging might occur e.g. when such an amount of data and information is stored in a knowledge repository that it becomes nearly impossible to make sense of the contents of the repository. This repository will then develop into another passive storage medium that will add very limited value to the knowledge base of the organization due to the absence of any linkage to

organizationally relevant actions. Clearly, it is important to raise questions that address the actions the introduction of ICT will affect and in what way they are affected.

Another aspect of organizational knowledge is the group aspect. The group aspect refers to the question whether the individuals or the organization foremost will benefit from the knowledge management interventions. The group concept is to be seen in a broad sense, i.e. not only referring to institutionalized teams, but to any system of which individuals are a part, such as communities of practice etcetera. The positioning of ICT will accordingly be affected by the possible tension between individual aspirations of knowledge workers and the shared objective of the whole organization. Hendriks (2001) have furthermore made a division within the group aspect. Two elements define the group characteristic of organizational knowledge: partly the group as a passive entity and partly the group in an active sense. The group as a passive entity is represented by the concept of organizational memory⁶ (Stein and Zwass 1995). ICT-applications that are commonly mentioned as tools for organizational memory are knowledge repositories with their associated browsing, search and retrieval possibilities (Hendriks 2001). The group in an active sense is on the contrary represented by concepts such as communities of practice, knowledge communities, and knowledge teams (Wenger 1998). Here, Intranets and groupware are typical applications that are considered being useable ICT-applications. However, regardless which group aspect that are considered, the challenge lies in assessing whether the knowledgeability of the group or organizational function is positively affected by the implementation of the applications or not.

Dimension 4: Relationships between ICT and the dynamic character of knowledge

As already mentioned, one of the most widely spread reasons for linking ICT with knowledge management involve their claimed beneficial advantages for knowledge processes. A selection of such knowledge processes is presented in table 2. This selection of processes can be seen as stepping-stones for relating ICT to knowledge management. In

⁶ See chapter 3.3 for more information regarding for example organizational memory.

chapter 3.3 a profound distinction between viewing knowledge management from a control or a process perspective was introduced.

Table 2 Examples of knowledge process approaches (Hendriks 2001).

Authors	Knowledge processes as stepping-stones for valuing ICT as knowledge management tools
Laudon and Laudon (1997)	Knowledge capture and codification, knowledge sharing, knowledge distribution and knowledge creation
Ruggles (1997)	Knowledge generation, knowledge codification, and knowledge transfer
Davenport and Prusak (1998)	Knowledge capture, knowledge storage, and knowledge transfer
Balasubramanian et al. (1999)	Capture, transform, disseminate, classify, discover and maintain

Even though many of above different approaches to processes are similar, such a distinction leads to the question of which approach is the most appropriate in a certain individual situation. Another question arises when a particular process perspective has been adopted, and it is how a satisfactory perception of the role of ICT is reached. Hence it is important to pay attention not only to possible gains from a particular ICT but also for potential drawbacks. Cohen (1998) exemplifies this when introducing the “killer-app” of knowledge management, the intranet. The intranet is highly praised as a tool/ instrument for knowledge sharing because the intranet facilitates the location of other employees that either might acquire or provide relevant knowledge. Electronic yellow pages, automated knowledge maps and expertise skill banks are a selection of applications that via the intranet connect people. However, in order to assess whether an intranet helps to connect people or not, a more profound understanding of the process of knowledge sharing is necessary. The intranet and its organizational role are linked to removing barriers and to enhance and facilitate knowledge sharing behavior. Within knowledge sharing also more fundamental issues can be identified, e.g. as to what degree people are able and willing to share their knowledge with others as well as to absorb knowledge from others. Clearly, concepts such as trust, motivation etcetera and the intranet’s relation with these concepts are important. According to Davenport and Prusak (1998) an intranet and the knowledge map it contains, actually might create distrust between organizational individuals or departments. If this is the case, the intranet will disconnect people instead of connect them, and will therefore not enhance

knowledge sharing but limit it. The intranet as the killer-app of knowledge management suddenly takes a cynical new meaning.

Even though the various perspectives on knowledge processes and the respective role of ICT introduce many relevant issues, questions, and answers, they do not completely cover the fourth dimension. According to Hendriks (2001) it is important to be attentive to two additional sets of questions. *Firstly*, the improvement of individual processes might lead to the opposite development for the overall organizational chain of processes, i.e. the latter deteriorate. *Secondly*, the process perspective⁷ on knowledge does not completely cover the quality of knowledge as a dynamic resource.

Gill (1995) presents an example of how a too strong reliance on ICT for optimizing their operations can affect companies negatively. These two organizations lost their fundamental capacity to change along with changes in the competitive environment. When replacing knowledge functions with ICT, they also lost the underlying business models of both the knowledge processes and the ICT support for them. According to Gill (1995), if too much effort is put into retrieving and retaining knowledge “as it is”, knowledge transforms into a static and passive asset instead of being an active ditto.

Dimension 5: Relationships between ICT and other knowledge management measures

The relationship between ICT-tools and knowledge has an inherent problem, a problem that is caused by the fact that these tools primarily are constructed to address data and information, not knowledge. There are, however, knowledge management measures that more truly are knowledge management measures, such as Human Resource Management⁸ (HRM) (Hendriks 2001). ICT should rather be seen as a tool that complements and enhances other knowledge management measures.

⁷ See the comparisons between the different perspectives on knowledge in chapter 3.2.

⁸ For the definition of HRM see the glossary.

Relevant questions to be raised are as follows:

- How can ICT help and enhance other knowledge management measures?
- Are there any other knowledge management measures that are needed in order to give ICT a knowledge management profile?
- Does the installation of ICT conflict with other knowledge management initiatives that are already operational?

However, according to Junnarkar and Brown (1997) are above raised examples of pertinent questions rarely or never asked. Furthermore, Junnarkar and Brown (1997) accentuate that, to reach a high level of usability and effectiveness in knowledge management, a symbiosis between people, information, and information technology is necessary. Other authors that have put emphasize on this matter are for instance Davenport and Prusak (1998). They stressed that technologies alone will not result in an improved management of knowledge in an organization. Nevertheless, many authors have neglected the relationship between knowledge management measures and ICT, and chosen to point out the generic conditions for ICT to become successful, or to point out additional measures to be taken that not directly can be related to knowledge management. As said by Hendriks (2001) the assessment of ICT as a tool for knowledge management requires that an effort to localize various links to other management measures is made. Do some measures presuppose others? Or, can some measures support each other? Finally, maybe some measures actually counteract others? If such an effort is not made, the probable perspective from which the ICT-applications are addressed is an information management perspective and not a knowledge management perspective.

As an example, for an intranet, “the killer-app of knowledge management,” to become effective is depending, partly, on the competencies amongst the individuals for expressing their knowledge and understanding what others say or show. These individual competencies are greatly dependent on the way labor is allocated within the organization. Obviously, employees that work in an organization that is team-based face a completely different situation than people that mainly share knowledge through the desk of their manager. Thus, the benefits for the latter type of organization are somewhat limited due to job-related

restrictions in the abilities to communicate knowledge. On the contrary, team-based organizations can achieve great benefits when using an intranet. However, the question for team-based organization is whether they need an intranet for knowledge sharing within each team or whether they need an intranet for sharing between different teams or perhaps both. Issues such as trust, motivation, sharable content etcetera, are therefore likely to mean different things in the two situations. Consequently, intranets as knowledge sharing mediums are depending on the way knowledge work is arranged. Additionally, to truly make an intranet effective, a wide spectrum of measures might be necessary, such as motivational measures and reward systems for sharing knowledge. Due to Hendriks (2001), these additional measures will help to determine whether the implemented intranet facilitates knowledge sharing and not just the transportation of information through the organization.

The presentation of the five ICT-dimensions will sum up the theoretical framework of the thesis. In addition, the five ICT-dimensions accentuate and concretize the presented theory; these dimensions will also form the analytical base, upon which the analytical conclusion drawn from the empirical framework and research will made.

In the following chapter, relevant information regarding Oracle and its functions will be presented. The chapter is accordingly named empirical framework, and gives the authors as well as the readers of the thesis the fundamental knowledge in order to fully comprehend the research results as well as the analysis, and consequently the design proposals.

4 EMPIRICAL FRAMEWORK

The following chapter gives the reader the necessary background information to fully understand the results of the survey, as well as a presentation of Oracle and the EMEA Support organization. Furthermore, the support process and the functions, which were in effect until December of 2003, of the support process are described.

4.1 General presentation of Oracle

Oracle was founded in 1977 by Larry J. Ellison with the vision to provide relational databases to organizations, something that was not commercialized by any other company. They were also the first company to develop a completely Internet enabled enterprise, as well as various support decision tools. Today Oracle is the world's leading information management software supplier and the world's second largest independent software company with more than 42 000 employees 2003, of them 6 600 were employed within Oracle Support. (www.oracle.com).

Business areas

The primary products of Oracle today are Databases, E-business platforms, Applications servers, Development tools, and Business intelligence. The corporation is furthermore divided into five business areas: Development, Sales, Consulting, Education and Support. These are in turn placed in four different geographical areas: The US (North and South America), EMEA (Europe, Middle East, and Africa), APAC (Asia, and the Pacific) and Japan. In 2001, license fees accounted for 43 percent of its revenues, i.e. the lion's share; support agreements accounted for 33 percent, while consulting services and education accounted for 20 percent and 4 percent, respectively. An interesting fact is that even though Oracle Support only contributes with 16 percent of the total number of employees it generates 33 percent of the total revenues. Since the thesis is focusing on the support organization, this department is presented in the following piece, 4.2.

