Knowledge Management from Case Studies with ATLAS.ti

Diploma Thesis in Information Technology

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Abstract

Knowledge management has evolved into an important topic within the scientific community. The general question is: How can firms document and utilize the intellectual capital of their employees? Corporations able to answer this question are rewarded with increased organizational wealth and sustainable competitive advantages.

In research projects based on case studies, knowledge management has to meet specific requirements. The research project “Good Practices of Stakeholder View” exemplifies how knowledge management can be implemented and which suitable IT tools exist. For this purpose, different knowledge management models and IT-based knowledge management tools are evaluated. Subsequently, the tools are compared with ATLAS.ti, a software for qualitative data analysis as it is required in case studies, and ATLAS.ti’s suitability for knowledge management in case studies is evaluated.

Zusammenfassung


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Introduction

Knowledge management has become an important concept for firms as it is an interdisciplinary business model dealing with all aspects of knowledge within the context of the firm, including knowledge creation, codification, sharing, learning and innovation. It describes how companies document and utilize the intellectual capital of their employees. Knowledge and its management thus enables firms to gain vital competitive advantages since it is a resource that is difficult or even impossible to imitate or co-opt, giving its possessor a unique and inherently protected commodity. Therefore, any techniques or methods which sustain knowledge growth and distribution are key to the success of today's organizations.

Similarly, firms can also profit from their stakeholders and the knowledge they may share and contribute. Nurturing a stakeholder network is therefore equally important to firms as this allows them to enhance their competitive advantages, to create innovative solutions and to increase their organizational wealth from which, in turn, the stakeholders benefit as well.

To investigate stakeholder relations and the resulting benefits for all parties involved, a research group has analysed the role of the firm and particularly the firm’s stakeholder management for several years. By employing a series of longitudinal case studies, the project aims at deepening and broadening insights gained in previous case studies. For this purpose, approximately ten Swiss-based, yet internationally active firms in different industries (e.g. financial services, telecommunications, chemical industry) are investigated, firms that already display a stakeholder orientation.

In this thesis, the relations between knowledge management and the research project, as well as the software supporting both are evaluated. In a first step, three approaches to strategic management and their benefits for firms to develop organizational wealth and to gain sustainable competitive advantages are briefly introduced: Porter’s market-based view, the resource-based view as described by Prahalad and Hamel, as well as the stakeholder view. Afterwards, the research project “Good Practices of Stakeholder View”, the case studies conducted to support this strategic focus and the requirements with regard to knowledge management are explained. In addition, some light is shed on the correlation between the stakeholder view and knowledge management, i.e. the advantages corporations can gain by combining the two concepts to generate unique knowledge.

An extensive section describes different models of individual and organizational learning, knowledge creation as well as knowledge management. In this respect, the SECI model by Nonaka and Takeuchi is particularly interesting, as it allows the combination and integration of all of the above described aspects, and helps to transform implicit (i.e. personal) into explicit (i.e. reproducible and transmittable) knowledge.

In the following chapters, various IT tools are investigated and discussed with respect to their suitability for knowledge management in case studies and their integration into the SECI model.
In the final section, ATLAS.ti is evaluated from three different perspectives: Its general suitability for knowledge management compared to other tools, its integration into the SECI model, and its specific suitability – including advantages and disadvantages – for knowledge management in case studies.
Part I: The Research Project

1 Strategic Management

The “Theory of the Firm” attempts to answer the question of which strategy a firm has to apply in order to gain a sustainable competitive advantage over rival enterprises. In the field of strategic management, three important research streams are distinguished: the Market-Based View (MbV, also called Industry Structure View ISV), the Resource-Based View (RbV), and the Stakeholder View (SHV). In the following paragraphs, all three theories will be briefly described.

1.1 The Market-Based View

The Market-Based View was mainly influenced by Porter (1985; 1991; 1996; 1998). In his opinion, a firm has to first analyse its strengths and weaknesses, compare them with the opportunities and threats that the markets offer, and then choose an appropriate and attractive industry in which to be active. The attractiveness of an industry is defined by five forces, i.e. competition within the market, potential new competitors, possible substitutes as well as market power of suppliers and customers:

The goal of competitive strategy for a business unit in an industry is to find a position in the industry where the company can best defend itself against these competitive forces or can influence them in its favor. Since the collective strength of the forces may well be painfully apparent to all competitors, the key for developing strategy is to delve below the surface and analyze the sources of each. Knowledge of these underlying sources of competitive pressure highlights the critical strengths and weaknesses of the company, animates its positioning in its industry, clarifies the areas where strategic changes may yield the greatest payoff, and highlights the areas where industry trends promise to hold the greatest significance as either opportunities or threats. (Porter 1998, p. 4)

Once a firm has chosen a certain industry, it has to decide on its position within this industry, i.e. the strategy it will follow: cost leadership, differentiation or concentration on niches. If the market is well chosen and the firm is able to maintain its competitive advantage, it will be able to gain a strategy rent.

1.2 The Resource-Based View

The Resource-Based View can be defined as follows: “The resource-based view perceives the firm as a unique bundle of idiosyncratic resources and capabilities where the primary task of management is to maximize value through the optimal deployment of existing resources and capabilities, while developing the firm’s resource base for the future.” (Grant 1996, p. 110) Resources are of financial, physical, technological, organizational or human nature. The firm can gain a sustainable competitive advantage if its resources are valuable, scarce, difficult to imitate and difficult to substitute. According to Prahalad and Hamel (1990), the firm must use these resources
to build and exploit unique core competences which represent the firm’s collective learning and are enhanced with use, allowing the firm to collect an efficiency rent. In order to create such core competences, the firm needs a specific ability to achieve new forms of competitive advantage, which Teece, Pisano and Shuen (1997) call dynamic capabilities: “We define dynamic capabilities as the firm’s ability to integrate, build and reconfigure the internal and external competences to address rapidly changing environments.” (p. 516) In other words, without learning, the firm will not be able to develop a sustainable competitive advantage. This approach is further elaborated by several authors (Grant 1996; Teece/Pisano/Shuen 1997) into a knowledge-based theory of the firm, in which intangible assets such as knowledge are of fundamental strategic importance. In addition, path dependences (Nelson/Winter 1982; Burgelman 1996) play a vital role as well, since they contribute to the building of resources that are difficult to imitate. Path dependences describe the firm’s unique development, its history, its trials and errors and (hopefully) learning processes in developing new products and services and in adapting to new challenges.

1.3 Brief Evaluation

Both theories, the MbV as well as the RbV, have their drawbacks and deficiencies. 1 Porter’s theory ignores the fact that a firm cannot simply imitate the success of another firm and also disregards organizational learning, i.e. the firm’s ability to adapt to changing environments and requirements. The problem the resource-based view cannot solve is that unique resources can also be a disadvantage, if the use of certain resources and irreversible investments in them lead to the firm’s inability to adapt to new developments (Sachs 2000, p. 51). This is where the stakeholder view comes in as it integrates and expands both the MbV and the RbV.

2 The Stakeholder View of Management

2.1 Definition of Stakeholder

The term “stakeholder” was first introduced by Freeman in 1984. Since then, the term has been defined in various ways (see e.g. Philips 2003). The definition used here is the same as the one given by Post, Preston and Sachs (p. 19):

The stakeholders in a corporation are the individuals and constituencies that contribute, either voluntarily or involuntarily, to its wealth-creating capacity and activities, and that are therefore its potential beneficiaries and/or risk bearers.

This definition not only includes shareholders – the stakeholder group that is often considered to be the most important by the firms – but also employees, customers, suppliers, regulators, governments, communities, NGOs, etc.

As the term already implies, stakeholders are persons or institutions that have something “at stake”, i.e. at risk in relation to the firm (Clarkson 1995). This means that they can benefit from or be harmed by the firm’s activities. Needless to say stakeholders do not want to be harmed or disadvantaged in any way by the firm; on the contrary, they expect to profit in some way or at least to be able to maintain a status quo.

The definition also implicitly relies on the suggestions of Kochan and Rubinstein (2000, p. 373) who claim that stakeholders must fulfil three preconditions in order to be important for the firm: They must supply resources that are critical for the firm’s success, they must have some valuable asset at risk, and they must possess sufficient power to influence the firm.

2.2 Stakeholder View and Stakeholder Management

The stakeholder view groups the firm’s stakeholders into three categories according to the firm’s strategic environment, hence on the one hand integrating the resource-based view and the industry structure view into the stakeholder view framework, and on the other hand extending the framework by social and political aspects (Post/Preston/Sachs 2002, pp. 54-55):

- The first group comprises the firm’s own resources such as employees, customers, suppliers and investors. This category reflects the resource-based view as all of the company’s resources are represented in some way by various stakeholders. Besides, the company’s relationship with its stakeholders allows it to make the resources available and productively functional.
- The second group consists of the stakeholders affecting the firm’s industry, i.e. regulators, unions, joint venture partners. Depending on the type of relationships that the company has developed with its stakeholders, they will be more or less
collaborative and reliable in their dealings with the company, as stated in the industry structure view.

- The third group includes the firm’s social and political environment, i.e. governments, communities, and NGOs. The stakeholder view thus provides a comprehensive perspective on the operations of the company, it penetrates the strategy-structure-culture nexus and leads the company to engage in continuous organizational learning.

As implied above, the stakeholder view is based on reciprocal relations between the firm and its stakeholders since the stakeholders can benefit from the firm and vice versa. Even though the relations between firm and stakeholders are usually dyadic, the stakeholders build a network from the firm’s point of view, i.e. the stakeholders are also connected among themselves through their relations to the firm. In order to benefit from this network and to generate sustainable wealth for all parties included, a firm must “manage” its stakeholder interactions (Sachs/Munshi 2003). This management includes the identification of the main stakeholders, getting acquainted with their interests and desires as well as the establishment of mutually beneficial relations to them. The ultimate product of effective stakeholder relations is the company’s “license to operate”, an asset without which the company cannot exist.

2.3 Stakeholders and Organizational Wealth

The creation of organizational wealth with the support of its stakeholders is vital to the firm. Wealth is not an abstract notion but has decisive impacts on the company and its stakeholders. Employees may benefit from higher salaries, better job and career conditions; shareholders can expect higher returns on their investments; customers may buy products of higher quality; and the firm itself is generally better equipped to deal with adverse conditions, to enhance its wealth by investing in new ideas, new
products, new markets or other firms and thus into sustainable success. In short, wealth represents long-term value (Post/Preston/Sachs 2002). Both the company and its stakeholders can therefore benefit from mutually respectful relations and the joint creation of wealth.

Wealth can be of tangible (e.g. property, capital) and/or intangible (e.g. knowledge, reputation) nature (Sveiby 1997). Stakeholders can transfer their knowledge to the firm and hence contribute to the creation of new knowledge, i.e. they are resources who provide valuable intangible assets. Thus, by establishing and maintaining good relations to and knowledge exchange with their stakeholders, firms are able to create resources that are difficult to imitate since no other firm can establish the same relations to the same stakeholders and create the same knowledge. The major advantage of the stakeholder management and the stakeholder view therefore lies in the creation of a sustainable competitive advantage, which is especially important in a dynamic and rapidly changing environment (Teece/Pisano/Shuen 1997). The requirement of the resource-based view to create firm specific competences and the demand of the market-based view to raise the entry barriers to markets are both met by the stakeholder view.

The combination of knowledge management and stakeholder management may present a solution to the corporations’ dilemma between exploration and exploitation (Crossan/Berdrow 2003). Not only do firms need to gain a competitive advantage, they also need to be innovative in order to be continually successful. Too often, however, it can be observed that firms have difficulties finding a balance between these two poles, adhering to once successful strategies and walking down beaten paths for too long, until they are finally overtaken by competitors (Brown/Eisenhardt 1997). In this situation, the stakeholders’ knowledge may be helpful not only in finding and evaluating new processes, products, and services, but foremost in perceiving the changes in the environment and the dwindling competitive advantage.

### 2.4 From Theory to Practice

In order to benefit from stakeholder relations, firms have to know how they can develop and implement such relations, i.e. how the stakeholder view can be applied in practice. This is the goal of the research project that will be described in more detail in the ensuing part.

In a first step, the firms’ stakeholder relations are analysed in order to develop tools, policies and practices for stakeholder management. In a second step, problems that may arise in the implementation phase are investigated and solved. And finally, once a successful stakeholder view has been established in the firms, their effects have to be measured, i.e. the financial, economic, social and ecological results of the applied practices are recorded.

The project not only aims at establishing good practices for the firms, but also at advancing the stakeholder view as a scientific concept.
3 Research Project “Good Practices of Stakeholder View”

3.1 Background and Goals

Led by the professors Sachs and Rühli, a research group has existed for several years which committed itself to the investigation of the role of the firm and particularly the firm’s stakeholder management. In three longitudinal case studies in which the firms Cummins, Motorola, and Shell were involved, the group – in cooperation with James Post and Lee Preston – has gained insights into the firms’ evolutions, their learning processes and the development of their respective stakeholder management. The results of this project are elaborated in the book “Redefining the Corporation” (Post/Preston/Sachs 2002).