4.2 Support organization

The support provides customers with a wide range of support services that include on-site support, telephone or internet access to support personnel, as well as software updates, e.g. patches for different errors, so called bugs. The support is also divided geographically into the US, EMEA, APAC, and Japan. The support segment of EMEA is the segment that this thesis is focusing on. Therefore a more thorough presentation of how the EMEA support is divided into various support segments is introduced in the figure below. The two main segments, Systems and Applications, are in turn divided into five sub segments: Data Server, Application Server and Development Tools, Financials, Manufacturing, and CRM. Since we focus on the Systems area within the EMEA Support, we have chosen to only list those underlying field areas.

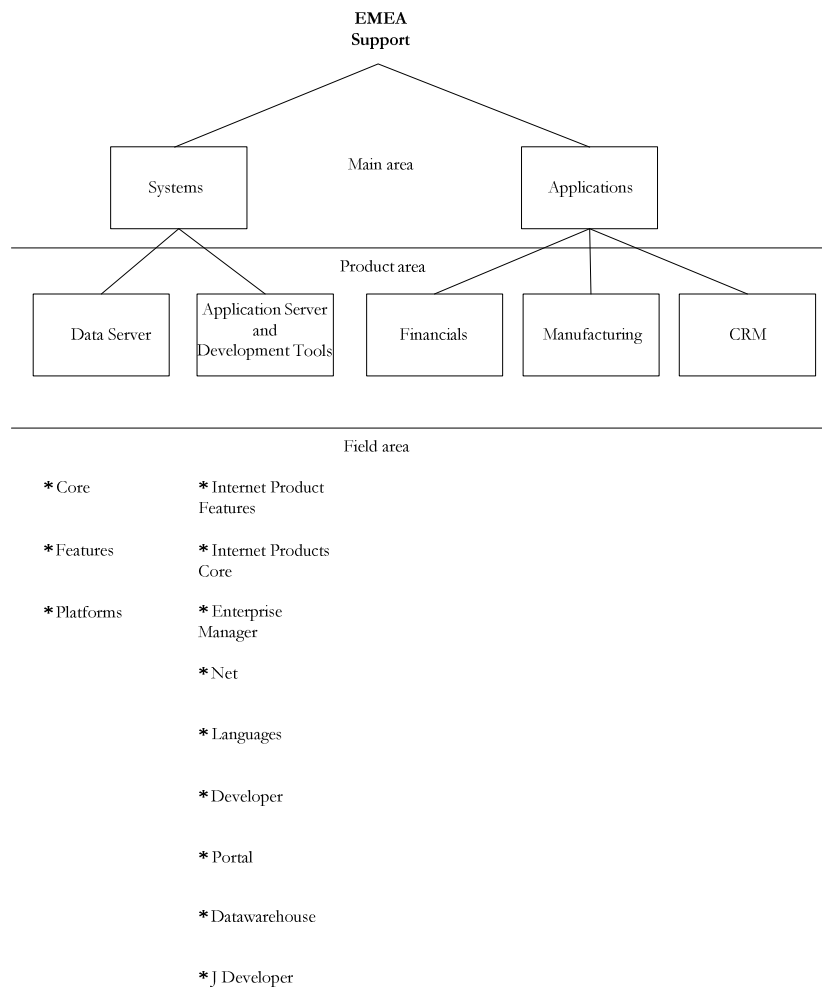


Figure 3 EMEA Support specific fields.

The role of the support staff

Every employee in the support organization is supposed to divide the amount of time and effort that is put into his work into three different categories. *Firstly*, problem solving, i.e. solving incoming SRs (Service Request). *Secondly*, knowledge contribution, i.e. updating knowledge management tools and systems. And *thirdly*, education, keeping his or hers competence and skills up-to-date.

4.3 The EMEA support process

In the following informative text and figure, the authors describe the process of handling support errands at EMEA. All the tools that are introduced are presented in a more profound way in the glossary that can be found in appendix I. Furthermore, the functions regarding the EMEA support process (Triage, Config/ Usage, Defect, and SCI) will be further described in the functions chapter. The information that this description is derived from and based on is obtained from the support manual of Oracle Support.

Description of a support errand

The customer has a problem which he can seek assistance for either via OTN (Oracle Technology Network)⁹ or Metalink.¹⁰ OTN is an open website. This site is free of charge and contains technical information that is shared between customers and Oracle employees. However, as a customer with a specific problem you can not be certain that you will get assistance due to the fact that the site is monitored on voluntary basis. OTN can work as a free support for those clients that lack a valid support contract with Oracle, however no analyst will be appointed directly to his problem.

⁹ It is a site that is free of charge and which contains technical information shared between customers and Oracle's employees.

¹⁰ Connected with WEBIV functions as an incoming and outgoing interface towards the customer. In addition it is a technical forum with both keyword and catalog search.

If the problem arrives via Metalink, a SR is created in Internal Tracking System (ITS)¹¹ and after a rough sorting via the Skillsbank¹² it is handled by Triage. A task can reach Metalink either by the customer directly or via a dispatcher if the customer phones in the problem. To ensure customer focus, Standard product Support Country Interface (SCI) monitors specific customer's SRs via Queue Monitor (Qmon),¹³ thus being able to have an overview regarding that specific customer's all errands.

If Triage can not solve the problem with the help of WEBIV¹⁴ or other knowledge management tools, the SR is handed over to Config/ Usage via a more fine-tuned sorting by the Skillsbank. Config/ Usage creates a document in WEBIV. The case in ITS is matched with the document that is created in WEBIV and suggestions to problem solving solutions are brought to the customer via Metalink. If the solution solves the problem and the customer reports back, the WEBIV document can be reviewed, published, and made available to other customers. If a problem can be derived to an error in the product itself, it is handed over to Defect which handles Bugs (i.e. errors in the products). Defect is responsible for updating the Bug Data Base (BDB).¹⁵ Defect also functions as an interface towards Research and Development (R&D) who handles the OTN. This is the case despite the fact that R & D is not an actual part of the support organization.

¹¹ The actual work system where the analyst handles specific errands.

¹² Assess skills of all analysts in order to be able to allocate SRs depending on availability and workload

¹³ A system where specific customers and their errands are searchable. It is mainly used by the SCI function of Oracle Support.

¹⁴ It is Oracle Support's primary knowledge management system. It is a knowledge repository where solved support tasks and bugs are stored. WEBIV is searchable through keywords and catalogs.

¹⁵ A database where solved bugs are stored. The BDB is connected with WEBIV.

Oracle Support – Can it be made more intelligent?

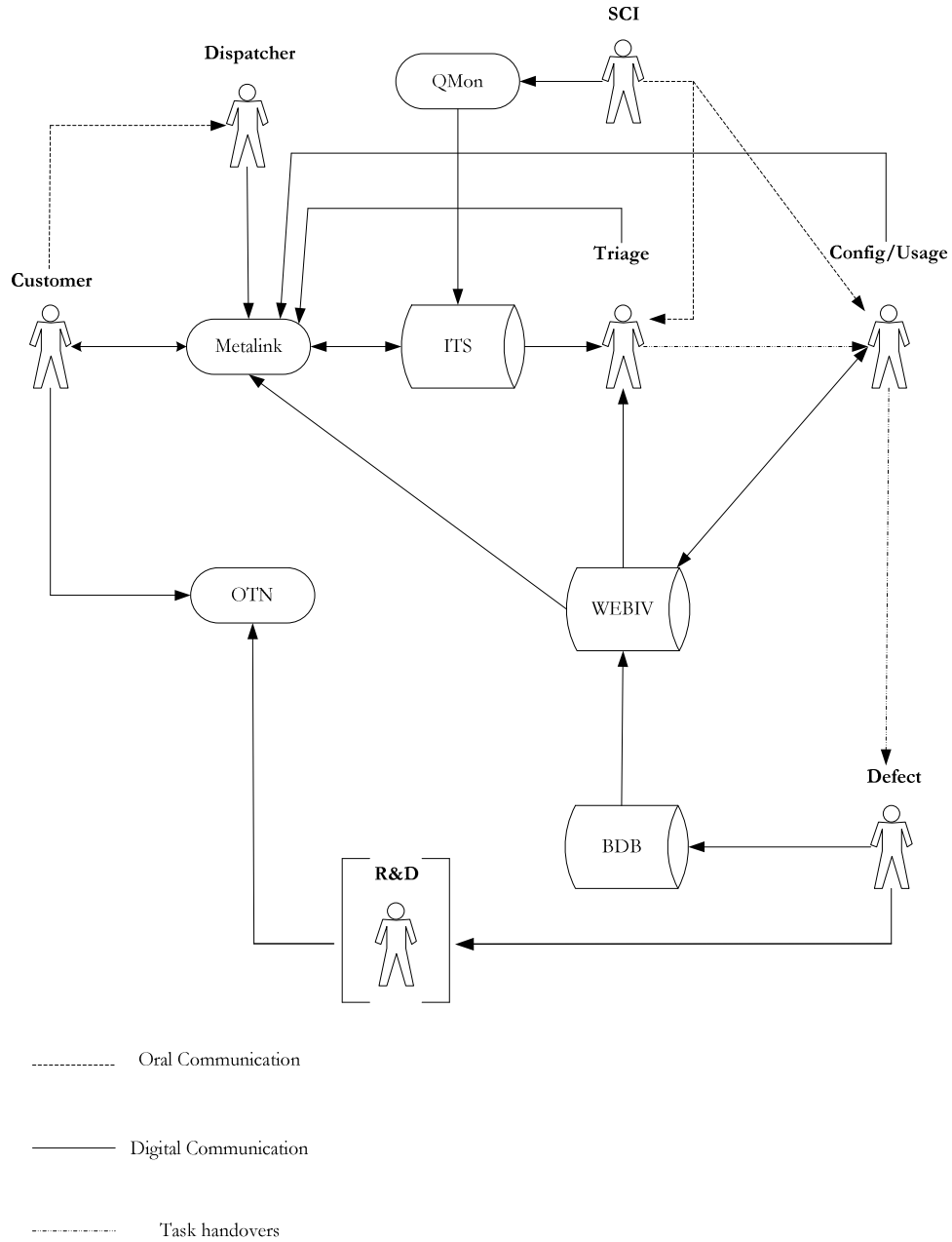


Figure 4 The EMEA support process.

4.4 Functions

In this section we aim to describe the various functions in the Oracle Support Process for EMEA as they are described in their manuals. Beside the functions that are described in the manuals at the Oracle Support, we will also present the Standard product Support Country Interface (SCI), which is not yet described in the support manual due to its recent implementation. When the work with the thesis began, the Triage function was still in use. However, as already stated, the Triage function is now terminated, but the type of errands that the Triage used to handle still exists. Thereby making it interesting to describe the process.

Triage

The first person that comes in contact with an SR is an analyst that is employed within Triage. Triage is groups of country based generalists whose task is to make sure that the SR is complete and all relevant information is gathered. The analyst in Triage contacts the customer if further information is needed. The analyst in Triage foremost uses WEBIV for further search when trying to match the customer's problem with an existing solution. Triage handles a SR from four hours to four days; the latter is a case that requires a new solution. However, the average time that SR stays within Triage is two days. If personnel in Triage can not solve the problem the SR is handed over to experts at Config/ Usage. Before the SR is sent to Config/ Usage, where it pops up on the targeted specialist's ITS list, the analyst in Triage should have gathered all relevant facts, facts as version number, technical name of affected files, and so forth. In addition the analysts agree on a level of severity together with the customer. Before handing the case over to Config/ Usage the following questions need to be answered:

- What does the customer experience exactly?
- When did the problem occur first? What has been changed before?
- Why did the problem occur (first shot)?
- Who is the right contact to investigate further?

Triage should use On Demand Connection (ODC) to let the customer explain the problem to the analyst, thus trying to locate the root cause of the issue.

Triage can also be used to assist Config/ Usage when translations are needed in conversation with the customer; this is due to the fact that Triage is country based.

Config/ Usage

Config/ Usage is based upon the five sub segments that were introduced in the figure 4. Since the Config/ Usage segment is divided into product fields within EMEA, the segment is not based on a division between specific countries as Triage is. In each product area the staffs are divided by expertise in specific fields that were described in the same figure.

Config/ Usage also uses WEBIV as a knowledge management tool when searching for possible solutions. But as the SR already has been screened by Triage, they have to create a new solution in most of the cases. When the analyst in Config/ Usage has a problem that requires a new solution he is supposed to create a new document in WEBIV. It is possible for the analyst merely to work with the case in ITS but then no knowledge sharing is conducted with coworkers and customers. The analyst links his solution to the document in WEBIV which thereafter is available for the customer via Metalink. If the suggestion solves the problem the customer is expected to report back so the document can be published in WEBIV and thus be available to other customers via Metalink. The problem can also be a bug in the system, then the case is assigned to Defect and registered in the Bug Database. Search for bug cases are also made through WEBIV. Customers can see bug cases via Metalink, though only if they are published. The second task that an analyst in Oracle support has at Config/ Usage, besides the solution centered support, is to create more extensive articles, called Bulletins. Bulletins are handled in Problem Avoidance Architecture (PAA), which is available via WEBIV. In PAA you include *Content work* and *Analyses*. Content Work is used to create articles, review other articles, publish articles, and to maintain the structure of articles. With Analyses you search the ITS for incoming SRs concerning a specific product and see what could have prevented these SRs from arriving.

Defect

Before a SR is handed over to Defect, the analyst in Triage or Config/ Usage must ensure that the problem requires skills that only are available in the Defect function. The engineers at Defect will provide assistance on escalated and critical issues as well as take ownership of SRs (i.e. changing the function to Defect), where this is agreed to be the best way to expedite the resolution. However, ownership of the SR will not automatically change. This will only happen when the skills required or customer impact dictates that the SR should be transferred. Generally, a test case (either internal or on the customer's site) is required before engaging the Defect function on an SR. The following bulletin list summarizes the roll of the Defect function.

- To handle product defect related activity
- To handle SR related activity
- The Defect function handles both SRs and product defects
- Typical situations where an SR may become a Defect function handled SR:
 - Cases where ALL research and resources have been exhausted and more expertise is needed
 - Highly escalated or complex issues
 - There is a documented test case

SCI

SCI (standard product Support Country Interface) is a new function that has been implemented as a response to the reorganization that occurred when Triage was launched. In the wake of reorganization, customers' problems could be handled without having the customers' best in focus. For instance a customer can file seventeen different support tasks which in turn are handled by seventeen different analysts in seventeen different areas without anyone of them having an overview. This obviously, on occasion, influences the customers' satisfaction negatively. A analyst in SCI has the task of being a "controller" whose function it is to ensure that errands do not escalate unnecessary thus maintaining an overview perspective regarding specific customers and their support tasks.

The information that has been presented in this chapter, the empirical framework, has been gathered from written digital sources that are supplied by Oracle. The sources are mainly company internal manuals, as we previously have stated, but also information from the company's web site has been used. The information from the empirical frameworks will be complemented by information that has been gathered from the employees of the support department via qualitative interviews. The interviews and the results thereof will be presented in the following research chapter.

5 RESEARCH

In this chapter we are initially introducing the questions that the research is based upon. Further, the results that were received through the interviews are also presented. The answers from the interviews are treated anonymously and grouped together under appropriate headlines. The answers are furthermore divided on the basis of two of the functions of the support organization, Triage and Config Usage.

Based on the ethnographical study that was conducted at Oracle in October 2003, four in-depth interviews were carried out in November 2003 with the support staff at the Oracle Support Office in Gothenburg. The ethnographical study provided the topics that were significant to investigate in order to illuminate the main problems of the thesis. Furthermore, the ethnographical study made it possible for the authors to recognize the tools of the knowledge management and task processes, as well as how these tools were used when the study were conducted. Additionally, the study made the authors aware of what type of questions that could be of importance to put emphasis on for the following interviews. The interview guidelines (in Swedish and in English) are in appendices II and III.

5.1 The interviews

Introductory questions

Initially, all interviewees were asked to state in which function they were employed within Oracle Support, as well as their main technical field. Additionally they were asked to provide the authors with their formal job title and for how long they have been employed within Oracle. These initial questions made it possible for the authors to categorize each individual employee under the correct function of the Oracle Support organization, thus making it possible to observe if, and how in that case, different functions use the different tools and systems in the task process. Furthermore, the personal information that these introductory questions provided facilitated the analytical process due to, for example, the possibility that

persons that if they have similar background (years employed, function, etcetera) act in similar ways. Consequently, conclusions that are made out of these observations are given a higher level of significance.

Tools

The following type of questions that were asked should be considered to be work-tool specific. Initially, the interviewee was asked to state all the available tools (knowledge management tools, tools for task execution and so forth) he or she was aware of in order to be able to do their work in an efficient way. In the follow-up question, the interviewed analyst answered how they used the different tools respectively. They were then asked if they were able to rank the tools mutually. Finally, they were asked why they did not use certain tools. The primary reason why the authors put forward the above type of questions was that information regarding the knowledge, usage, and attitude towards the various tools is essential when a further analysis is to be conducted.

Knowledge contribution

In this category of questions, the interviewees were asked to describe if they contributed with new knowledge to the tools that they were using. If they answered affirmatively, the follow-up question concerned in what way, which tools, and how frequent. On the contrary, if the interviewee answered negatively, they were asked to explain why they did not contribute with knowledge. The reason why we put some of our focus on issues that can be derived from this area, is that the support manual require for example up-dated knowledge management repositories, and the tools in general demand to be up to date, and must be considered to contain relevant information if they ought to be used at all.

Design proposals from the employees

In this final category of questions, the reader will be introduced to the employees' own suggestions in how to improve work tools and relevant systems in order to enhance the possibility of a better performance in for example the handling of SRs. The suggestions that

come from the analysts, i.e. the ones that use the tools and systems daily, provide the authors with crucial information when constructing the authors' own design proposals.

5.2 Research results

When presenting the answers we gained from the interviews conducted, we divided the answers into two main groups that can be derived from the functions at Oracle Support; Triage and Config/ Usage, as there were no analysts that represented Defect that were employed within the Gothenburg office, no such interview was conducted. The foremost reason for dividing the answers into two main groups was that the answers received were strongly influenced by which function the interviewee where employed within. The results of the study will be presented both in written form as well as in graphical forms via figures that illustrates the answers.

5.3 Results received from analysts at Triage

Introductory questions

The three interviewees from Triage were working within three different work fields; Applications, Databases, and Portals. All of the employees that were interviewed from Triage had an extensive work experience, which ranged between four to six years of employment. Furthermore, the analysts within Triage had similar educational background with some form of degree in computer science. Additionally, all of the interviewees had been employed within other technical organizations prior to the employment at Oracle.