By employing a new series of longitudinal case studies, the current project aims at deepening and broadening the previous research (see also Sachs/Rühli 2004). Approximately ten Swiss-based, yet internationally active firms in different industries (e.g. financial services, telecommunications, chemical industry) are being investigated, firms that already display a stakeholder orientation. The question is raised why and how these firms develop their stakeholder management, and how this influences their creation of organizational wealth. By analysing the implementation of the Stakeholder View in practice, the research team intends to develop tools and good practices for the Stakeholder View, to refine the Stakeholder View framework and to contribute novel insights to the strategy theory. For this purpose, the following research questions will be investigated:

1. How and why did each of the participating companies adopt a broad stakeholder orientation?
2. What is the content of their stakeholder-oriented policies and their impact on knowledge management? How is stakeholder management institutionalised and how is the corporate governance influenced? What are the core values on which the stakeholder orientation is based?
3. How are stakeholder policies and practices implemented and what are the corresponding learning processes?

By answering these questions, the research project is based on the principle that “corporations ARE what they DO.” (Post/Preston/Sachs 2002, p. 8)

3.2 Design and Method of the Case Studies

Case studies are – compared to e.g. experiments, surveys or other research strategies – the most suitable research instrument “when ‘how’ or ‘why’ questions are being posed, when the investigator has little control over events and when the focus is on a contemporary phenomenon within some real-life context.” (Yin 1994, p. 1) They are especially useful “when the boundaries between phenomenon and context are not clearly evident.” (Yin 1994, p. 13) Moreover, multiple sources of evidence can be
investigated. The current research project on the firms’ stakeholder management fulfils all of these conditions, i.e. case studies are the appropriate procedure.

In the current project, the case studies comprise significant documents and interviews with corporate representatives. The documents are supplied by the firms and will be analysed in a first step. Based on these findings, the questions for the interview partners are elaborated, and finally, the results of the document analysis and the interview statements are compared in order to disclose possible discrepancies between the firms’ assertions and visions and their actions. Thus, the statement of the stakeholder view that firms are what they do, can be evaluated.

Yin differentiates between five applications of case study research: “The most important is to explain causal links in real-life interventions that are too complex for the survey or experimental strategies. (...) A second application is to describe an intervention and the real-life context in which it occurred. Third, case studies can illustrate certain topics within an evaluation, again in a descriptive mode (...). Fourth, the case study strategy may be used to explore those situations in which the intervention being evaluated has no clear, single set of outcomes. Fifth, the case study may be a ‘meta-evaluation’ (...).” (Yin 1994, p. 15, italics by Yin) The research project will primarily make use of the first two applications.

As far as the case study design is concerned, Yin (1994, p. 38ff.) distinguishes four types which can be combined: single case versus multiple case designs and holistic versus embedded case studies resulting in holistic single-case, holistic multiple-case, embedded single-case or embedded multiple-case studies. Yin describes the advantages and suitability as follows:

- Single-case designs: A phenomenon can be studied in depth. It allows to test a well-formulated theory by studying (1) a critical case, (2) an extreme or unique case or (3) to analyse a previously inaccessible phenomenon resulting in a revelatory case.
- Multiple-case designs: This approach considers a phenomenon in a more general way but it also offers the opportunity to compare the findings of the different cases with each other.
- Holistic: This means that a single unit of analysis is chosen which can then be viewed in its entirety. The case is examined in its global nature.
- Embedded: Here the focus lies on multiple units of analysis, i.e. subunits of the case.

For the present research project, an embedded multiple-case study has been chosen as the different firms are to be compared with regard to different aspects (history, culture, strategy, etc.) of their stakeholder relations. These aspects are treated as subunits of the overall case.

As the case studies are used for theory building, the research methods must not only include qualitative-explorative methods as described by Yin (1994) but also comprise techniques for qualitative data analysis and for grounded theory building (Eisenhardt 1989, pp. 532-533). The grounded theory “relies on continuous comparison of data and theory beginning with data collection” (Eisenhardt 1989, p. 534), i.e. it consists of
an interplay between data and theory which mutually influence each other. Just as the case studies, this method is also highly suitable for the investigation of unexplored phenomena, as it is likely “to generate novel and accurate insights into the phenomenon under study.” (Brown/Eisenhardt 1997, p. 2)

Qualitative data is a term to represent verbal or narrative pieces of data, as opposed to quantitative data, i.e. numbers. Qualitative data is collected through interviews, open ended questionnaire items, and other less structured situations. In the research project, the analysis of the data is accomplished with ATLAS.ti.

3.3 Objective Hermeneutics

The objective hermeneutics which are mainly influenced by Oevermann (2002) are a qualitative method to interpret texts. Its aim is not to unveil the author’s intended meaning but to discover the text’s latent meaning. The text is analysed sentence by sentence or even word by word rather than as an integrated unit, i.e. a sequential analysis is made. Again, this is a method suited to shed light on the structures of little explored research fields and phenomena.

The objective hermeneutics’ core statement is that “Der Fall ist, was der Fall ist”, i.e. only what actually happened is relevant. This implies that a difference between a statement and an action can occur. The paramount goal is to access the data as unfiltered as possible, i.e. richness of data is the primary goal, while the methods used to process the data are secondary. The fundamental claim of the Stakeholder View, i.e. that corporations are what they do, has therefore to be grasped in as original a way as possible.

The objective hermeneutics accepts that the data collection is subjective. In analysing the data, however, objectivity is strived for. The traces of actions can be elicited in the minutes of the accomplished interviews. The texts and the minutes are the measuring data (Oevermann 2002, pp. 3ff.). The case is not described by the interviews but reconstructed (Oevermann 2002, p. 10). Thanks to the sequential analysis, change processes become visible allowing generalisations to be made based on the research results (Oevermann 2002, p. 12).

In order to interpret the texts, they need to be codified sentence by sentence. These codes can then be compared to the codes of other texts and similarities and differences can be elicited. This leads to a qualitative data analysis which is done – as mentioned above – with the help of ATLAS.ti.

3.4 Procedure of Coding

The text interpretation is divided into several phases and supported by ATLAS.ti. In a first step, coding teams are built (usually in pairs) who each deal with a particular aspect of the text, i.e. one team may analyse a firm’s strategy, another the same firm’s history and a third its structure. The documents are then analysed and coded individually and afterwards the results are compared within the team and coded in ATLAS.ti. The purpose of this separation between individual and team coding is to
measure the interrater reliability, i.e. the extent to which two or more individuals (coders or raters) agree on the codes they have made in the documents. The interrater reliability addresses the consistency of the implementation of a rating or code system. Thus, the higher the percentage of agreement within the team, the better. Once all codes are recorded electronically in ATLAS.ti, they can be examined in order to see what insights can be gained on the firm with respect to its stakeholder management.

3.5 Status Quo of the Case Studies

Currently (end of August 2004), two case studies have been finished. As one of the analysed firms, Sunrise, has not (yet) agreed to a publication of its case results, they cannot be included here. Therefore, only the results gained on Swiss Re are briefly summarized in the following paragraphs.

3.5.1 Swiss Re

The aim of the project is to examine firms’ learning processes. The team consequently makes references throughout to the “the stakeholder view of strategy” (Post/Preston/Sachs 2002) and to the methodology of comparative case research.

The team carried out its analysis of Swiss Re from a stakeholder perspective between June and December 2003. The results and findings are based on the analysis of some 20 key documents and on 21 interviews conducted with the former and current CEO, other members of top management, divisional heads and staff members of the different business groups in Europe, the US and Asia.

The key results can be summarised as follows:

The research group identified nine events that have deeply influenced Swiss Re’s development and – more specifically – its interaction with stakeholders throughout its history since 1863. The most important event of the last decade was “globalisation”, which induced Swiss Re to transform itself from a diversified international Swiss company into a global company with three quite different cultures, three business groups and a focused divestment as well as a merger and acquisition strategy. Throughout its turbulent history, Swiss Re has continuously developed its strategy, its structure and its culture in response to these nine events. However, there was not one single event which acted as a “wake-up call”, prompting the company to make fundamental changes in the way in which it interacted with its stakeholders. The amount of attention Swiss Re paid its strategic stakeholders changed over time and was influenced by each of the events in question. Two key patterns emerge when the company's history was examined:

- Swiss Re has repeatedly responded in a proactive manner to new economic and environmental trends, developing the requisite resources to gain or sustain a competitive advantage.
- Swiss Re has maintained an extremely solid financial structure over the years so as to overcome setbacks and major failures and, therefore, to maintain trust.
Given the highly uncertain and volatile conditions in which Swiss Re operates, these two patterns point towards a promising future.

The analysis has made clear that Swiss Re (and this is in line with the concept of the stakeholder view of strategy) views interaction with its strategic stakeholders from a value creation perspective. Stakeholder relations are viewed for the most part in terms of their value creation potential. Consequently, stakeholders are either risk bearers resp. risk providers, or benefit bearers resp. benefit providers. There were few references in the interviews to stakeholder attributes such as power, legitimacy, urgency or interrelatedness. Shareholders/investors, employees and clients are Swiss Re's traditional strategic stakeholders, while regulators are regarded as being a future strategic stakeholder. Swiss Re must therefore act with professionalism when dealing with these relationships, especially at the local level.

Based primarily on the interviews, improvements in stakeholder management could be made in the following areas:

- The relative importance of traditional and future strategic stakeholders should be clarified so as to avoid unnecessary costs and a deterioration in performance arising from uncertainty, as well as to avoid losing their trust.
- A systematic stakeholder identification and evaluation process can contribute to more focused stakeholder management. Given Swiss Re's remarkable differences by region (Asia, US, Europe) and product line, it may be necessary to complement a general stakeholder analysis with specific aspects of the different regions and business groups.
- Interaction with future strategic stakeholders, such as regulators, rating agencies, analysts, etc, could be increased to improve their value contribution.
- Networked thinking could be developed further and lead to the systematic use of unique internal and external sources of knowledge.
- The responsibilities of the different organizational units as regards stakeholder management and interaction could be expanded so to ensure “stakeholder-networked” thinking.
- The process of systematic involvement of stakeholders in the company's strategy could be improved. The Top Topics approach could be linked up more systematically with stakeholder management. By adopting not only an issue-centred approach via its Top Topics but also a stakeholder-oriented one, Swiss Re would have a system of “diagnosing” future topics of strategic relevance.

Swiss Re’s strategy from a stakeholder perspective is a prime example of a resource-based company. Employees are viewed as key knowledge providers and clients enjoy a high level of knowledge-based services. The company invests a considerable amount in the development of its employees, while acquisitions have always been partly aimed at acquiring knowledge. In an ever more complex and knowledge-oriented society, investments in knowledge development in the context of a stakeholder network are crucial if a company is to secure future competitive advantages. Mergers and acquisitions are also widely used to enhance market share and market coverage. Furthermore, a strong capital base is crucial in the reinsurance business and a precondition for any strategic move. Shareholders are thereby “strategic” stakeholders. After some substantial divestments in the 1990s, Swiss Re had the
financial resources to make acquisitions in its core business area. This strategy has been welcomed by strategic stakeholders, such as investors, clients and employees, but leads to higher exposure by attracting the attention of an increasing number of stakeholders.

By means of far-reaching changes in the 1990s, Swiss Re fundamentally restructured its business and organizational structure to respond to the necessities of globalisation and to its own strategic focus. Swiss Re has developed an increasingly transnational structure with specific organizational units devoted to improving relations with its stakeholders (e.g. units dealing with investor relations, sustainability, governmental relations).

Swiss Re is in the vanguard of developments in the corporate governance area (e.g. composition of the board of directors), meaning that its board members are required to take stakeholder relations into account. New developments in the field of corporate governance processes (e.g. reporting, disclosure) are being studied. As far as the role of stakeholders in corporate governance is concerned, shareholder representatives continue to predominate, while the potential of other stakeholders as knowledge providers is taken into account indirectly via board members' personal and professional relationships.

Due to its worldwide activities, Swiss Re has broad experience in working in different cultural settings. This experience can also be put to good use in stakeholder relations, where differences exist between clients, employees and regulators. Swiss Re is currently in the throes of a transformation process from an international to a globalised company. At the corporate level, Swiss Re aims at maintaining a number of core values, sustainability being one of them. However, the interpretation of what sustainability is across the Group is very unclear and contradictory. Clarification is needed. Remarkable cultural differences exist between the European (Zurich), Anglo-American and Asian cultures, which challenges the new core value of “multiculturalism”. There are some uncertainties about the growing Anglo-American influence and the shift from an employee- and client-oriented culture to a cost- and performance-oriented one that favours shareholder and investor relations. At divisional level, cultural differences arise from the different nature of business carried out by the three business groups, which in turn influences client, employee and regulator relations. In addition, there is a need for core values to be interpreted at a regional level. This makes for a stimulating sense of diversity but is not always without its tensions.

Due to the nature of reinsurance business, Swiss Re takes a mainly long-term view in its planning processes. Stakeholders, especially strategic ones, are involved in the company's strategic processes in a number of ways and to varying degrees. As in other companies, Swiss Re's employees have a major influence on these processes due to their know-how and to stakeholder relations. Based on corporate law, shareholders and, more specifically, their elected members on the board, have a dominating influence through their voting power. When executing this power, they are often influenced by other stakeholders and opinion leaders, such as rating agencies, analysts, etc. Special information processes are institutionalised to maintain good investor relations. As regards the planning processes, there is considerable stakeholder
involvement on the part of clients which is based on an interactive relationship. As regards other stakeholder relations, Swiss Re’s processes are characterised to a high degree by a top-down approach that is centralised at corporate level.

In keeping up with the current trend that can be seen in the western economies, Swiss Re is now clearly performance driven. This is particularly evident in Swiss Re's Anglo-American lines of business. Even if the company has a sustainability report and issues clear statements on ecological and social performance, such aspects are expected to make a clear contribution towards improved financial performance. The contribution of the sustainability concept to Swiss Re’s results and success was viewed differently by those interviewed.

Swiss Re demonstrates a great deal of willingness to learn, as evidenced by the “globalisation”, “economic downturn after 2000” and “terrorism” events. Swiss Re demonstrates the importance and impact of these events in three basic ways:

First, the nature of the reinsurance business is long term and aimed at sustainability. This makes it extremely important for Swiss Re to monitor risk in a comprehensive way, thereby challenging the company to remain at the forefront of economic, social and ecological developments.

Second, Swiss Re has always demonstrated humanistic commitment to its employees. Their knowledge is vital if the company is to succeed in its aim of being an authority on managing capital and risk. Swiss Re thus constantly aims at being a good employer. This humanistic commitment is now being challenged by certain events, especially by the drive towards more efficiency in a purely economic sense given the often short-term nature of shareholder and investor relations. Furthermore, we can observe a growing challenge arising in the area of social development. Society's new understanding of risk is bringing Swiss Re increasingly into the limelight with the growing importance of insurance industry regulations.

Third, the growing number of natural catastrophes and globalisation are challenging Swiss Re's sustainability and multicultural focus. This enhances the importance of stakeholders, such as NGOs and regulators, and increases the complexity of the stakeholder environment in which Swiss Re operates. The globalisation challenges have led to a transformation in Swiss Re's learning process and to fundamental changes in its core structure. The cultural changes are still under way, while the other events are less important and still require a process of ongoing adaptation and learning. Some interview partners considered that more systematic learning was necessary.

At the moment, two further case studies are under way, both done with firms from the telecommunications industry. This will lead to first intra-industry comparisons.
4 Knowledge Management Requirements in Case Studies

In order to gain and create knowledge from case studies, the following preconditions have to be fulfilled:

a) Comparability
In case studies, numerous data from documents and interviews have to be collected, processed, analysed and compared. This comparison needs to be done in an efficient way and across the single cases as well as between the data and their underlying theory in order to adapt the theory if necessary. A connection has to be made between the data and the conclusions drawn from them, so that the path the researcher has followed to reach his/her conclusions can be comprehended and reconstructed by others, thus rendering more plausible results. To compare the cases, patterns have to be extracted and tested against each other in order to be able to generalize them and to make universally valid statements.

b) Different Perspectives
The data has to be viewed from different angles so as to prevent the researchers from jumping to premature conclusions. Instead, reliable theories are to be built and novel insights discovered. This implies that the data has to be structured in a way that allows for the building of categories that can be compared and contrasted or that cases can be compared in pairs in order to gain new knowledge (Eisenhardt 1989, p. 540).

c) Accessibility
In longitudinal case studies, it is important that the data can be quickly and easily accessed and reproduced several years after it has been collected. Hence, old and new cases can be compared and new knowledge can be generated.

d) Visibility
In order to create new knowledge from case studies, the results and insights have to be made visible and explicit so as to be able to share them among the researchers.

e) Knowledge Creation
The results gathered from the case studies mainly represent data and information. They have to be converted into knowledge in order to gain generally valid insights which can in turn be applied to further case studies.

f) Knowledge Dissemination
The knowledge has to be dispersed within the team so as to lift everybody to the same level of knowledge, and also to shape this knowledge into good practices for the corporations.
Part II: Knowledge Management

In this part of the paper, different aspects of knowledge and different models for knowledge creation and management will be described and examined. By combining knowledge management and stakeholder management, firms are enabled to learn from their stakeholders, to transfer the stakeholder knowledge into the firm and combine it with the employees’ knowledge which in turn leads to the creation of valuable intangible assets and the increase of the company’s wealth (cf. Part I). For this reason, individual and organizational learning play an important role and are regarded as vital parts of knowledge management.

Simultaneously, a knowledge management model must also be applicable to the research project and to the knowledge creation and dissemination that occurs in case studies. And last but not least, the chosen model must be suited to integrate IT systems and tools that support knowledge management in case studies (cf. Parts III and IV).

5 From Signs to Knowledge

As mentioned above, knowledge is a valuable, yet intangible asset to firms since it can constitute a sustainable competitive advantage. However, it is also an elusive good which has to be carefully nurtured. In contrast to other firm resources, it is unlimited and does not diminish with use. Quite the opposite is true: The more it is used, the more it increases. Or as Davenport and Prusak formulate it, “Ideas breed new ideas, and shared knowledge stays with the giver while it enriches the receiver.” (2000, p. 17) Its potential for growth is without limits.

Knowledge is as elusive as the term is difficult to define. In the following paragraphs, an attempt will be made to shed some light on it and to look at it from different perspectives.

5.1 Signs, Data, Information

In knowledge management literature, a differentiation between signs, data, information, and knowledge is commonly made. The terms can be defined as follows (Davenport/Prusak 2000; Krcmar 2003):

- Signs: Comprising letters and figures, signs are located at the bottom level and build the foundation for all higher-order terms.
- Data: When signs are attributed to an alphabet, they turn into data. The formation of the signs has to adhere to certain syntactical rules in order to become data, thus resulting in objective facts about events. Data itself carries no meaning but build the raw material for the creation of information.
- Information: Data enriched by a context which gives it a specific meaning is called information. Information is some type of message, be it written, audible or visible. Information is exchanged between a sender and a receiver and contains a meaning which can be semantically analysed. To Bateson, information consists of “differences that make a difference.” (1979, p. 5) This is the preliminary stage to
knowledge as it affects knowledge by restructuring or expanding it (Machlup 1983).

### 5.2 Definition of Knowledge

To Probst, Raub and Romhardt (2003, p. 22), knowledge comprises all skills and abilities that individuals use to solve problems. Knowledge therefore possesses theoretical and practical characteristics which are based on data and information.

The definition given by Davenport and Prusak is broader as it includes experience and bridges the chasm to organizational knowledge:

> Knowledge is a fluid mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms. (2000, p. 5)

Davenport and Prusak stress the contrasts and paradoxes inherent in knowledge, i.e. it is fluid yet formally structured, it exists in people but also in firms.

To Willke (2001, pp. 11-12), the important aspect of knowledge is that it cannot exist without a (human) memory and is therefore tightly interwoven with experience. Moreover, it is always tied to a purpose and created when experience is enriched with information.

Different as their definitions may be, all authors agree that knowledge is many-faceted, is tied to human beings and their experiences, and combines theory and practice. Knowledge allows people to integrate new information, to make decisions and act efficiently. It is constructed by individuals and depends on their perceptions, pre-knowledge, and motivation to acquire new knowledge. As an individual’s knowledge is unique, it cannot be copied by others.

By ascribing dynamical aspects to knowledge, Nonaka and Takeuchi (1995) further broaden its definition and introduce qualities to explain not only knowledge as such but its actual creation as well. For this purpose, the authors differentiate between epistemology and ontology. Epistemology is the theory of knowledge in which the distinction between implicit and explicit knowledge builds the cornerstone (for a definition cf. chapter “5.3 Implicit Versus Explicit Knowledge”). Ontology is concerned with the different levels of knowledge-creating entities, be they individual, group, organizational or inter-organizational.

To Nonaka and Takeuchi, knowledge consists of three components:

First, knowledge, unlike information, is about beliefs and commitment. Knowledge is a function of a particular stance, perspective, or intention. Second, knowledge, unlike information, is about action. It is always knowledge ‘to some end’. And third, knowledge, like information, is about
meaning. It is context-specific, and relational. (1995, p. 58, italics by Nonaka/Takeuchi)

With their view of knowledge as a “justified true belief”, Nonaka and Takeuchi introduce a dynamic aspect: “We consider knowledge as a dynamic human process of justifying personal belief toward the ‘truth’.” (1995, p. 58, italics by Nonaka/Takeuchi) Knowledge is considered as a flow of information tied to a person’s beliefs and commitment and therefore related to human action. This combination of knowledge and action is the bridge to knowledge creation. As knowledge creation represents an important aspect of this paper, this is the definition that will be used hereafter.

5.3 Implicit Versus Explicit Knowledge

For knowledge management and the case studies, the distinction between implicit (or tacit) and explicit knowledge – which was first introduced by Polanyi (1958) – is of vital importance. Explicit knowledge can be reproduced and transmitted by words or figures, i.e. by language and is therefore knowledge of which people are aware. Implicit knowledge, on the other hand, is difficult to formalize and to pin down as it contains a personal quality, i.e. it is tied to a person and is interwoven with the person’s actions and experiences in a certain context. The person may be unconscious of this implicit knowledge (Nonaka/Takeuchi 1995; Willke 2001). Polanyi expressed these characteristics by stating that “we know more than we know how to say.” (1958, p. 12)

Nonaka and Takeuchi (1995, p. 60) apply Polanyi’s definition in a practical way by attributing technical and cognitive elements to tacit knowledge. The latter comprise mental models, such as beliefs, paradigms, schemata which are created by human beings in order to define their world, to integrate new knowledge and to combine it with existing analogies and images. Practical know-how, crafts, and skills, on the other hand, build the technical side of implicit knowledge.

The aim of the case studies is to derive good practices of stakeholder management for the firms. Such practices represent explicit knowledge which can only be obtained if the implicit knowledge that the researchers acquire during the case studies can be externalised, formalized and converted into explicit knowledge. The following models illustrate the different attempts to solve this problem.
6 Organizational Learning and Knowledge Creation

When Argyris and Schön first introduced their notions on organizational learning in the 1970s, even scholars turned their backs on these novel ideas as they found them confusing or even repugnant:

To the distinguished social scientists who were repelled by the idea when we first broached it in the early 1970s, ‘organizational learning’ seemed to smell of some quasi-mystical, Hegelian personification of the collectivity. Surely, they felt, it is individuals who may be said to learn, just as to think, reason, or hold opinions. To them, it seemed paradoxical, if not perverse, to attribute learning to organizations. (1996, p. 4, italics by Argyris/Schön)

Even their publishers had second thoughts on the topic and doubtfully asked Argyris: “We know you and we know Don, and we respect both of you, but do you think this topic will ever be of interest to the business community?” (Crossan 2003, p. 40)

Today, in the “knowledge age”, organizational learning is an undisputedly important concept, an imperative both in the academic and the practical world, especially as it is a prerequisite for organizational knowledge creation. Yet, the fundamental questions posed in 1978 remain unchanged: What is organizational learning and how can it be achieved?

Organizations are social systems populated by human beings. Argyris and Schön even describe them as living organisms consisting of cells, each of them containing a small, changing image of itself that contributes to the whole, overall picture (1996, p. 16-17). The foundation for organizational learning is therefore built by these cells, i.e. by individual learning. In order for organizational learning to occur, the various authors who investigated this topic agree that the individuals in the organization need a common basis which they can develop and alter together. This basis is by some described as shared mental models (Kim 1993; Nonaka/Takeuchi 1995), by others as a collective frame (Probst/Raub/Romhardt 2003), or as metanoia which means a “shift of mind.” (Senge 1990) Whichever term is used, all authors also agree that organizational learning is – similar to organizational specialization which leads to higher productivity – ideally more than merely the sum of individual learning. In addition, it is the basis for knowledge creation and knowledge management, as will be seen in the following chapters where four models of organizational learning are introduced.

6.1 Organizational Learning by Argyris and Schön

Individual and organizational learning are, according to Argyris and Schön (1978; 1996), indispensable prerequisites to organizational knowledge. Human action and human learning are part of knowing. As learning consists of taking action and reflecting on it, organizational knowledge is related to tasks that can be represented as “systems of beliefs that underlie action.” (1996, p. 12) This is the foundation of Argyris and Schön’s “theories of action” which consist of norms, strategies, and
assumptions. They can be divided into “espoused theories” and “theories-in-use” which can differ considerably:

- **Espoused theories:** These are the official theories in an organization, represented for example by strategic concepts, organization charts, job descriptions or policy statements and express explicit knowledge. They form a frame of reference, a scaffold to support employees in their decision-making processes but also leading them in a direction desired by the organization.