Tools

When asking for the tools that exist with the aim to facilitate the handling of SRs, the interviewees were aware of all the tools that were presented in the introduction of tools with one exception. One analyst at Triage was not familiar with the Global Workbench.¹⁶

WEBIV

Almost all of the respondents regard WEBIV as the most important and frequently used knowledge management tool when handling SRs. However, one of the analysts used the customer interface Metalink when searching for possible solutions for SRs. When searching for solutions or prior SRs in WEBIV, the analysts used keyword search. Their search techniques varied however. Some used a wide-to-narrow approach when searching, i.e. starting out with just a few relevant keywords and then narrowing it down by using additional keywords until they find what they were looking for, if possible. On the contrary, others started out with a very specific search and then widened the search by excluding keywords.

TARSearch¹⁷

Even though TARSearch (Technical Assistant Request) was not the highest ranked tool, TARSearch was also used by all respondents as an important knowledge management tool to facilitate the handling of SRs. Common for the usage of all the respondents was that TARSearch was used to find existing SRs. As in WEBIV, the search function in TARSearch is also based on Boolean keyword search. Consequently, the search techniques for finding existing SRs were similar to those that were used to search through the knowledge repository, WEBIV. TARSearch was used on a regular basis during the SR handling process.

Construction of test cases

One of the interviewees still constructed test cases when handling SRs. According to the analyst that used this form of tool, a test case was a very useful mean to see the problem from the customer's point of view, i.e. being able to understand the customer's situation

¹⁶ A portal with discussion forums, calendars, shortcuts to WEBIV, manuals (e.g. the support manual), etcetera.

¹⁷ Interface that is used to search the ITS. TAR is the former name of SR. The search function of TARSearch is based on keyword search.

better. However, to use test cases when handling SRs is not a general practice at Triage and is accordingly not mentioned in the support manual. It is rather a remnant from his former work position, prior to the implementation of Triage, where he actually solved SRs. In his current position as a Triage analyst he does not use test cases as frequently as before, but foremost when the SR is within his own field of competence. Additionally, using test cases when handling SRs is not applicable for all support areas. For example, when handling SRs that can be derived from problems with a portal, the Triage analyst does not need to construct a test case since the customer's environment is already available to him or her.

*Mailing list*¹⁸

To use mailing lists when handling SRs is seldom used by the analysts at Triage. This is mainly due to the fact that the key purpose of the Triage is not to solve SRs by constructing new solutions, but rather to find already present solutions that can be used. Furthermore, when the respondents on occasion use a mailing list in the task of handling SRs they do neither expect to get any immediate nor relevant answers. Hence, the usage and usability of mailing lists is somewhat limited.

External sources

External sources of information and knowledge such as Google, is not used on a regular basis by the analysts at Triage. The primary reason for this is the same reason that limited the usage of mailing lists in the handling of SRs, the focal point of the analysts at Triage is not to solve problems by constructing new solutions, but to reuse existing dittos. However if an analyst, on occasion, chooses to use for example Google, it is because it is within his own field of competence and/ or interest.

OTN (Oracle Technical Network)

None of the respondents at Triage used OTN at all. The reasons for not using this knowledge management tool varied. According to one of the analysts, OTN is primarily emphasizing on Systems, and is therefore not of particular interest for all analysts, e.g. if they are focusing on other fields of interests. Furthermore, as said by another analyst, when

¹⁸ Newsletters where analysts are participating in various groups based on specific fields of interests. It is used to send solution suggestions and to ask for aid regarding task solutions.

explaining why he did not use OTN, was that WEBIV already contained all relevant SR information. A third analyst pointed out that the search function was substandard, and even though the OTN could contain substantial and usable information, it was hard to find.

Global Workbench

Global Workbench is another tool that none of the respondents used. In addition, one of the analysts was not even aware of its existence. The interviewees that were aware of the Global Workbench considered the tool to add little or no value. The respondents do not see the Global Workbench as a tool for facilitating the handling of SRs, but rather as an amalgamation of clickable links to already existing tools. In addition, they believe that the interface is confusing and the windows are too small for convenient use.

Knowledge contribution

In general, none of the analysts that were interviewed at Triage contributed with knowledge to the systems, i.e. knowledge up-dating. One of the respondents, however, contributed with knowledge on occasion when answering questions that were put forward in a mailing list that was within his field of expertise. However, none of the interviewees believed that knowledge contribution to knowledge management systems and tools were in line with their job assignment. When the follow-up question was put forward, i.e. why they did not update the systems, they answered that due to the fact that they are trying to solve the customers' problems by using already created solutions, they do not contribute with any new knowledge that is important to store and transfer. In addition, due to heavy workloads, updating the knowledge management systems is given a low priority.

Design proposals from the employees

The interviewed analysts at Triage have contributed with several suggestions and thoughts that they believe will facilitate their management of knowledge in general and the handling of SRs in particular. A common suggestion that was put forward by all the interviewees was to have a more customer oriented approach of the handling of SRs. I.e. they were interested in receiving relevant information regarding the customer when handling the customer's SR.

Relevant information could for example be size of the client, number of SRs from the customer, the importance of the customer (i.e. how much the customer has paid for the support) and so forth. When an analyst opens a SR in ITS they believe they would benefit from receiving automatic customer information that is presented via for example a separate pop-up window. An area where such customer information could prove valuable is when ranking SRs based on more criteria than for example severity. One specific example that was put forward by one of the analysts, was that an important client that even though it has vast expenditures on support costs from Oracle Support, it logs few actual SRs since they are able to handle most problems internally. Such a company should, according to the analyst, be prioritized when they actually log an SR. This will keep this customer satisfied. Furthermore, even if the SR of this particular company in fact is not of the highest level of severity, it should be treated as such.

Another suggestion that was proposed by one of the analysts was to develop an interface that summarizes all relevant knowledge management tools. Thus, avoiding the need of opening several windows and copy/ paste the same search questions into various knowledge management and SR handling tools' search functions. The analyst wanted to be able to start the search in one window's interface, and then the typed question would automatically be searched for in all available knowledge management repositories and databases.

A third interesting proposal that was suggested by one of the interviewees at Triage was a more extensive usage of compulsory scripts in the Metalink. By that meaning that the customer is forced to use standardized scripts that gather information regarding the client and the product that he is using. Actually, at present, such a script procedure already exist in Metalink, however this script is not mandatory to perform when logging. The same analyst also wanted that all SRs either were connected to an existing solution that was accessible through WEBIV, or that a new document was created for the new SR. I.e. every SR should be connected to a document in a knowledge management repository, here WEBIV. Thus meaning, when solving a SR, you are forced to contribute knowledge, as you should not be able to close an errand in ITS before it is connected with a document in WEBIV.

Another suggestion that was believed to enhance the handling of support errands was proposed by yet another analyst. This analyst wanted to alter the presentation of search results in Metalink so it was similar to the search results of the WEBIV. Consequently, the analyst and the customer achieve the same visual presentation of the results, this in turn enabling a better understanding of the customer's situation.

One analyst considered the errand handling system (ITS) to be slow, disordered, and having a poor interface. However, another analyst did not face the problem with the lack of speed, since he used the ITS Enhancer. ITS Enhancer is a “skunk work” that was developed within Oracle. The ITS Enhancer is not part of any official manual, but its usage is distributed by more informal means. The ITS Enhancer has the same graphical interface as the ITS, but it is considerable faster.

5.4 Results received from an analyst at Config/ Usage

Introductory questions

The interviewed analyst at Config/ Usage has an additional function as a team leader. He is employed within the business area of Support Development tools, and handles the product Languages. Thus meaning, he manages problems that can be derived to Java programming, and these problems influence on various Oracle products. He has been employed within Oracle Support for four years. As many of his colleagues that work within the support, he has obtained a degree in computer science. Likewise, he has been employed within the line of business prior to his employment at Oracle.

Tools

Unlike many other analysts, the interviewed analyst at Config/ Usage is not logged onto the ITS handling system since he has the additional function as team leader. The SRs that he actually handles, is passed on to him by other co-workers at Config/ Usage level. Due to his high level of competency in Languages, he functions as an additional support person for his support team.

When asking for the tools that exist with the aim to facilitate the handling of SRs, the interviewee was aware of all the tools that were presented in the introduction of tools. However, he ranked the usability of the available tools somewhat different in comparison to the analysts at Triage, in addition he used more tools, and he contributed with knowledge to a greater extent.

Construction of test cases

When solving SRs, the analyst at Config/ Usage usually starts his handling process by creating a test case. Thus, being able to reconstruct the customer's problem, hereby he can localize: when, where and how the problems occurs. Contrary to the SR handling at the Triage level, the construction of test cases in Config/ Usage is used more commonly. The usage of test cases at Config/ Usage has been a continuous works of practice regardless the

influences from the creation of Triage. However, it is still not stated in the support manual. As is the case of Triage, the usage of test cases when handling SRs is not applicable for all support areas in Config/ Usage.

WEBIV

The analyst regard WEBIV as an important knowledge management tool when solving SRs and other related problems, second only to the construction of test cases. He opens the errand in WEBIV, and performs a search for a possible solution within WEBIV. He uses a wide-to-narrow approach when searching the WEBIV. Since the SRs he handles already have been screened by an analyst at Triage, there should not be a specific tailored solution to that SR. If that should have been the case, the analyst at Triage should have found it. Instead, he searches for closely related topics and possible solutions, thus being able to resolve the problem.

OTN (Oracle Technology Network)

The third tool of choice is the OTN (Oracle Technology Network). Contrary to the analysts at Triage, the interviewed Config/ Usage analyst uses the OTN relatively frequent. The main reason for using the OTN is that the network contains system specific information that facilitates his creation of solutions to SRs that are handed over to him. The Config/ Usage analyst uses the OTN due to the fact that he solves new problems primarily, not by finding old solutions as is the case in the Triage SR handling process. As the OTN is system oriented, his choice of search method is searching by catalog, not by keyword.

Mailing list

The fourth most used tool when solving handed over SRs is various mailing lists. He uses this knowledge management tool by putting forward errand specific questions with the aim to receive answers from other analysts that might have faced a similar problem prior to him, thus being able to provide him with an adequate and relevant answer. When using the mailing list he is well aware of the fact that other analysts not are obligated to answer his question, however he uses the mailing list just-in-case.

External sources

Another cluster of tools that can prove valuable when searching for information is a range of external sources. The two main sources of this category are Google and various Usenets. When searching in Google, he uses a wide-to-narrow keyword approach. Since most of his cases concerns Java-programming, he can also acquire interesting and fruitful information from different Usenets that discuss *open source*¹⁹ programming.

TARSearch

The use of TARSearch differs from the way the analysts at Triage use the tool. He uses it only when searching for a specific SR, i.e. not when looking for a related SR problem. Consequently, he does not use it as a knowledge contributing tool and therefore it is not frequently used.

Metalink

The interviewed analyst at Config/ Usage does not use Metalink as a knowledge management tool whatsoever. The only function that Metalink contains that concerns him is its function as an interface that communicates with the customers via ITS. Additional information, as well as all the information that Metalink include, is also available in WEBIV. The analyst also prefers the text-based interface that WEBIV has.

Global Workbench

Neither the Global Workbench is used by the analyst at all. He considers this portal to be disorganized and messy. Furthermore, according to the analyst the portal does not provide any additional functionality to his job procedures. Like the analysts at Triage he considers Global Workbench to merely be a combination of links to already existing tools.

Knowledge contribution

Unlike the analysts that are employed within Triage, the interviewed analyst at Config/ Usage contributes with new knowledge to some of the knowledge management tools that are available at Oracle Support. This is due to the fact that analysts at Config/ Usage level

¹⁹ For the definition of open source see the glossary.

actually solve new problems. The tool that he updates most frequently is WEBIV. When contributing with knowledge to this repository he uses two different approaches depending on the nature of the knowledge that is contributed. When updating WEBIV with new knowledge that has been gathered by the process of solving a SR, he uses the Authoring Wizard. The Authoring Wizard is an updating and article creating tool for WEBIV. The other approach he uses when updating WEBIV, is when he reviews and publish a draft article in WEBIV, thus making it available in Metalink and in turn accessible to customers.

On occasion he updates various mailing lists, i.e. answers questions that other analysts put forward. However, this happens relatively seldom due to the lack of time.

Design proposals from the employee

The analyst at Config/ Usage has several design proposals that he believes can improve the existing knowledge management initiatives and handling of different SR related problems. When asking for design suggestions from the employees at Triage, most of them wanted to receive customer specific information. This suggestion was also put forward by this analyst. He was interested in receiving customer related information such as number of employees, country of origin, and the amount of revenue the customer generates for Oracle. This function should be automatic, meaning that a new window containing above mentioned information appears automatically when a SR is opened in ITS. According to the analyst, the process of prioritizing would be facilitated by such a function. Additionally, a higher level of customer focus and consciousness could be obtained.

Another design proposal that was presented by the analyst was to replace the strongly criticized Global Workbench, with a tool that inherits a higher level of functionality. This new function could still be in form of a portal, but instead of being just an amalgamation of clickable links brought together in an unstructured and confused way, it should consist of truly connected knowledge management tools and systems. This means that the tools and systems within the suggested new function should be connected by a mutual search function. The search function should scan both internal (WEBIV, ITS, Mailing lists etcetera) as well as external (Google, Usenets etcetera) sources. When searching, the question that is presented

should only be needed to be typed once. Furthermore, the query results should be presented in a better manner, preferably via some sort of cluster function where the results are clustered, based on e.g. products. Additionally, the analyst at Config/ Usage would like to have the possibility to customize the portal's contents regarding knowledge management tools and systems, i.e. each analyst should be able to choose the tools that he or she prefers when handling for example SRs.

Config/Usage

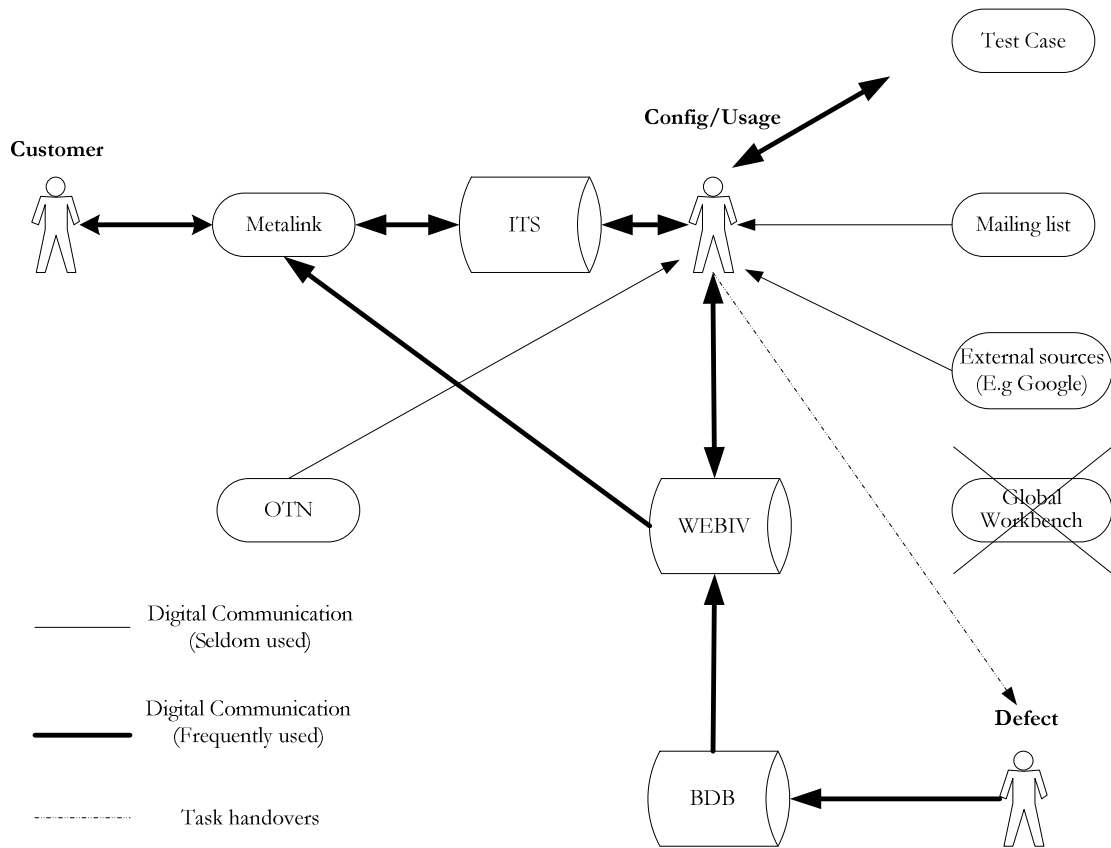


Figure 6 Usage of knowledge management tools at Config/ Usage.

This fifth chapter that have introduced the questions that was put forward to the employees as well as the results from these interviews, together with the two preceding chapters, the theoretical and empirical frameworks, will form the platform from which the authors are able to analyze and hopefully answer the problems that were stated in the introductory chapter.

6 ANALYSIS

In the following chapter the authors will discuss the current knowledge management situation at Oracle Support that was described in the empirical chapter as well as via survey results through the five ICT-dimensions that were introduced in part 3.8. The discussion that accordingly was based on the five dimensions will eventually lead to an appropriate answer proposal to the main question; Are intelligent agents capable of improving the support process at Oracle?

6.1 Information and communication technology within Oracle Support

In this the initial dimension the focal point is on the relationship between ICT and the knowledge management strategy of Oracle Support and how ICT is positioned in the general knowledge management policy.

Oracle Support is an organizational unit that is highly dependent on the competencies and knowledge of the employees within the entity. Thus being a knowledge-intensive organization, where the knowledge of its employees is the core asset.

As the products of Oracle are in fact products/ tools that can be defined as ICT, with an origin in databases and knowledge repositories, Oracle is a cooperation that has a high level of confidence in ICT-related products and that ICT should be seen as essential parts in knowledge management strategies. Furthermore, Oracle is a large software company, and obviously do not create small systems from scratch, and their products are based on foremost reusable knowledge. Accordingly, they mainly use a codification strategy in their knowledge management work. The codification strategy implies that the usage and storage of knowledge or information is independent of the person that developed it.

As one of the main tasks of the support organization at Oracle is to solve customers' problems that can be derived from Oracle products, they reuse structured knowledge via codified information from previous cases, thus being able to avoid reinventing already

existing solutions, i.e. not creating new unique solutions for each new SR. Oracle Support uses WEBIV as a knowledge repository for storing codified information regarding already solved SRs. This is in line with the belief of the company that the solution provided has generic qualities, meaning that one solution that was created for one particular customer also is applicable to many other customers with similar problems.