- **Theories-in-use:** They are not given but must be constructed from observation and comprise the activities of daily life, thereby representing tacit knowledge. Constructing their own individual images of their organization and the world, employees use these images as theory-in-use for their activities. These images do not exist on their own but individuals strive to complete them by adapting them to those of other individuals. Theories-in-use may or may not be compatible with the espoused theories, irrespective of whether a person is aware of a possible mismatch. Changes in the theory-in-use lead to organizational learning.

Individuals construct their own image of the theory-in-use. However, since these images are always imperfect, individuals continually strive to complete them. Simultaneously, conditions inside and outside the organization change which forces the individuals to modify their images. Yet, individuals also need external references to adjust their images, such as organizational maps (e.g. work flow diagrams, organization charts), memories (e.g. files, databases), and programmes or organizational routines (e.g. policies, protocols, guidelines). Together with the employees’ individual images, these maps, which represent shared descriptions of the organization, build the basis for organizational learning. The organization is thus perceived as an organism consisting of numerous cells, each containing a tiny part of the overall image and each not only constantly changing its own shape but also that of the whole organism. Organizational learning is therefore perceived as an active process in which members attempt to understand their organization and to know themselves in the context of the organization.

The context in which organizational learning occurs, is described as follows by Argyris and Schön:

*Organizational learning occurs when individuals within an organization experience a problematic situation and inquire into it on the organization’s behalf. They experience a surprising mismatch between expected and actual results of action and respond to that mismatch through a process of thought and further action that leads them to modify their images of organization or their understandings of organizational phenomena and to restructure their activities so as to bring outcomes and expectations into line, thereby changing organizational theory-in-use. In order to become organizational, the learning that results from organizational inquiry must become embedded in the images of organization held in its members’ minds and/or in the epistemological artefacts (the maps, memories, and programs) embedded in the organizational environment.* (1996, p. 16, italics by Argyris/Schön)
Changing the theories-in-use is therefore always a collective act and is accompanied by changes in behaviour and of the individual images. Learning processes occur when individuals realize that the theories-in-use do not lead to the expected results. At this point, the learning loop sets in as individuals reflect and change the theories-in-use. Argyris and Schön distinguish three types of learning in such a situation: single loop, double loop, and deutero learning.

- **Single loop learning**: This is the simplest type in which learning occurs in a single feedback loop when actual and expected results are compared. If a discrepancy becomes visible, the strategies of action are altered but not the values underlying the theory of action. However, neither the expected results (such as objectives, values, norms) nor the reason for the divergence are analysed. Single loop learning is suitable when errors are detected and have to be corrected. It leads to efficiency, i.e. the focus lies on doing things right and achieving existing goals at the lowest possible costs. Even though individuals learn, the organization does not, as the individuals’ discoveries are not embedded in the shared maps of the organization’s theory-in-use. Thus, the common basis upon which the members act remains unchanged.

- **Double loop learning**: A double feedback loop is applied in which the values of the theory-in-use not only change but are also questioned and adapted if they are considered undesirable or inadequate. This results in efficiency as well as effectiveness, i.e. in doing the right things which is achieved by communication processes among the individuals as they exchange different views on the problem and eventually agree on a new, common strategy and theory-in-use. Hence, the results are embedded in the maps and images of the organization, which means that – as they build the foundation upon which the individuals act on behalf of the organization – the organization and the individuals both have learnt.

- **Deutero learning**: This is the highest level of learning or “second order learning”, as Argyris and Schön call it and focuses on learning how to learn. It enables individuals to “discover and modify the learning system that conditions prevailing patterns of organizational inquiry.” (Argyris/Schön 1996, p. 29) Efficiency and effectiveness are achieved as individuals learn to handle single and double loop learning, i.e. they become aware in which situation single loop learning is adequate and when double loop learning is required. Getting acquainted with the mechanisms that foster or inhibit learning, they invent new learning strategies, evaluate novel insights and adapt their images and maps, thus also altering the organization’s images, maps and theories-in-use (Argyris/Schön 1978, p. 27). Learning processes are hence consciously incorporated into the organization which means that both individuals and organization learn. As Argyris and Schön define organizational knowledge as “systems of beliefs that underlie action”, the knowledge basis is broadened as well.

The three types of learning can be illustrated by the following graphic:
6.2 The Cycle of Choice by March and Olsen

According to March and Olsen, learning processes occur in ambiguous situations, i.e. if the organization’s goals are not clearly defined or even conflicting (1988). By applying the concept of bounded rationality to organizational learning, they strive to improve the theory of organizational decision making. March and Olsen see organizational learning as a stimulus-response-cycle between individual and organization as well as between inside (organizational) and outside world, which is triggered by a discrepancy that individuals notice when they compare the world (or their organization) as it ought to be to how it actually presents itself in reality:

At a certain point in time some participants see a discrepancy between what they think the world ought to be (given present possibilities and constraints) and what the world actually is. This discrepancy produces individual behavior, which is aggregated into collective (organizational) action or choices. The outside world then ‘responds’ to this choice in some way that affects individual assessments both of the state of the world and of the efficacy of the actions. (March/Olsen 1988, p. 337)

Based on these assumptions, March and Olsen developed their concept of the cycle of choice which consists of four parts. The first is individual beliefs and comprises a person’s cognitions and preferences, his/her models of the world. The cycle starts when individuals note certain events in their environment, compare them with their individual models of the world and act upon the results of this comparison. In the second part, the actions and choices of individuals influence the organization’s actions, and in turn the results that are achieved. With this the third part of the cycle, the transition from individual to organizational learning is accomplished. The final part contains the environment’s actions and reactions which again influence the individuals’ beliefs, thereby completing the cycle.
Learning therefore means that the individuals and the organization adapt to their environment by influencing each other and by reacting to these influences. However, four cases exist in which the learning cycle is interrupted and remains incomplete.

1. Role-constrained experiential learning: In this situation, individual learning has no or only little effect on the individual’s behaviour. The reason lies in the difficulty of transferring perceptions into actions. Constraints of role-definitions or standard operating procedures are responsible for the interruption of the circle.

2. Audience experiential learning: The connection between individual and organizational behaviour becomes problematic. Thus, a situation occurs in which the individual learns and adapts his/her behaviour but has no influence on the organization’s behaviour and actions. This may be caused by micro-political influences barring and dominating social processes.

3. Superstitious experiential learning: Even though individuals learn and act accordingly and even though the organization is influenced by the individuals’ behaviour, the organization’s activities evoke no (detectable) reaction and no change in its environment. Despite this lack, the learning process of individuals and organization continues and their behaviour alters. However, as no environmental reaction is detectable, this can be misinterpreted by individuals which leads to a new learning process and an organizational behaviour that again does not affect the environment.

4. Experiential learning under ambiguity: In this case, an environmental reaction can be detected, but what happened or why it happened remains unclear. Since this leaves much room for (mis)interpretation, individuals may draw wrong conclusions. This may occur when individuals’ maps and images are strongly influenced by the organization and hence differing images are not perceived or denied.
According to March and Olsen, an organization can only be successful if it is able to adapt to its environment. The people in the organization are the key to success. Their experience and their learning processes influence the organization’s actions and improve its situation over time – provided the information on which the individuals rely is accurate, the goals to be achieved are clear and unchanging, and the environment stable. As March and Olsen know that these prerequisites are unrealistic, they plead for further investigation into learning processes under ambiguity because irrespective of the situation learning always takes place:

Despite the difficulties, it is important to study the process of learning in organizations. Individuals try to make sense of their experience, even when that experience is ambiguous or misleading and even when that learning does not affect organizational actions. (March/Olsen 1988, p. 356)

### 6.3 Individual and Organizational Learning by Kim

Kim’s learning model is a combination and extension of the approaches by March/Olsen and by Argyris/Schön which he calls OADI-SMM (Kim 1993). This acronym stands for “Observe, Assess, Design, Implement – Shared Mental Models.” The mental models not only serve as a construct explaining how people and organizations operate in the real world but they also illustrate how individual is transferred to organizational learning.

All organizations learn consciously or unconsciously, and this learning always occurs through individuals. Consequently, Kim builds his model of organizational learning on individual learning. According to Kim, learning can be split into two parts: One consists of know-how which means the acquisition of skills, i.e. a physical ability. The other is know-why or the conceptual understanding of an experience. Operational and conceptual learning are synonyms used to describe this differentiation. Learning is thus defined as “increasing one’s capacity to take effective action.” (Kim 1993, p. 38)

The individual learning cycle consists of four phases, i.e. “observe”, “assess”, “design”, implement” or OADI as Kim calls it. The cycle is tied to activities in an organizational context and starts when individuals notice certain events and observe their environment. In a next step, they judge and assess their experiences by reflecting on their observations. This is followed by phase three where people design an abstract concept that represents their observations. And finally, these concepts are implemented into real life situations and thereby their suitability is tested which leads to new experiences that trigger a new cycle.

As Kim states, this model does not take memory into consideration which plays a critical role in linking individual to organizational learning. For this reason, Kim introduces a distinction between learning and memory. From his perspective, learning means acquisition of knowledge, while memory is concerned with the preservation of knowledge and also comprises active structures which shape thinking, perception and action. Memory is therefore not simply a repository in which all experiences and perceptions are stored but it contains active components. In attempting to grasp the role and active structures of memory, mental models play an important part. They are
deeply held internal images of how the world works, which have a powerful influence on what we do because they also affect what we see. (…) Mental models represent a person’s view of the world, including explicit and implicit understandings. Mental models provide the context in which to view and interpret new material, and they determine how stored information is relevant to a given situation. (…) Mental models not only help us make sense of the world we see, they can also restrict our understanding to that which makes sense within the mental model. (Kim 1993, p. 39).

Within the mental models, two parts can be distinguished, i.e. frameworks and routines which comply to the terms introduced above, namely conceptual (reflecting on concepts, i.e. know-why) and operational (completing a particular task, i.e. know-how) learning respectively. Both affect and are affected by individual learning (cf. figure 4). This means that individual learning occurs when the individual changes his/her beliefs and these alterations are codified in the individual mental models.

Even though organizational learning is composed of individual learning, it is more than the sum of it. Yet, without individual learning, no organizational learning exists. Kim’s definition of organizational learning is analogous to individual learning, i.e. it is the organization’s capacity to take effective action. This is based on individual learning which changes the individual mental models and thus evokes an individual double loop learning. In a next step, these changes are made explicit and can hence be incorporated into the organization by affecting the shared mental models (which corresponds to an organizational double loop learning) representing the organization’s memory and its knowledge.
Kim also considers cases of incomplete learning. In addition to the four types distinguished by March and Olsen, he adds three more: situational, fragmented, and opportunistic (cf. figure 4).

- **Situational learning**: This type occurs when an individual encounters a difficult situation, finds a solution to the problem and moves on to the next task. Thus, even though individual learning does occur, the mental model remains unaltered as the solution is not codified and hence no organizational learning can ensue. A typical example of this kind of learning is crisis management.

- **Fragmented learning**: In this case, the individual learns and adapts his/her mental models but no transfer is achieved to change the shared mental models. This means that the newly acquired knowledge is lost when the individual leaves the firm. As an example of this learning type, Kim mentions universities: “Professors within each department may be the world’s leading experts on management, finance, operations, and marketing but the university as an institution cannot apply that expertise to the running of its own affairs.” (1993, p. 46)
Opportunistic learning: Sometimes, organizations need to quickly find a solution to a problem and have no time to follow the established way of doing so. They therefore purposely attempt to surpass the standard procedures. In such cases, an individual or a small group cuts the tie between shared mental models and organizational action in order to seize an opportunity. Kim’s example refers to IBM’s development of the personal computer.

In order to close the gaps on situational learning, Kim suggests that individuals must learn to transfer their insights into their own mental models and into those of the organization. Fragmented learning can be avoided by establishing micro-worlds or learning laboratories in which the consequences of organizational actions can be experienced with the help of simulators. A further advantage of such environments is that the implicit mental models are made explicit and can be transferred more easily between organization and individuals.

6.4  Knowledge Creation by Nonaka and Takeuchi

Taking the theories on organizational knowledge one step further than the authors discussed above, Nonaka and Takeuchi (1995) not only treat the question of how knowledge is transferred from individuals to organizations, but especially how new knowledge can be created, made available to all members of the organization and embodied in products and services. In order to explain their theory, Nonaka and Takeuchi distinguish between an epistemological and an ontological dimension of knowledge. The former describes the theory of knowledge, particularly its nature, sources, limits and comprises tacit and explicit knowledge. The latter, i.e. ontology, is concerned with the levels of knowledge creating entities to which the authors add individual, group, organizational, and inter-organizational knowledge. Within these two dimensions, knowledge develops as a dynamic, continually growing spiral (cf. figures 5 and 6).