According to Ponelis and Fairer-Wessel (1998) a well balanced combination of people-centered and technology-centered knowledge management approaches is the optimal strategy. In addition, to solely focusing on either of the approaches may lead to failure. We consider that the aim of Oracle is to have a combination of the two approaches, since it is clearly stated in company manuals that the role of an employee at Oracle Support is both to contribute with codified knowledge to the knowledge management systems and tools (technology-centered approach) as well as to improve individual skills through education and experience (people-centered approach). However, this is the aim of the company, and it differs from the real situation. In reality, the people-centered approach is highly neglected due to lack of time as well as lack of motivation according to the interview results. In fact, barely the technology-centered approach is reached, since knowledge contribution also in many cases is ignored due to similar reasons. The technology-centered approach and its applicable tool (WEBIV) can be used to capture and reuse structured knowledge as well as to structure and map knowledge needed to enhance performance. The people-centered approach with its applicable tools (Skillsbank and mailing lists) can on the other hand be used to identify sources and networks of expertise, but also to capture and share lessons learned from practice.

6.2 The relationships between information, knowledge, and ICT

The second dimension is focusing on relationships between ICT and various knowledge and information categories. Since the different functions at Oracle Support handle foremost either information or knowledge it is important to be aware of the differences between these two concepts. According to Nonaka and Takeuchi (1995) information is a flow of messages; and knowledge is what is created by the flow of information. At Oracle Support, the Triage

function mainly handles information and is not creating knowledge. They merely forward a flow of messages to other functions. The Config/ Usage function on the other hand actually creates knowledge when updating the knowledge management repositories (WEBIV, Metalink) with structured and codified knowledge. In addition, according to the authors, the focus is on explicit, role-based actions (mimeomorphic actions). Even though Oracle Support's focal point is on the explicit side of knowledge, they are not unaware of the tacit side. However, due to the fact that Oracle Support mainly uses codified information, it is hard to capture tacit knowledge. According to company policy, one of three pillars of the support staff is education; this education is not only product specific but is also aiming to spread tacit knowledge as well as best practices. However, the interview results do not indicate that this is the case. The method to capture the tacit knowledge is lagging according to the interviewed employees, since the education that does exist is product specific only. This leads to an uncontrolled dissemination of embedded/ tacit knowledge throughout the organizations, partly within geographical entities and partly within geographically dispersed teams. This tacit knowledge consists of the usage of skunk works (e.g. ITS-enhancer), search methods in knowledge management tools (e.g. wide-narrow), approaches to solve incoming SRs (e.g. the creation of test cases), and which knowledge management tools that are used when solving SRs. Even though the support manuals describe how different errands ought to be classified as well as how they shall be handed over from one function to another, they do not explain how the various knowledge management tools are supposed to function and collaborate.

6.3 ICT and the organizational perspective on knowledge

In the third analyzed dimension the emphasis is on the relationship between ICT and the organizational perspective on knowledge. As said by Hendriks (2001), distributing knowledge with the aid of an intranet will only prove relevant if the knowledge that is disseminated is translated into creative and new ideas that in turn add value to the company, or if it leads to a rewarding reapplication of existing knowledge. Oracle Support is highly dependent on well-functioning intranet-based tools, foremost the knowledge repository, WEBIV. We find that the reapplication of existing knowledge is satisfactory at Oracle

Support, as the reused solutions of SRs have generic qualities in many cases. Furthermore, the authors also consider that the overall use of ICT at Oracle Support do not show any signs of conflicts between the entities that provide the knowledge and the entities that use the same knowledge, consequently the use of ICT can be beneficial in many cases to the management of knowledge at Oracle Support. Further, the authors have found no evidential signs that there are tensions between the individual aspirations of the knowledge workers and the aspirations of the organization. As summarized by Hendriks (2001), there are two elements that define the group aspect of organizational knowledge; the group as a passive entity, and the group as an active entity. During the research it has become evident that the Triage function ought to be considered to be a passive entity, as their main work tools are in the field of organizational memory, such as a knowledge repository (WEBIV) with its associated browsing, search and retrieval tools. In addition, the use of applications that can be considered of being of an active nature, such as intranets and groupware, are rarely used. On the contrary, the Config/ Usage function, when using the Hendriks (2001) definition, can be considered to be a group in an active sense, since it is represented by such concepts as communities of practice and electronic networks of practice. Furthermore, Config/ Usage uses typical applications that might be helpful to a group in an active sense, such as intranet-based tools (Mailing list), as well as above mentioned communities of practices (Usenets).

However, according to Davenport and Prusak (1998), there are also some drawbacks when relating ICT to the organizational perspective on knowledge. As we have stated in the theoretical chapter, they introduced the concept of deknowledging. They partly define deknowledging as a state that might occur when too much data and information is stored in a knowledge repository (relevant as well as useless information) that it becomes practically impossible to make sense of the contents of the repository. In the case of Oracle Support, the authors did not find the amount of stored data and information in the repository (WEBIV) to be the main problem, but rather how this content is presented when searched for. When for example searching for a solution of a particular SR via Metalink, the searcher (customer) will generally be presented to too many and irrelevant alternative hits. Consequently, this results in an information overload and a deknowledging situation for the customer, and he will in turn be forced to file his SR to Oracle Support.

6.4 Knowledge processes within Oracle Support

The fourth dimension that is elaborated in this analytical chapter has its focal point on the relationships between ICT and the dynamic character of knowledge. When investigating the knowledge processes that are used by Oracle Support, we have emphasized on the categorization that was introduced by Alavi and Leidner (2001). They define the step stones of a knowledge process in the following way: Creating knowledge, storing and retrieving knowledge, transferring knowledge, and applying knowledge. When doing our research we have found interesting insights regarding the process of knowledge at Oracle Support. The Triage function did not create knowledge in any way, this due to the fact that they merely had a filter function and retrieved already existing solutions to known problems, and do not generate new solutions. Accordingly, the only process step stone that the analysts at Triage used on a daily basis was the storing and retrieving of knowledge, with an emphasis on retrieval. Transferring knowledge is rarely done, since the employed analysts within Triage not are participating actively in any communication via e.g. Mailing lists or Usenets, i.e. active group tools. The fourth and perhaps the most severe deficiency is the absence of applying knowledge from the Triage function. This will lead to a lack of motivation, and this will in turn lead to a passive general behavior and a deterioration of the analysts' existing knowledge. We, the authors, consider this to be an example of an extended definition of the concept of deknnowledging. This aspect of deknnowledging is even more dangerous for a company. When applying the same knowledge process step stones on the Config/ Usage function, the outcome was quite different. Config/ Usage actually solve new SRs with new solutions, they apply their own existing tacit knowledge into the solving of incoming SRs via ITS. However, due to experienced lack of time as well as to weak incitements to contribute knowledge, the transfer of the newly created knowledge from ITS to WEBIV is haltering. Thus, the transfer of tacit knowledge from the analyst to explicit knowledge in various knowledge management tools is lost. Since the creation of knowledge is limited, it can not be stored and consequently not transferred nor applied by others. During the research we have discovered that the support manuals are insufficient in the sense that they do not include best practice regarding for example knowledge management tools. As we have already mentioned does this lead to an uncontrolled dispersion of various handling and search

methods. In addition, since the way the analysts treat incoming support errands differ in so many ways from the instructions in the manuals, we question whether the analysts consider the content of the manuals relevant, in fact we are not sure whether they have actually use the instructions at all. To the authors it seems that the way analysts perform various work tasks are sprung from an ad hoc learning approach, e.g. learning-by-doing or learning-by-watching.

The most important application, the “killer-app,” for knowledge transfer within an organization is the intranet claimed to be. This is also the case when discussing the functions of Oracle Support, Triage and Config/ Usage. The Global Workbench, a portal that is supposed to function as a linking intranet-tool, is not functional. Therefore, none of the interviewed analysts used it. This is unfortunate since the Support department does not have any inherent impediments against knowledge transfer. This can partly be derived to the fact that revenues that are created by the support are fixed sums on a yearly basis; each solved SR does not result in increased revenues directly. Consequently, support analysts do not gain advantages by withholding information and knowledge from co-workers and others. On the contrary the analyst actually gains from sharing knowledge, since this increases his colleagues’ ability to solve problems and in turn assist him in the future, as well as limit his burden of work. However, this is not the case in the Consulting or Sales departments. This is due to the internal competitive situation that is present in both these departments. Here the revenues are generated on specific occasions that are directly linked to an act of either a consultant or a sales person. The employees within both these departments compete with their own co-workers, and the competitive weapons they use are their own competencies. Thus, there are not incentives for the consultants and the sales personnel to share their knowledge as this will aggravate their own competitive situation. Consequently, Oracle ought to focus on the Support department when aiming to transfer knowledge as there is no inbound competition within this department by default. In addition, the Support department actually generates a third of the total revenues, thus accentuating its importance even more.

According to Hendriks (2001) problems might occur when an individual process is optimized, since this optimization can lead to a deterioration of the overall chain of processes of knowledge management. This is definitively the case in Oracle Support, since

an analyst can improve his own SR handling's speed by neglecting to contribute the knowledge obtained to WEBIV. He is able to solely work in ITS, as there are no forcing scripts that obliges him to open a new document in WEBIV. If the analyst consider himself having a time deficit, he is very likely to prioritize the tasks that he is assessed upon, i.e. the task lists. In addition the errands in his task list are visible on the screen, and they insist on his immediate attention and response since there is a customer on the other end that is awaiting a quick solution on his reported problem.

In addition the authors have found that there exist conflicts between different department and their applied knowledge management tools. For an employee within the R & D department at Oracle it is in his interest to bring forth solutions to problems that were put forward to him via OTN. However, if he answers these problems promptly, it might be in conflict with the general interest of Oracle. Even though this might sound peculiar at first, this conflict of interest occur when a specific support errand is forwarded both to OTN and to Metalink by the same customer. It is obviously devastating to the customer's willingness to pay for support if the free-of-charge assistance at OTN is quicker than the support help that he actually pays for from the Oracle Support. This internal competition is unfortunate and clearly contra productive.