Organizational knowledge can only be created if the individuals’ knowledge represented in mental models can be accessed, made transparent and disseminated throughout the company. This knowledge conversion can be achieved through a process of social interaction between tacit and explicit knowledge which comprises four modes: socialization, externalisation, combination, and internalisation, or abbreviated SECI (cf. figure 5).
Socialization is a process in which tacit knowledge such as shared mental models or technical skills is created by sharing experiences. The knowledge acquisition occurs without using language but rather through learning by doing, i.e. observation, imitation or practice. Within an organization, this type of learning can be fostered by on-the-job training, apprenticeships or other forms of shared experience. Nonaka and Takeuchi mention Honda as an example where brainstorming camps were introduced – “informal meetings for detailed discussion to solve difficult problems in development projects.” (1995, p. 63) Shared experiences allow for the dissemination of knowledge that cannot be explicited and grasped other than by associated emotions. Also the context in which the experiences are embedded play an important role. Socialization starts with building a so-called “field of interaction”, which facilitates the sharing of experiences and mental models.

With externalisation, tacit is converted into explicit knowledge. For this reason, it is the most important step in this model since it creates new knowledge. In dialogues and collective reflections, the explication becomes visible and assumes the shape of concepts, hypotheses, analogies and especially metaphors. By combining two ideas and allowing discussions on their similarities, inconsistencies and contradictions, metaphors not only support the explication of implicit knowledge but also the creation of new knowledge. Externalisation hence results in new concepts and common goals.

Through the process of combination, the metaphors, analogies and concepts gained in step two are transferred into a knowledge system. Explicit knowledge is linked, standardised and made accessible and thus disseminated throughout the organization. Combination is achieved through social processes such as meetings, e-mails, exchange of documents, etc. The reconfiguration and categorization of the available knowledge – in databases, for instance – can generate new knowledge. Examples of knowledge
transfer by combination are education and training at schools. In business, combination occurs when middle management break down the organization’s visions and turn them into operational concepts and actions. Explicit knowledge is tied to practical tasks.

The fourth and closing phase of the cycle is internalisation, where explicit is turned into implicit knowledge. This means that knowledge becomes embodied through collective activities, e.g. learning by doing or by trial and error processes. Experiences are internalised as shared mental models or skills and become valuable, intangible organizational assets. Parallel to the individual’s knowledge base, the organization’s knowledge base is expanded as well (cf. figure 6).

![Figure 6: Spiral of organizational knowledge creation (Nonaka/Takeuchi 1995, p. 73)](image)

In a next step, the cycle starts anew and grows into a self-enforcing spiral or, as Nonaka and Takeuchi explain:

The organization has to mobilize tacit knowledge created and accumulated at the individual level. The mobilized tacit knowledge is ‘organizationally’ amplified through four modes of knowledge conversion and crystallized at higher ontological levels. We call this the ‘knowledge spiral’, in which the interaction between tacit knowledge and explicit knowledge will become larger in scale as it moves up the ontological levels. Thus, organizational knowledge creation is a spiral process, starting at individual level and moving up through expanding communities of interaction, that crosses sectional, departmental, divisional, and organizational boundaries. (1995, p. 72)
Knowledge creation and expansion hence consists of implicit and explicit knowledge – which are “mutually complementary entities” (Nonaka/Takeuchi 1995, p. 61) – and social interaction. The organization can nurture this process by providing an appropriate environment that facilitates individual knowledge creation and group activities. Nonaka and Takeuchi identify the ensuing five elements to keep the knowledge spiral expanding (Nonaka/Takeuchi 1995, pp. 73-83):

- **Intention:** This describes the organization’s strategy, i.e. its aspirations and goals. The critical element is to conceptualise a vision indicating the type of knowledge that should be developed. Intention is often expressed by organizational standards which can be used to evaluate the created knowledge. By fostering the employees’ commitment, the organization can support knowledge creation.

- **Autonomy:** Individuals should be allowed to act as autonomously as possible. As this has a motivating effect on the employees and their willingness to create new ideas and to diffuse them in the team, the organization may be able to profit from unexpected opportunities, to increase its knowledge and therefore be able to react with greater flexibility to new challenges.

- **Fluctuation and creative chaos:** These are two elements that stimulate the organization’s interaction with its environment thus offering the opportunity to gain new insights and create new knowledge. Fluctuation is not a disorderly state but order containing patterns that are difficult to detect. Fluctuation can be purposely introduced into an organization in order to force individuals to break with their routines, habits and frameworks, and to fundamentally question and reconsider their thinking and their perspectives. Similarly, chaos can be generated intentionally as well by challenging tasks, hence evoking a sense of crisis in the individuals. The result of this “creative chaos”, as Nonaka and Takeuchi (1995, p. 79) call it, is that individuals focus their attention on the problems to be solved.

- **Redundancy:** Even though redundancy is usually frowned upon in information technology, Nonaka and Takeuchi advocate this concept of intentional overlapping of information. Having more data and information at one’s fingertips than actually needed supports knowledge creation: “Sharing redundant information promotes the sharing of tacit knowledge, because individuals can sense what others are trying to articulate. In this sense, redundancy of information speeds up the knowledge-creation process.” Nonaka and Takeuchi call this “learning by intrusion.” (1995, p. 81) Redundancy can be achieved by job rotation or competing groups developing different approaches to solve a problem. However, information overload should be avoided.

- **Requisite variety:** In order to successfully rise to new challenges, an organization’s internal diversity must match the complexity and variety of its environment. A possible solution to this problem is to develop a flat and flexible organizational structure in which all employees have equal access to information and in which the different units are interlinked with an information network.

As far as organizational knowledge creation is concerned, “the essence of strategy lies in developing the organizational capability to acquire, create, accumulate, and exploit
knowledge.” (Nonaka/Takeuchi 1995, p. 74) The main element in knowledge creation and management, however, is what Nonaka and Konno (1998) call “ba” (which can be translated by “place”). “Ba” can be any type of shared space that serves as a foundation for knowledge creation, i.e. it is a platform that turns information into knowledge:

… ba can be thought of as a shared space for emerging relationships. This space can be physical (e.g. office, dispersed business space), virtual (e.g. e-mail, teleconference), mental (e.g. shared experiences, ideas, ideals), or any combination of them. What differentiates ba from ordinary human interaction is the concept of knowledge creation. Ba provides a platform for advancing individual and/or collective knowledge. (1998, p. 40, italics by Nonaka/Konno)

Nonaka and Konno distinguish four types of ba, each of which corresponds to a specific stage in the SECI model, and each of which supports a particular knowledge conversion process, and thus advances the knowledge spiral:

- Originating Ba (socialisation): In this place, individuals not only share physical, face-to-face experiences, but also mental models, visions and culture. It is the starting point for the actual knowledge creation process.

- Interacting Ba (externalisation): In order to externalise tacit knowledge, a place is needed where peer-to-peer dialogues and collective reflections can take place and where meanings and values are created.

- Cyber Ba (combination): In this virtual world of group-to-group interaction, existing explicit knowledge can be combined with novel ideas and information, which results in the generation of new knowledge. In this context, Nonaka and Konno emphasize the importance of IT: “The combination of explicit knowledge is most effectively supported in collaborative environments utilizing information technology. The use of on-line networks, group-ware, documentations, and database has been growing rapidly over the last decade, enhancing this conversion process.” (1998, p. 47)

- Exercising Ba (internalisation): This includes on-the-site training and hence the conversion of explicit to implicit knowledge.

A company does not just need one ba, but a combination of several interacting types of ba. Ba is a way to organize knowledge creation within a company but also across organizational borders (Nonaka/Toyama 2004; Ahmadjian 2004).
7 Knowledge Management in Case Studies

7.1 What Is Knowledge Management?

Once knowledge has been created, it has to be managed, i.e. retained, disseminated and used in some way. Knowledge management can be described as a concept to design and shape organizational knowledge, and is therefore applied consciously and systematically in order to achieve a purposeful and specific use of knowledge within the organization (Probst/Raub/Romhardt 2003; Winkler 2004). In the following paragraphs, two models are depicted in more detail.

The first one which stems from Probst, Raub and Romhardt (2003, pp. 27-33) is intended for practical use and was developed in cooperation with managers of different industries. It consists of the following eight processes:

- Knowledge goals: This first step indicates the direction of knowledge management and determines on which levels knowledge will be built.
- Knowledge identification: A firm needs to gain an overview over its existing knowledge and establish an inventory of it.
- Knowledge acquisition: This relates to a company’s decision as to which knowledge it intends to obtain from outside, either from customers and suppliers, from partners, experts or other sources.
- Knowledge development: This complements knowledge acquisition and refers to the development of new knowledge within the firm.
- Knowledge dissemination: This process has to solve the question how knowledge can be distributed within the firm in a way that all employees profit from it.
- Knowledge utilisation: The emphasis of this process lies on the productive application of organizational knowledge.
- Knowledge retention: In order to dispose of the acquired knowledge, an organization has to retain it in some way which implies a selection, i.e. valuable knowledge has to be distinguished from obsolete knowledge.
- Knowledge assessment: The final process serves to examine if the goals have been reached and influences the specification of further knowledge goals.

The so-called Munich knowledge management model is based on the one by Probst, Raub and Romhardt described above and combines human beings, organizations and technology (Winkler 2004 pp. 13-21). Since people and their knowledge are seen as the mainspring of continuous learning and thus the core of knowledge management, their competences, skills and their knowledge have to be fostered. The organization’s task, on the other hand, is to provide structures and conditions that allow the exchange of knowledge. With the help of technology, tools and communication infrastructure, knowledge-based processes are established.

Knowledge management as such is seen as a combination of defining goals, of knowledge representation, knowledge communication, knowledge creation, knowledge utilisation and evaluation.
Knowledge Management from Case Studies with ATLAS.ti

- Goals: On an individual and organizational level, goals have to be defined to lead knowledge management in the appropriate direction and to evaluate the results in a later phase.
- Knowledge representation: This process aims at making knowledge transparent, e.g. by identifying and storing it, and also detecting knowledge gaps.
- Knowledge communication: As the dissemination and communication of knowledge are important aspects of successful cooperation within the firm, an organizational culture and structure that foster these processes – e.g. communication platforms – are indispensable.
- Knowledge creation: With respect to the development of skills, new products and improved processes, the acquisition of external knowledge is part of this step to the same extent as personal and technical knowledge networks.
- Knowledge utilisation: The new knowledge that has been created has to be applied in practice, i.e. incorporated in products and services, and affect decisions and actions.
- Evaluation: At the end of the knowledge management cycle, the validity of the acquired knowledge has to be examined and the results fed back into the goals.

7.2 SECI as Knowledge Management Model

With respect to the remarks above, the model by Nonaka and Takeuchi will be chosen as a basis as it offers several advantages and is almost tailored to the knowledge management in the research project. Compared to the models by Argyris and Schön, March and Olsen as well as Kim (cf. chapter “6 Organizational Learning and Knowledge Creation”), the model by Nonaka and Takeuchi is more comprehensive, since it not only provides a convincing explanation of organizational learning by taking up Kim’s mental models but, most importantly, also includes the actual process of knowledge creation and dissemination. By allowing the use of different tools for the different SECI stages, the model also integrates the knowledge management requirements in case studies as described in chapter 4 (for a detailed description of the tools, cf. Part III):

- Comparability: As an example, synchronous tools with shared view can be used as part of the SECI model.
- Different perspectives: Again, synchronous tools with shared view are well suited.
- Accessibility: Case-based reasoning or asynchronous tools provide the necessary characteristics.
- Visibility: A good example are drawing tools or concept maps.
- Knowledge creation: Communities are a good solution as they provide a place (ba) where knowledge creation can occur.
- Knowledge dissemination: This can be achieved with communities or asynchronous tools.

In addition and for the purpose of this paper, the SECI model also allows the integration and representation of knowledge management models, such as those by Probst, Raub and Romhardt (2003) or the Munich model (Winkler 2004). Both of them stress the practical implementation of knowledge management which can be
realised with the SECI model. Moreover, the requirements of the case studies can also be integrated:

- **Socialization**: This phase deals with learning by doing processes. It can be used to represent the first part of the coding in the case studies where individuals code the documents and probe into the applicability of the codes before comparing their results with their partners. This represents an individual learning process.

- **Externalisation**: The conversion of implicit into explicit knowledge by dialogues and metaphors is contained in this phase. Knowledge development, assessment and communication as demanded by Probst, Raub and Romhardt can be summarized under this phase just as well as knowledge communication, creation, and evaluation of the Munich model.

In the research project, this is the phase were the individual codes are discussed with a partner, the individual knowledge is thereby made explicit and new knowledge can be created.

- **Combination**: According to the explanations of Probst, Raub and Romhardt, knowledge identification (e.g. with the help of yellow pages), acquisition (e.g. through cooperations or strategic alliances), dissemination and utilisation can be summarized under this phase. The Munich model mentions similar activities, i.e. knowledge representation (storage e.g. in a database) and utilisation.

In the case studies, the coding of the documents in ATLAS.ti, the subsequent building of families and networks to visualize relationships among the codes and the interpretation of the results and insights can be included here.

- **Internalisation**: In the case studies, the individuals go back to coding new documents, bearing in mind the discussions with their partners and especially the code definitions on which they originally disagreed. In the discussions, the partners have found mutually satisfying code definitions which will be applied on the new texts and which illustrate the individual learning processes.

- **Ba**: Ba comprises all physical, virtual and mental places where knowledge is created, used and disseminated and is therefore an indispensable part of the SECI model. It is equally valuable for theoretical as well as for practical use, i.e. the goals of the model by Probst, Raub and Romhardt can be well integrated.

The goal definitions as stated in the two knowledge management models are included in Nonaka and Takeuchi’s conditions for organizational learning, i.e. in the organizational intention. Even the demand of the Munich model to combine individuals, organizations and technology can be fulfilled by the SECI model and ba as IT can be easily integrated in the shape of databases, yellow pages, discussion platforms, etc.

For the case studies, the model by Nonaka and Takeuchi thus offers additional advantages over conventional knowledge management models, as it includes and even emphasises individual learning. This is especially important with regard to the interrater reliability which ought to be continually improved.
Part III: Tools for Knowledge Management

In order to combine knowledge management, stakeholder management and case studies, a suitable tool has to be found which allows on the one hand the integration of these three topics and on the other hand can be integrated into the SECI model.

8 Introduction

The number of knowledge management tools is large and covers a wide range from simple knowledge storage to knowledge discovery and knowledge dissemination. The systems presented in the following chapters do by no means represent a complete overview of tools and technologies that are available on the market. Only a small sample of systems have been chosen, i.e. systems that might be interesting and useful for case studies.

In the ensuing sections, the main characteristics of all tools are briefly described without going into too much technical details. The reason for this is that the functions of the tools are attributed more importance than their implementation. In a second step, these features are then evaluated with respect to the requirements in case studies (i.e. comparability, different perspectives, accessibility, visibility, knowledge creation and knowledge dissemination, as described in chapter “4 Knowledge Management Requirements in Case Studies”) and assessed with regard to the contributions they make to the knowledge management model chosen for this paper, i.e. the SECI model by Nonaka and Takeuchi (i.e. socialisation, externalisation, combination, internalisation and ba, cf. chapters “6.4 Knowledge Creation by Nonaka and Takeuchi” as well as “7.3 SECI as Knowledge Management Model”).

Knowledge management implies a number of topics:
- Motivation of employees to share their knowledge
- Trust among employees and their superiors
- Avoidance of free riding
- Group dynamics
- Implementation and support of knowledge management systems (i.e. insertion of new data, deletion of old data, consistency, user access including authentication, security)

All of these topics are not treated in this paper as they are too comprehensive to be described in a few sentences. The emphasis therefore lies on the systems’ features, their contribution to knowledge management in case studies and their compatibility with the SECI model and ba.
9 Computer Supported Cooperative Work (CSCW)

Computer Supported Cooperative Work systems (CSCW) are nowadays widely used for knowledge management. CSCW is a collective term that – according to Schwabe and Krcmar – describes software which alleviates and improves group work and in addition enhances group productivity and flexibility. This can be achieved as CSCW tools contribute to bridging geographical and temporal gaps, which allows group members to work at any location as well as parallel, and thus to use all available channels simultaneously (Schwabe/Krcmar 1996).

Further advantages of CSCW systems are that they allow group members to have a comprehensive knowledge of the work of the other members but at the same time, undisturbed work is also possible. Different forms of collaboration are enabled, i.e. members can work on their own, the group can interact as a whole or subgroups can be built (Schwabe 2002).

CSCW systems are classified into synchronous and asynchronous systems both of which are usually based on a client/server architecture, i.e. the web browser – such as Netscape Navigator, Microsoft Internet Explorer, Opera – is the client while the usual web server is used on the server side. The client hence represents the user interface while the server hosts the collectively used applications (Appelt/Busbach/Koch 2001; Schümmer/Schuckmann 2001).²

9.1 Characteristics of Synchronous Tools

Synchronous tools allow group members to work simultaneously on the same data which implies that alterations in the data have to be visible instantly for the other group members. Thus, identical views on the data can be ensured which is expressed in the acronym “WYSIWIS”, i.e. “What you see is what I see”. In order to work effectively, the group members additionally need information on the presence of other users and their actions, i.e. who is online, who is not, who is also working on the same data, who is merely watching. This is summarized in the term “awareness information.” (Schümmer/Schuckmann 2001, p. 297)

The instant visibility of changes demands a synchronous replication of the data. Two forms exist: Full replication, i.e. the whole document is copied, and partial replication which means that a user only receives a specific part of a document he/she is momentarily interested in. In both cases, only the altered parts are replicated. In order to better perceive changes and to undo them more easily, a layer technique is applied so that all users dispose of their own layer on which they can work (Holmer/Haake/Streitz 2001, p. 182). In order to notify the group members of any changes, triggers can be used (Barent/Gräslund/Schwabe 1995, p. 9).

As in synchronous systems several people are allowed to work in parallel, further problems to be solved are data consistency and the integration of concurrent

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processes. In order to guarantee consistency, two strategies are applied, a pessimistic and an optimistic. With the pessimistic method, local actions are only accepted and made visible if consistency with the alterations of all other users can be achieved. This generally results in a slower reaction time. The optimistic procedure accepts and updates local changes instantly. In case a conflict occurs later on, the local action of one user is undone (Holmer/Haake/Streitz 2001, p. 182). An even trickier problem to solve is fault tolerance which means that the application is supposed to remain stable even if computers or networks fail.

As replication, triggers, fault tolerance as well as the guaranteeing of consistency and the coordination of concurrent actions are intricate procedures which also occur in databases and have been solved there, Barent, Gräslund and Schwabe (1995) on the one hand and Unland (2001) on the other hand suggest using the technologies applied in Database Management Systems for synchronous CSCW tools.3

Schwabe and Krcmar (1996) mention various tools for synchronous group work. Their functions are summarized in the following paragraphs. Some tools, however, such as voting tools and tools for software design are not discussed as they are not relevant for the research project:

- Text editors: They allow participants to optionally work on their own or within a group. Some tools provide several cursors, one for each participant which allows for parallel written input throughout the document without disturbing the others and without overwriting their inputs. In order to work jointly on a text, group members can activate a shared view and with the help of telepointers, participants can draw the attention of their colleagues to a certain segment within the shared view. Texts which are worked on can be locked in order to prevent overwriting. The joint work can thus be coordinated and the overall progress is visible at any time.

- Drawing tools: Their functions are similar to those of text editors, i.e. they provide single and shared work spaces, telepointers as well as locks for objects. Some tools allocate each participant his/her own drawing layer. They possess several advantages: Each person can work separately on the common drawing; the layers can be combined to reveal the whole drawing; and changes can only be made on one’s “own” layer, i.e. alterations can be reconstructed at any time and attributed to a specific person.

- Group support systems: These are not single tools as the ones described above but rather collections of tools for medium-sized groups (10-40 participants). Depending on the group’s needs, various tools can be chosen at the appropriate time, e.g. for agenda setting, voting, brainstorming, project management, decision making. In contrast to the above mentioned tools, group support systems do not allow participants to delete older contributions but only to add new ones. Neither do functions exist to watch or coordinate work progress.

3 The following authors discuss solutions to these problems: Schneider (1993a) and Budhiraja et al. (1993) on replication; Dittrich and Gatzii (2000) on active database systems and triggers; Schneider (1993b) as well as Hadzilacos and Toueg (1993) on fault tolerance; Elmasri and Navathe (2000) on consistency and concurrency control.
• Shared screen/shared view: With these tools, individual tools are easily turned into group tools as they collect individual keyboard inputs and multiply them for the output on the screen. The inputs can be gathered for the whole screen or a specific section.

• Audio and video systems: Tools for telepresence aim at conveying the impression of working in a common room to the group members. Some systems allocate the group members a private and a public window, the latter of which is accessible to all. Other systems allow for a better coordination among the participants by establishing a virtual office in which each participant has his/her own room. Thus, the whereabouts of the other members can be elicited quickly and easily. In order to establish eye contact between the participants, some systems apply mirroring to achieve this effect which is important to improve the sense of other people’s presence.

9.2 Characteristics of Asynchronous Tools

In contrast to synchronous tools, asynchronous systems allow group members not only to work at different locations but also at different times. This implies that – apart from collaboration – communication is an important element as well in order for group members to coordinate their schedules and their work. The group shares a common work space which serves two functions: On the one hand, to exchange documents and information, on the other hand, to bridge the geographical and temporal gaps. Asynchronous tools demand self-organization within the group, they are mainly suited for small or medium-sized groups. The coordination effort for large groups would be too time-consuming (Appelt/Busbach/Koch 2001).

Asynchronous systems typically dispose of the following basic elements:

• Documents and tools to edit them. The documents can adopt different formats, such as texts, graphics, tables, etc.
• Means to structure and coordinate the different private and public working areas. These include folders and drawers to structure the shared work space.
• Meta information allow group members to comment on and retrace the different phases as well as the current state of the work progress. This can be achieved by annotations, the recording of events as well as the documents’ histories and is a precondition for the above described awareness function. Further possibilities to handle meta information are filters (to search data and satisfy the user’s specific information requirements) and event services (to notify the user when a certain event has occurred).
• Access rights and concurrent processes are further concepts that need to be integrated and for which solutions can be borrowed from other applications (cf. synchronous tools).
• User administration: The size of the group has to be adapted dynamically (e.g. when new members join, others leave or sub-groups are built).

Examples of asynchronous tools are the following:
• E-Mail: Since it is readily available and easy to handle, e-mail is a wide-spread tool for asynchronous group work and mainly suitable for the exchange of short messages and attachments. With respect to the management of shared material, e-mail is ill suited as it lacks the opportunity to structure and permanently manage information (Schwabe 2002, p. 404).
• Recommender systems: Their aim is to recommend items of information based on the user’s preferences. They will be further discussed in chapter “12.2.2 Interface Agents”.
• Discussion platforms: They support the exchange of opinions and suggestions to further develop ideas.

Basic Support for Cooperative Work (BSCW) is probably the most wide-spread asynchronous tool. It is suitable for project and document management which supports small or medium-sized self-organized work groups. As most CSCW applications, BSCW is based on a client/server model, consisting of a BSCW server and a BSCW client. The client is a simple web browser such as Netscape Navigator, Microsoft Internet Explorer or Opera. Thus, the users do not need to install any specialised software (cf. figure 7) (Appelt/Busbach/Koch 2001). While offering a common work space, BSCW is at the same time divided into different areas. The first contains functions to manage groups and their members, to archive documents and to protocol events that occurred in the shared work space. The second allows users to annotate and assess documents which, according to Schwabe, is a fundamental precondition to building knowledge and therefore an important feature for knowledge management in general (Schwabe 2002, p. 405). BSCW is a comprehensive tool that is not only equipped with the features mentioned above but also with additional ones (Appelt/Busbach/Koch 2001; Schwabe 2002):

• Texts, graphics, notes and annotations can be exchanged and discussions held.
• Authentication: Only users who identify themselves by their login and password are given access to the BSCW work space.
• User administration: This includes the management of the shared work space, adding and removing users, granting privileges to users (reading and/or writing documents) as well as the management of the users’ e-mail addresses, phone and fax numbers, etc.
• Awareness services: A user entering the shared work space is informed of recent events. In addition, users can be informed of other users being present in the shared work space and their activities which allows synchronous communication among them.
• Mechanisms to lock documents: While a user is working on a certain document, it can be locked from other users.
• Annotations: Documents can be annotated and commented on by different users.
• Event messages: Users are informed of different events (i.e. when the shared work space is accessed in order to fetch or update a document, to add a new user, etc.) in various ways, e.g. by e-mail or by a daily report. Users can specify the events of which they want to be informed.
• Specific access rights in the shared work space: Sometimes it is useful to grant certain users merely reading but no writing privileges.
• Search functions: Objects can be found based on their content or on characteristics such as author or date.
• Interface for synchronous cooperation such as audio/video conferences.
• Document formats: BSCW supports over 30 different document types such as PDF, GIF, JPEG, HTML, LaTex, MS Office, ZIP, etc. The documents can also be transformed from one format into another.
• Further features include discussion groups, tools to organize and conduct meetings, a calendar and a schedule as well as an address book (BSCW 2004).

9.3 Evaluation of CSCW Tools

The main advantage of CSCW tools is that they serve the needs of small and medium-sized groups and that they allow collaboration independent of the users’ locations. In addition, as asynchronous tools also permit joint work at any time, they are better suited for case studies than synchronous tools which force all users to log into the system simultaneously. Besides, many asynchronous tools give the user the choice to work synchronously as well. The most useful features – with respect to case studies – are the text editors, the drawing tools, shared screens, awareness services, annotations and discussion platforms which inform users of the work and progress of other group members. Audio and video facilities, however, may be regarded as bonus features but do not really enhance efficiency in case studies, while e-mail can only be used to exchange short messages but not large amounts of data and information as used in case studies. Administrative tools facilitate the coordination within the group.
A major drawback of CSCW tools – and of all IT tools used for knowledge management – is that social interactions which play an important role in knowledge creation are lost. These include accidental gatherings in the coffee room as well as facial expressions and gestures (Malafsky 2003, p. 96).