6.5 Knowledge connectivity within Oracle and Oracle Support

The focus of the fifth and last dimension is on the relationships between ICT and other knowledge management measures. The connection between different knowledge management tools and systems within Oracle Support are hindered due to barriers between these tools and systems. Foremost, we want to illuminate the fact that there are no connection between the support handling system (ITS) and the primary knowledge repository (WEBIV). This lack of connection leads to an unnecessary extra work effort when updating the knowledge management system, as already existing information must be reprinted when contributed to WEBIV. Clearly, since there are no connections between the closely related tools within Oracle Support, there is no surprise to the authors that

connections to other systems (HRM and CRM)²⁰ outside the Support department do not exist. In view of the fact that the functions of Oracle Support consist of geographically dispersed teams, they will benefit greatly from an improved communication and control that can be derived from relationships between ICT and other knowledge management measures. According to Piccoli and Ives (2000) a higher level of management control and communication would improve team efficiency. However, it is important to be aware of that an intranet to become effective is dependent on the individuals' competencies and their willingness to express and share knowledge. In our research of Oracle Support we have not discovered any incitement programs or reward systems for sharing knowledge.

As previously stated under chapter 6.4 there are no built in obstacles within Oracle Support to share knowledge, but there are on the other hand not that many incitements built in to share knowledge either, thus making it vulnerable to negative behavior from other departments. An example is the situation when a consultant blames the Support for his own failure. Since the consultant is dependent on his reputation from the customer to gain revenue, he has incitements to blame others for his shortcomings. Clearly, if consultants and sales persons act in such manners, the incitements for Oracle Support to share knowledge with these departments will disappear.

6.6 Analytical conclusion

As a conclusion to the analytical chapter of this thesis, we will now answer the main problem definition that was presented in 1.3 as well as in the introductory text of this chapter. The answer to the problem are based upon the results of the analysis of the five dimensions, these five dimensions are in turn based upon the theoretical chapter, the empirical framework, as well as the results from the interviews. The definition of the main problem is as following:

A re intelligent agents capable of improving the support process at Oracle?

²⁰ For definitions of CRM and HRM, see the glossary.

The answer to this question is according to us, yes. This affirmative answer can be derived from the following grounds.

Firstly, an intelligent agent can remedy the problems regarding the lack of connectivity between knowledge management tools and other systems, both within Oracle Support as well as between Oracle Support and other Oracle departments. This is due to the fact that an intelligent agent is able to handle both structured as well as unstructured information; this functionality is a step further to just connecting various databases. In addition, Oracle can avoid conflicts between different departments that can occur when an individual tries to optimize his own work at the expense of the general interest of Oracle, as we stated in chapter 6.4. If you settle with just connecting different databases, the risk of deknowledging as stated by Davenport and Prusak (1998), is even more imminent. In contrast, an intelligent agent can assist the user to manage huge amounts of information and help to present this information in a representative way, thus avoiding too many irrelevant answers. Intelligent agents are also able to facilitate the problem solving process, e.g. the analysts are via a clustering-function being guided to the correct area of the problem, if there is no existing specific solution to the problem.

Secondly, the usage of intelligent agents will also facilitate the creation of knowledge. Since there will be connections between various tools, an automatic transfer of information between the different tools will thereby be made possible. An advantage that an implementation of an intelligent agent may lead to, is that Oracle Support can create a forcing script in the errand handling system, ITS, to automatically open a document in the knowledge repository, WEBIV. If the information is transferred automatically the resistance to put work and effort into updating knowledge repositories, due to an experienced lack of time, will diminish. In addition, Oracle Support will not be obliged to introduce a reward system in order to increase the knowledge sharing within the department, thus reducing expenditures.

Thirdly, when introducing and implementing an intelligent agent, much routine work will be handed automatically, e.g. the gathering of customer specific information and making sure

that the incoming SR has all necessary information to be handled, thus releasing time for the employees to work with problem solving as well as personal education and development. In turn, the analysts within Oracle Support will avoid perfunctory work assignments that can lead to our extended definition of deknowledging as well as creating lack of motivation.

Fourthly, an intelligent agent is also able to create a balance between the technology-centered and people-centered knowledge management approaches, as it enables a connection between the tools that support each approach respectively. In the case of Oracle Support this is represented by WEBIV as a technology-centered knowledge management tool and Skillsbank and Mailing lists as people-centered tools. Even though an intelligent agent ought to be seen as a technology-centered knowledge management tool, we believe that the use of such technology as a connector also may improve the people-centered knowledge management approach.

Since the main problem of this thesis was answered affirmatively, we will in the next chapter continue with the answering of the two sub problems regarding intelligent agents:

- *Where should they be implemented?*
- *How are they supposed to function?*

In the following chapter we will present concrete suggestions regarding the implementation and function of intelligent agents at Oracle Support. These design proposals are based on the analysis of the five dimensions in the analytical chapter as well as the design proposals that the analysts of Oracle Support provided.

7 DESIGN PROPOSALS

In this seventh and final chapter we put forward the design proposals of the thesis regarding intelligent agents. Furthermore suggestions for further studies will be presented.

During the interviews with the employees of Oracle Support the authors became aware of the fact that many of the interviewed analysts were dissatisfied with the Triage function as it was when the interviews were conducted in the fall/ winter of 2003. Today (January 2004) the Triage function has been abolished, and the allocation of SRs is based on the information that is contained in the Skillsbank. The original idea of the Triage function was that it was supposed to function as a filter that eliminated already solved problems, unfortunately did this idea not work out as good as it was intended despite its good intentions, this due to the way it was implemented. Perhaps this implementation had been more successful if it was used during an expansive phase for Oracle Support with many new employees; hence the Triage function could work as a training ground and make the newly employed familiar with the environment of the SR handling process as well as how to use the different tools and systems within Oracle Support. The authors have identified two areas where the implementation of intelligent agents will prove to be beneficial to Oracle Support.

7.1 Customer specific intelligent agents in Metalink

The first design proposal that we put forward is related to the customers' interface, Metalink and how this interface can be improved by the implementation of intelligent agents. This design proposal is aimed to construct an intelligent agent that is specific and customized for each individual customer. The purpose of this implementation is to adjust Metalink to become a smarter interface that can function as a filter towards already solved SRs. Hence, with the assistance of intelligent agent technology an improved filter function can be obtained, but now without having to employ over-qualified analysts for simple tasks. By this implementation, Oracle Support will be able to allocate resources to problem solving,

knowledge creation, and education for the employees. Thus, as routine tasks hereby are avoided more motivating work tasks will be performed by the analysts; this will in turn lead to a higher degree of work satisfaction, and a more cost-effective handling of SRs.

The increased functionality of Metalink that is created by the implementation of intelligent agent technology, is partly due to the possibility for the customer to search in both structured and unstructured information, thus providing a larger search area, as the search method is based on content search as well, i.e. an extended functionality in comparison to the traditional key-word based search method that is the technique of today. The content based search method enables a concept matching; the significance of a reported problem is matched with the relevance of an existing. Consequently, only relevant solutions are presented, i.e. the risk of deknowledging is diminished and the handling of SRs will be facilitated as well as made more rapid. The aim of having an improved Metalink is not merely to connect various sources of information. Because the intelligent agent can be trained when used, it has the possibility to be personalized to each customer's specific situation. This will in turn facilitate the process of reporting SRs, since the intelligent agent provides the system with relevant information regarding the customer. The customer will, when reporting a SR, be presented to various pre-stated options that are based on the customer's system environment. The aim of this approach is to make sure that a SR that reaches an analyst in the Support department is complete, i.e. includes all needed facts for the solution process. Furthermore, we recommend that it should be possible for the customer to influence the design of the interface so it suits his way of searching for solutions and reporting SRs, as it is important to be aware of the fact that different customers have different ways of performing searches in Metalink. Design proposals that could originate from the customers are for example the number of presented solution suggestions. Since the customers' that use Oracle products generally are large organizations and accordingly possess a high level of competency regarding the systems that they are using, we think that a complementary free-text search function, which is made possible due to the fact that the information is categorized by the intelligent agent, would be suitable. The primary purpose of a free-text search is not to find an existing solution but rather to broaden the horizon with relevant information that might help the customer solve the problem by himself, thus reducing the work load for the Support department.

Since an intelligent agent allows the handling of vast amounts of up-to-date information, it is possible to make Metalink dynamic. This means that the list of possible solutions will be updated immediately when additional information is put in to the system by the customer. This is not the case today, as the customer first provides information to the system and then possible solutions are listed, if none of them are appropriate, the customer adds additional information when creating a SR. This additional information is unfortunately not used to search for other solutions, hence creating unnecessary work for the Support department.

It is important according to the authors that a customer interface of a company is consequent, clear, as well as without contradictory information. Unfortunately, Metalink does not prove to have all above mentioned characteristics. For example, we have observed that Metalink uses the old designation TAR (Technical Assistant Request) when discussing a support errand, while the analyst that handles the support errand uses the term SR for the very same errand. Obviously, this does not give the customer a professional impression of Oracle Support, besides being confusing.