<table>
<thead>
<tr>
<th>Computer Supported Cooperative Work</th>
<th>Assessment</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Synchronous Tools</td>
</tr>
<tr>
<td>Comparability:</td>
<td>5</td>
</tr>
<tr>
<td>In synchronous as well as in asynchronous tools, data and information can be compared. This is especially facilitated if shared views exist.</td>
<td></td>
</tr>
<tr>
<td>Different perspectives:</td>
<td>5</td>
</tr>
<tr>
<td>The drawing tools and text editors allow the exchange of different views and opinions in synchronous and asynchronous tools.</td>
<td></td>
</tr>
<tr>
<td>Accessibility:</td>
<td>3</td>
</tr>
<tr>
<td>Accessibility is restricted in synchronous tools since they require simultaneous presence of all users. With asynchronous tools, however, data access is guaranteed at any time.</td>
<td></td>
</tr>
<tr>
<td>Visibility:</td>
<td>4</td>
</tr>
<tr>
<td>If drawing tools are available, visibility can be easily established in synchronous and asynchronous tools.</td>
<td></td>
</tr>
<tr>
<td>Knowledge creation:</td>
<td>5</td>
</tr>
<tr>
<td>Both synchronous and asynchronous systems offer features for knowledge creation, such as shared screens, drawing tools and discussion platforms.</td>
<td></td>
</tr>
<tr>
<td>Knowledge dissemination:</td>
<td>3</td>
</tr>
<tr>
<td>This is easily achieved with asynchronous tools. As far as synchronous tools are concerned, knowledge dissemination depends on the facilities offered to view old documents and drawings, especially of group sessions in which a user was not able to participate.</td>
<td></td>
</tr>
<tr>
<td>SECI:</td>
<td>5</td>
</tr>
<tr>
<td>Depending on the combination of tools, CSCW can cover all four SECI stages.</td>
<td></td>
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<tr>
<td>Ba:</td>
<td>5</td>
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<tr>
<td>Discussion platforms and shared screens provide valuable places for knowledge creation and exchange.</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>

Key: Assessment from 1-5  
1: not at all applicable  
5: fully applicable

*Table 1: Assessment of CSCW (source: author)*
10 Communities of Practice

10.1 Definition of Communities

A community can be described as a group of people who share a common interest or knowledge. For this reason, two types of communities are distinguished: Communities of interest on the one hand, where people with a common interest meet, be it they collect stamps or want to improve neighbourhood safety. Communities of practice, on the other hand, are characterized by a joint context. Both community types are mainly virtual, i.e. the people who join the community often do not know each other personally as they do not communicate face-to-face but via an IT platform. For this paper, only communities of practice are relevant. Wenger defines communities of practice as follows:

Members of a community are informally bound by what they do together – from engaging in lunchtime discussions to solving difficult problems – and by what they have learned through their mutual engagement in these activities. A community of practice is thus different from a community of interest or a geographical community, neither of which implies a shared practice. A community of practice defines itself along three dimensions:

- What it is about – its joint enterprise as understood and continually renegotiated by its members.
- How it functions – mutual engagements that bind members together into a social entity.
- What capability it has produced – the shared repertoire of communal resources (routines, sensibilities, artefacts, vocabulary, styles, etc.) that members have developed over time. (Wenger 1998)

Communities can be clearly distinguished from teams. A team is built by management to accomplish a specific task and is held together by the project’s goals. Often teams are split up again, once they have fulfilled their tasks. A community, by contrast, is an informal organization freely joined by its members and “glued” together by the members’ commitment and their identification with the community. As long as people are interested in the community’s purpose, it will continue to exist (Wenger/Snyder 2000, p. 142).

10.2 Knowledge Creation in Communities of Practice

Today communities of practice are wide spread in firms and have become somewhat of a hype within the knowledge management discussion. One reason may be that employees have always built (face-to-face, not virtual) communities to share knowledge and profit from mutual experiences. As an example, Brown and Duguid (2001) mention Xerox technicians who started to exchange their notes on how to best repair Xerox machines concerning problems that could not be solved by following the firm’s manual.
To Brown and Duguid, “practice is central to understanding work” (1991, p. 40) and in this, collaboration plays an important role. Communities of practice are therefore well suited to exchange knowledge and experiences, as the case of the Xerox technicians illustrates. Moreover, as Brown and Duguid state, knowledge is not held individually but collectively in work groups, i.e. a single person cannot hold all the knowledge necessary to solve a problem. Knowledge is seen as a puzzle to which several people have to contribute a piece (i.e. their knowledge) in order to establish the whole picture and to solve the problem. This knowledge is also generated collectively, when people work together and build networks, i.e. in communities of practice which represent the collective knowledge. By adapting to changes in membership and to altering circumstances, communities are important sites of innovation (Brown/Duguid 1998; 2001).

10.3 Roles in Communities

In order to provide glue in virtual communities and to render them productive for corporations, they need a social structure. The number of roles may vary within a community, depending on its needs. However, the two basic roles are members and a moderator:

- **Members**: They are the people who actively participate in creating, exchanging and disseminating knowledge.
- **Moderator**: The moderator’s task lies in organizing and coordinating the community’s administrative activities as well as in motivating and linking the members (Mohr/Freudenthaler/Hofer-Alfeis 2002).

Böhmann, Pleick and Krcmar suggest to sub-divide the members into three further groups, i.e. into core group, peripheral members and users. They copy this structure from large, self-organized and successful open source communities (e.g. Linux, Apache web server). The core group is rather small and works daily on the project. In order to guarantee the project’s survival, a minimal input by the core group is required which means that it plays the role of the driving force. These members enjoy the highest status within the community. Peripheral members, on the other hand, commit themselves on an individual level, i.e. depending on their time, motivation and ideas. Their main contributions are suggestions for improvement, comments and eradicating mistakes. The core group assesses these inputs and decides which are integrated into the project. The users, finally, benefit from the work of the other two groups as they can work with the product the others establish. In order to apply this structure to corporations, the firms’ hierarchies must be neglected, i.e. whether employees belong to the core group, are peripheral members or users only depends on their commitment and the quality of their work and not on their position within the corporation (Böhmann/Pleick/Krcmar 2002).

10.4 Communication in Communities

A particular characteristic of communities is that the participants do not necessarily know each other. While face-to-face communication automatically involves seeing people and making their personal acquaintance at least to a certain degree, this is not the case in communities. Similar to CSCW tools, sender and receiver of messages
perceive no facial expressions and gestures of their partners which may make the interpretation of a message more difficult. It is always the receiver and not the sender who decides on the meaning of a message which can be derived from Shannon’s communication theory: The sender encodes his/her message, sends it via a channel to the receiver where it is decoded and reconstructed (Shannon 1948).

In virtual communication, the reconstruction and interpretation of messages is even more important. Consequently, participants of a virtual world (including communities) have to attribute meaning to messages to construct this virtual world (Marte/Schneider/Schauer 2004). Maturana and Varela described this concept of autopoiesis (Greek: self-reproduction) for biological organisms which means that all living systems have the opportunity to create their own world instead of merely reacting to their environment. Autopoiesis is hence a process of self-organization through cycles of self-referral (1987). Adapted to communities, this means that a shared reality is not given but constructed by the participants, based on their observations and their virtual communication (Marte/Schneider/Schauer 2004). This enhances the complexity of reality as more opportunities exist to construct it but not all of them can be realized simultaneously (Thiedeke 2001).

Returning to Shannon and thus closing the cycle, it can be said that the differences between face-to-face and virtual communication are not all that big, as in both cases the receivers of information always construct their own reality (Marte/Schneider/Schauer 2004). This is also in accordance with the fact that virtuality is not a new concept that emerged with the PC but an old one that has existed for centuries, for example in theatres where reality has always been constructed (Thiedeke 2001).

However, virtual communication also has advantages compared to face-to-face communication as knowledge networks can be easily built which in turn creates synergies that may be useful in other networks (Koch/Schauer/Schauer 2003).

### 10.5 Tools for Communities

A tool that specifically covers all the needs of communities does not exist. Instead, there are different products which cover one or a combination of different aspects. The most important tools are discussion platforms, facilities to pose questions to the community, “yellow pages”, i.e. a directory of the community members and their specific expertise, possibilities for synchronous work, a document repository combined with a good search engine to retrieve the files quickly and the possibility to build sub-communities. An overview of the tools and their functions is given in the graphic below (Wenger 2001).
The characteristics of the categories mentioned in the graphic can be described as follows (Wenger 2001):

- **Knowledge worker’s desktop**: The desktop serves as a portal to the whole enterprise, to projects, documents, teams, communities and other resources that are available in the firm. According to Wenger, they “merge work and knowledge management” and these systems “are based on the assumption that knowledge workers participate in multiple groups, projects, and communities, and have to manage this multimembership.” (2001, p. 11) In addition, they offer information repositories and powerful search engines.

- **Project spaces**: Although these tools are usually not specifically designed for communities but for project management, they comprise some features which make them useful community tools all the same. These include the management of memberships, access rights, personal customisation, team calendar, project management facilities (status, milestones), news and discussion boards or presence awareness.

- **Website communities**: Suited to handle large groups or communities, these systems allow the inclusion of extra-organizational parties such as customers, suppliers and partners. Interaction is attributed more importance than good repositories. Features comprise directories including members’ profiles,
awareness functions, building of sub-communities, activity analysis and management tools.

- Discussion groups: These tools offer the opportunity for on-line conversations on different topics and in large groups. On the other hand, however, they lack decent file repositories and good search engines for quick and easy document retrieval. Characteristics include user-oriented features (e.g. synchronous as well as asynchronous discussions, sub-communities, file upload with postings) and administration-oriented features (e.g. simple authentication capabilities, monitoring and administration facilities, customisable user privileges).

- Synchronous interactions: These products provide for on-line meetings including audio and video facilities as well as for “physical analogies, such as auditorium, conference center, or building.” (Wenger 2001, p. 28) Further characteristics are application sharing, whiteboard, chat or facilities for taking minutes.

- E-learning spaces: These are systems for educational purposes and are not explained further as they are only useful for communities when newcomers to the community are explicitly trained.

- Access to expertise: “Yellow pages” are included in many of the systems described above. However, products which are explicitly designed for knowledge exchange offer additional, more sophisticated functions such as repositories in which question and answer pairs can be accessed, feedback mechanisms or expert profiles and ranking.

- Knowledge bases: Repositories are an important feature for communities who produce and use countless documents. These systems therefore not only dispose of storage facilities and search engines but also of version control for documents, indexes and catalogues, preview of document summaries, creation and use of meta-data or recovery of deleted information.

Today the different community dimensions, the necessary tools and facilities are increasingly combined and the products converge. Communities can thus choose the product that best serves their needs:

> As system designers become increasingly aware of these dimensions and their interdependence, there is a convergence in the market of community-oriented technologies. More and more systems include multiple dimensions. (…) In fact, systems that focus exclusively on one dimension are becoming rare. (Wenger 2001, p. 44)

### 10.6 Evaluation of Communities of Practice

Communities combine synchronous and asynchronous work which gives them an advantage over the CSCW tools described above. Their main advantage, however, is that they mirror real work communities and their interactions. This also includes implicit and explicit aspects in knowledge creation and dissemination, i.e. the intricate
interplay between knowledge and practice as illustrated in the knowledge creation spiral by Nonaka and Takeuchi (cf. chapter “6.4 Knowledge Creation by Nonaka and Takeuchi”).

In spite of all these advantages, communities have one drawback which makes them less suited for our research project: They are designed for large groups which means that the effort to manage these tools and their users is also higher than in systems conceived for small groups. However, it might be worthwhile to evaluate if certain features such as project spaces, discussion groups, access to expertise or knowledge bases might be of use for medium-sized groups. The evaluation of communities therefore largely depends on the features of the system.

<table>
<thead>
<tr>
<th>Communities of Practice</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparability: If synchronous or asynchronous tools exist as used in CSCW systems, it is possible to compare data and information, especially in combination with shared views</td>
<td>5</td>
</tr>
<tr>
<td>Different perspectives: Discussion groups and access to expertise may contribute to viewing data from different perspectives.</td>
<td>5</td>
</tr>
<tr>
<td>Accessibility: If the system contains a knowledge base or repository combined with a powerful search engine, access to data is guaranteed.</td>
<td>4</td>
</tr>
<tr>
<td>Visibility: Visibility is best achieved by drawing tools which do not necessarily have to be part of community systems. Results are therefore mostly exchanged as text documents.</td>
<td>3</td>
</tr>
<tr>
<td>Knowledge creation: Communities are well suited for knowledge creation as they include the necessary social interactions and combine theory and practice.</td>
<td>5</td>
</tr>
<tr>
<td>Knowledge dissemination: Likewise, communities allow for easy dissemination of knowledge, be it through discussion groups, access to expertise or repositories.</td>
<td>5</td>
</tr>
<tr>
<td>SECI: Depending on the combination of features, communities may cover all four SECI steps.</td>
<td>5</td>
</tr>
<tr>
<td>Ba: Communities present a virtual platform for knowledge creation and dissemination.</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>37</td>
</tr>
</tbody>
</table>

**Key:**

- 1: not at all applicable
- 5: fully applicable

*Table 2: Assessment of communities of practice (source: author)*
11 Concept Maps

11.1 The Power of Visualization

"A picture is worth 1000 words." (Malafšky 2003, p. 98) This is the basic idea behind concept maps. They serve to visualize, structure and communicate complex knowledge, and to efficiently transfer this knowledge into the user's cognitive processes. For this purpose, the user can describe his/her knowledge in specific terms which are represented as nodes within the concept map. In order to visualize the relations between these terms, uni- or bi-directional, labelled lines can be drawn (cf. figure 9).