7.2 Intelligent agents for the employees

The second design proposal is to implement a specific intelligent agent supported function for each analyst. This specific intelligent agent will be personalized, meaning that the agent will be trained in the field the analyst is active in, as well as the work methods of the specific analyst. The intelligent agent will accordingly be familiar with preferred search methods, knowledge management tools etcetera. The primary intention of this implementation is not to search for existing solutions, since this should be covered by the intelligent agent supported Metalink, but to enable a search in sources that contain both structured as well as unstructured information. A connection between tools that only handle structured information such as WEBIV and ITS, is not a decisive factor of an intelligent agent, even though most intelligent agent are fully capable of doing that. To be able to search for information in more and different sources, than they are able to today, the horizon will be broadened in a more extensive way. The extended search will enable the analyst to find

possible problem solution areas, even in systems/ tools that he usually does not use, with the facilitation of a clustering function. The intelligent agent's clustering function will grant the analyst a variety of approaches to solve his specific SR with the help of other existing similar solutions in the same field. The problems that underlie these solutions do not have to be exactly the same as the current SR that he is processing. Even though the problems are not identical, the way of solving them may actually help him to create a new solution. Besides the increased support of the problem solving process, the clustering function also assists the education of the employees due to the widened horizon of knowledge.

To enhance the creation of knowledge, an automatic transfer of information between the errand tool (ITS) and the knowledge repository (WEBIV), should be implemented. To make this automatic transfer of information possible, one alternative is to create forcing scripts in ITS, that automatically opens a document in WEBIV. This document should either be connected to an existing solution or create a new solution. In exceptional cases, such as when a solution suggestion to a problem is sent by the analyst, but the customer has not reported back that the suggested solution actually solved the problem; the SR could be stored as a solved but unreported SR.

Obviously, as is the case of Metalink and the customers' option to design their own interface, the analysts should have similar design opportunities. The, by the analyst designed, interface should contain summarized information from both internal and external sources, thus avoiding any unnecessary extra work by using several different search tools in several windows. Here, an intelligent agent can prove valuable since it can accept a piece of content and return a summary of information that contains the most prominent concept in the body of information. Additionally, summaries can be generated that relate to the framework of the original inquiry, thus allowing the most applicable and dynamic summary to be provided in the results. This is a functionality sought after by many analysts at Oracle Support, both at Triage as well as Config/ Usage.

Another functionality that many analysts thought were of importance was to get a higher level of customer focus. For example, an intelligent agent can provide the analysts with customer specific information. This information can be gathered from both internal (Sales

and Consulting departments, knowledge repositories etcetera) as well as external sources (e.g. the specific customer's website), this information should then be presented in a predestined way of the analyst's own choice. In addition to this function, the analyst could receive a list of other current SRs that each specific customer has running, as well as a list of the analysts that handles which SR. As a result, the general customer awareness will increase among the analysts when they automatically receive information that today is handled by the surveillance function, SCI. The customer specific information also ensures that important customers are prioritized, e.g. customers' that create large support revenues should get their SRs handled more promptly. A customer's, which has high costs for support but files few errands, SRs must be solved rapidly. Even though the SRs might not be of the highest level of severity, it should receive a high level of priority.

Seeing that an intelligent agent receives up-dated information regarding the analyst's work expertise, field of interest, and way of conducting the SR handling process, a connection to people-centered knowledge management applications, such as the Skillsbank are made possible, leading to a more effective allocation of SRs. In addition, an intelligent agent can act as intermediary between co-workers that are interested in the same field but work in different departments and in other geographical areas, thus making them aware of each other. This is important as an intelligent agent is a technology-centered knowledge management application, and Oracle should strive to get a suitable balance between technology-centered applications and people-centered dittos

7.3 Recommendations for further studies

During the completion of this thesis the primary focus has been on Oracle Support, and their management of knowledge and how ICT can facilitate this management. To be able to further validate our research and consequently our results, a quantitative survey of the Oracle Support on a bigger scale could be conducted. In addition, we are aware of that to only focus on the internal processes is not sufficient in order to be able to obtain an overall picture of the situation. Consequently, the authors recommend that studies in the following fields would be of interest and may prove valuable to Oracle. Since the design proposals regarding

Metalink has been put forward without any profound studies of the actual customers, but can be derived from the analysts working at Oracle Support and accordingly it is their view on the customers' needs and behavior that above design proposals are based upon. We are conscious of the necessity to include the customers when designing the customer interface as well as the functions that this contains, since the customers are the actual users and the ones that should be able to harvest the benefits together with Oracle of such an implementation. Consequently, examples of further research areas that could be of interest are:

- Customer behavior when filing SRs
- Customer anticipation of the support process
- A compilation of the competency of the customers' contact persons

In addition, another interesting research area that the authors want to emphasize is the internal relationships between the various departments of Oracle, and how the transfer of knowledge between departments such as Support, Sales, and Consulting could be improved. Most likely, as previously stated in the thesis, Oracle Support has the potential of becoming a provider of important knowledge to both the Sales department as well as the Consulting department. At present, to use the information that resides within Oracle Support's repositories is complicated due the technical nature of this information. Accordingly, it is difficult to transform this information to knowledge that can be understood and used by sales men and consultants. Clearly, areas that could be of interest to enter more deeply into are therefore:

- What sort of information and accordingly knowledge are Sales and Consulting interested in?
- How should this information be presented so it more easily can be translated into knowledge and create additional value to these departments?
- In addition, which possibilities do other departments have to improve the work at Oracle Support?

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Appendix I - Glossary

BDB (Bug Database): A database where solved bugs are stored. The BDB is connected with WEBIV.

CRM (Customer Relationship Management): CRM is the concept that refers to an effective and efficient management of customer relations.

HRM (Human Resources Management): HRM is a normative management concept and method that is used with the intention to increase the productivity of an organization as well as to create an effective and competitive organization where the employees play a central role.

Metalink: Connected with WEBIV functions as an incoming and outgoing interface towards the customer. In addition it is a technical forum with both keyword and catalog search.

Newsletters: Mailing lists where analysts are participating in various groups based on specific fields of interests. It is used to send solution suggestions and to ask for aid regarding task solutions.

ITS (Internal Tracking System): The actual work system where the analyst handles specific errands.

Open source: When the source code of a program is open for anyone to alter so the program can be customized to the specific needs of for example an organization.

Oracle Global Workbench: A portal with discussion forums, calendars, shortcuts to WEBIV, manuals (e.g. the support manual), etcetera.

OTN (Oracle Technology Network): It is a site that is free of charge and which contains technical information shared between customers and Oracle's employees.

QMon (Queue Monitor): A system where specific customers and their errands are searchable. It is mainly used by the SCI function of Oracle Support.

Skillsbank: Assess skills of all analysts in order to be able to allocate SRs depending on availability and workload.

TARSearch (Technical Assistant Request): Interface that is used to search the ITS. TAR is the former name of SR. The search function of TARSearch is based on keyword search.

WEBIV: It is Oracle Support's primary knowledge management system. It is a knowledge repository where solved support tasks and bugs are stored. WEBIV is searchable through keywords and catalogs.

Appendix II - Intervjuguide

Introduktionsfrågor

- Vilken formel arbetstitel har Ni? (Analytiker eller team leader)
- Vilken avdelning tillhör Ni? (Triage eller Config/ usage)
- Inom vilket specifikt arbetsfält är Ni verksam?
- Hur lång tid har ni varit anställd på Oracle support?
- Vad har Ni för tidigare arbetslivserfarenhet?
- Vilken utbildningsbakgrund har Ni?

Systemspecifika frågor

- Kan Ni vara vänlig att räkna upp tillgängliga system som Ni känner till? Med system menar vi kunskapshanteringssystem, ärendehanteringssystem samt andra system som hjälper er i er arbetsuppgift.
- Vilka av de uppräknade systemen använder Ni?
- Hur använder Ni respektive system?
- Kan ni, om möjligt, rangordna systemen i förhållande till varandra?
- På vilket sätt har ni resonerat när Ni rangordnade systemen?
- Vad är orsaken till att Ni inte använder vissa system? (frågan ställs om så är fallet)
- Hur kommer det sig att Ni glömde att nämna ett specifikt system? (frågan ställs om så är fallet)

Kunskapstillförel

- Uppdaterar Ni systemen som Ni använder?
 - Hur går Ni tillväga när Ni uppdaterar systemen?
 - Hur ofta uppdaterar Ni systemen?
 - Varför uppdaterar Ni systemen sällan? (frågan ställs om så är fallet)
 - Varför uppdaterar Ni inte systemen? (frågan ställs om så är fallet)

Designförslag

- Har Ni några egna designförslag som kan förbättra er ärendehantering?
- Har Ni några egna designförslag som kan förbättra kunskapshanteringen?

Appendix III - Interview guideline

Introductory questions

- What is your formal job title? (Analyst or team leader)
- In which function are you employed within? (Triage or Config/ Usage)
- Within which specific field of work is you employed?
- For how long period of time have you been employed within Oracle?
- Do you have any work experience prior to your employment at Oracle?
- What is your educational background?

System specific questions

- Which systems and tools that are available are you aware of? When referring to systems we mean knowledge management systems, SR-handling systems, as well as other facilitating systems when solving SRs.
- Which ones of the enumerated systems do you use?
- How do you use those systems?
- Please rank the enumerated systems mutually.
- How have you reasoned when ranking the systems?
- Why do you not use certain systems? (question to be asked if necessary)
- How come you did not mention certain systems? (question to be asked if necessary)

Knowledge contribution

- Do you update the systems that you use?
 - How do you proceed when updating the systems?
 - How often do you update the systems?
 - Why do you update the systems so seldom? (question to be asked if necessary)
 - Why do you not update the systems? (question to be asked if necessary)

Design proposals

- Do you have any design proposals that may improve your errand handling process?
- Do you have any design proposals that may improve the management of knowledge?