![Concept Map Example](http://users.edte.utwente.nl/lanzing/network.gif)

Figure 9: An example of a concept map (source: http://users.edte.utwente.nl/lanzing/network.gif)

Thanks to this approach, concept maps are very useful in modelling and externalising knowledge, and to thus grant the user an overview over the correlations as well as to facilitate meta cognition, thinking processes and reflections. Moreover, this knowledge is easily transferred to other people. The use of these semantic networks – as concept maps are also called – represents mental models (Hillen/Berendes/Breuer 2000) and the way that humans store knowledge structures in their minds. In other words, concept maps comply with the human brain more closely than, for example, tree hierarchies (Zapata-Rivera/Greer/Cooke 2000; Jonassen 2003; Malafsky 2003).4

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4 For further information on the functioning of the human brain, cf. for example Spitzer (2000).
As mentioned above, concept maps externalise knowledge. This is also important with respect to learning and increasing one’s knowledge by acquiring new ideas and connecting them to prior knowledge. Jonassen remarks:

Semantic networks help in organizing learners’ knowledge by integrating information into a progressively more complex conceptual framework. When learners construct concept maps for representing their understanding in a domain, they reconceptualize the content domain by constantly using new propositions to elaborate and refine the concepts that they already know. More importantly, concept maps help in increasing the total quantity of formal content knowledge because they facilitate the skill of searching for patterns and relationships among concepts. Research has shown that well-organized and integrated domain knowledge (as evidenced by integrated semantic networks) is essential for problem solving. (2003, p. 372)

Since concept maps are dynamic, adaptable and interactive, they are suited for single persons as well as for groups (Weinberger/Mandl 2003).

One problem that remains to be solved is that numerous concept map tools exist – e.g. for brainstorming sessions, decision making, problem solving, public speaking, taking notes – most of which are proprietary file formats. This means that an exchange of maps constructed with different tools is not possible, i.e. no links to other maps, the web or external applications exist. Sharing knowledge thus encounters major difficulties and may even jeopardize the use of maps, especially in interdisciplinary fields. Zapata-Rivera, Greer and Cook attempt to overcome this obstacle by using XML (eXtended Markup Language) to eliminate proprietary files. They suggest the creation of a DTD file (Document Type Definition) to validate XML maps and to “consider the main characteristics of the maps, such as: linking nodes to external applications, to content on the web, and to other maps.” (Zapata-Rivera/Greer/Cooke 2000, p. 757) They see the following benefits in using XML:

- XML provides an open format to maintain and share maps as opposed to proprietary file formats.
- By using a common vocabulary in conjunction to XML-maps, it is possible to compare maps. That is, maps can be compared to find similarities and differences in the type of structure employed (thinking process used by the learner to analyse the topic), relation among nodes and types of links and documents attached to each node.
- Any XML query language such as XML-QL or XQL can be used to create queries to compare maps. By comparing maps it is possible to assess learners’ knowledge and determine possible misconceptions, or gaps on a specific concept or group of them. By analysing the type of map used to represent the knowledge it is possible to identify possible problems of the learner with a specific kind of reasoning.
- XML permits collaborative viewing of maps.
- By maintaining the student’s knowledge information (XML-maps) in the learner model, new interesting opportunities for assessment, collaboration, adaptation, and inspection can be explored.
• Opening visual knowledge representations is an important step towards the goal of capturing, sharing, and using knowledge across disciplines. (2000, pp. 757-758)

11.2 Evaluation of Concept Maps

Concept maps have two considerable advantages: The first is that visualizations are often better than descriptions. The second lies in the structure of concepts maps which mimics the function of the human brain. Both support the intuitive grasp of information and knowledge. In combination with XML, concept maps are a powerful tool for knowledge management as different maps can be compared, combined and elaborated. Concept maps are also suited for case studies and fit into the SECI model.

<table>
<thead>
<tr>
<th>Concept Maps</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparability:</td>
<td>5</td>
</tr>
<tr>
<td>As the data and information are presented as a “picture”, different parts of a case can be just as well compared as whole cases. Similarities, differences and patterns can be easily detected. A researcher’s thoughts and conclusions can be retraced by others, possibly without further comments.</td>
<td></td>
</tr>
<tr>
<td>Different perspectives:</td>
<td>5</td>
</tr>
<tr>
<td>The data can be viewed from different perspectives by renaming the nodes and connecting them in various ways. Hence, concept maps allow the researcher to “play” with different views, to compare them and to adapt them to new findings and insights.</td>
<td></td>
</tr>
<tr>
<td>Accessibility:</td>
<td>4</td>
</tr>
<tr>
<td>As concept maps display a picture, the information they contain can be easily accessed at later times and also by persons who were not involved in establishing the concept maps.</td>
<td></td>
</tr>
<tr>
<td>Visibility:</td>
<td>5</td>
</tr>
<tr>
<td>This is the most obvious characteristic of concept maps and therefore needs no further explanation.</td>
<td></td>
</tr>
<tr>
<td>Knowledge creation:</td>
<td>5</td>
</tr>
<tr>
<td>As concept maps mimic the human brain function, they are well suited to gain new insights and to create new knowledge.</td>
<td></td>
</tr>
<tr>
<td>Knowledge dissemination:</td>
<td>3</td>
</tr>
<tr>
<td>If concept maps are combined with XML, the knowledge they incorporate can be broadly disseminated.</td>
<td></td>
</tr>
<tr>
<td>SECI:</td>
<td>3</td>
</tr>
<tr>
<td>Concept maps mainly cover externalisation and combination. By building nodes and connecting them, the researcher’s implicit knowledge is made explicit and can then be discussed with others.</td>
<td></td>
</tr>
<tr>
<td>Ba:</td>
<td>5</td>
</tr>
<tr>
<td>Concept maps mainly represent mental places, i.e. the researcher’s mental model of a specific case. And since concept maps represent the way knowledge is stored in the brain, they can give insights into the researcher’s mind.</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
</tr>
</tbody>
</table>
Key: Assessment from 1-5
1: not at all applicable
5: fully applicable

Table 3: Assessment of concept maps (source: author)

Generally speaking, it can be said that concept maps are a promising tool for knowledge management and for case studies in particular. In fact, ATLAS.ti also uses this type of maps as will be shown in Part IV.
12 Artificial Intelligence

Techniques based on Artificial Intelligence (AI) are frequently used in knowledge management, even though their application may not be apparent at first sight. Tsui even goes so far as to state that “the fields of Artificial Intelligence … have a strong influence on the origin and evolution of KM [Knowledge Management] tools. (…) many of the proven techniques in AI have now evolved into commercial products.” (2003, p. 7)

As different as the systems may be, they have some features in common which clearly distinguish them from the above mentioned technologies such as BSCW or concept maps. They can adapt to changing conditions and environments, they are able to generalise and thus to learn. This is the paramount characteristic in order to sense and fulfil user needs and preferences. In the ensuing paragraphs, some of these technologies will be introduced and discussed.

12.1 Case-Based Reasoning

12.1.1 Characteristics of Case-Based Reasoning

Case-Based Reasoning (CBR) is a paradigm in automated reasoning and machine learning, which is based on the cognitive model of the human brain and thereby mimics the way human beings learn and remember. This combination makes it a very intuitive tool to work with. The aim of CBR is to profit from past experiences to find new solutions to new problems and thus to support and augment human memory (Gupta 1994; Lopez de Mantaras/Plaza 1997). To reach this goal, libraries with thousands of reference cases are used that provide examples of how to handle specific challenges. Knowledge is thus stored in the shape of cases, which means on the one hand that CBR provides a link to organizational memory (Tsui 2003, p. 9), and on the other hand is well suited to deduce best practices (O'Leary 2003, p. 36).

Within CBR, a case is considered as some type of knowledge which represents an experience. It includes a former problem and the circumstances under which it occurred, the solution to this problem and the outcome, i.e. the effect the solution had and whether it solved the problem or not. In short, a case consists of lessons that were formerly learned (Watson/Marir 1998).

When using CBR, a specific cycle is applied. When a problem description is entered into the system, the first step consists of retrieving similar cases. These cases are then reused in an attempt to solve the problem. If necessary, the proposed solution is revised and adapted to fit the current problem, and in a last step, the new solution is retained and stored in the case base (Watson/Marir 1998). This procedure turns CBR into an adaptable system, as on the one hand, new solutions are created and on the other hand, these new solutions are added to the repository and can in turn be used to solve future problems. Moreover, as the new solutions and their effects can be compared to the old ones, an evaluation of problem/solution pairs can be made. The CBR’s value may be increased if not just successful solutions are stored in the
repository but also failed trials. Hence, learning can take place when solutions to novel problems are found but also when failed solutions can be attributed to specific case features (Morris 1995).

In order to traverse this cycle, different elements are required:

- A case base, i.e. a repository in which the cases and their solutions are stored: This is the main element of CBR. A structure that supports efficient search and retrieval methods is important. One possibility is to organize the cases in a network of categories, semantic relations, cases and index pointers. A case is on the one hand attributed to a certain category. On the other hand, the case is given specific attributes which can be weighted in order to determine the case’s association with a category. Three types of indices exist to connect the problem, the case and its category (Watson/Marir 1998):
  - Links that point from the problem features to a case or a category.
  - Links that point from a category to its associated cases.
  - Links that point from a category to neighbouring cases which only differ in a small number of attributes.

- Case retrieval mechanisms: When a problem has been described, matching cases to solve it have to be found on the basis of the indices described above, i.e. the cases’ similarities have to be determined. Unlike conventional database searches, retrieval from case bases demands heuristics which perform partial matches, as there are usually not two exact cases in which the weights of the attributes match as well. This type of retrieval can be achieved in various ways, two of which are described here.
- Nearest Neighbour approach: This approach allows the comparison of similarities of stored and of new cases. The selection criteria are the weighted sum of the cases’ attributes. The drawback of this approach is that the searching time increases linearly with the number of stored cases, i.e. the more cases that have to be searched, the slower the system is (Watson/Marir 1998).

- Inductive algorithms: This approach is preferred for large repositories. The discriminating features in a case are determined heuristically. This results in retrieving those cases that are the most meaningful to solve the problem. The drawback here is that this approach is only suitable if the retrieval goal is clearly defined (Gupta 1994).

An explanation module is necessary for the system to “justify” its analysis of the current problem and the solutions it proposes. The user of the system can thus reconstruct why certain cases were chosen and others disregarded which in turn supports the user’s learning process (Gupta 1994).

### 12.1.2 Evaluation of Case-Based Reasoning

Case-Based Reasoning is an interesting tool for two reasons: On the one hand, CBR’s affinity to human learning considerably facilitates its use. When people look for solutions to a problem, they automatically take into account their past experiences and use them to find new solutions. CBR can thus be regarded as an extended memory that does not “forget” anything it is not supposed to and that can be easily shared with other people (Grupe 1993; Lopez de Mantaras/Plaza 1997). Comparing and reusing different cases, on the other hand, is certainly interesting and fruitful in case studies. The drawback, however, is that a large database of similar cases is needed before the case base may yield satisfactory results. For this reason, CBR is currently not suited for the research project as only few cases exist at the moment. Yet, at a later stage and possibly also when case studies of other researchers are available on stakeholder management, CBR might turn into a useful tool (Morris 1995).

<table>
<thead>
<tr>
<th>Case-Based Reasoning</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparability:</td>
<td>4</td>
</tr>
<tr>
<td>Accessibility:</td>
<td>5</td>
</tr>
</tbody>
</table>

- Comparability: Once the attributes of a case have been defined and weighted, the cases can be compared along these two dimensions. Systems containing an explanation module are to be preferred as this allows the researcher to retrace the results of the CBR system.

- Different perspectives: The perspective strongly depends on the case attributes and the weights. Researchers who are less skilled in describing the problem in varying terms will probably not succeed in looking at the problem from different viewpoints.

- Accessibility: Accessibility may be slow if the case base is very large. However, numerous cases can be reproduced with a mouse click.
Visibility:
Two factors are important: The researcher’s ability to build his/her own picture out of text-based cases which are described in abstract terms. And the decision, whether failed solutions are to be stored as well in order to gain new insights.

Knowledge creation:
Since old cases and solutions are compared with new ones, knowledge creation is inherent in CBR.

Knowledge dissemination:
Knowledge dissemination does not occur automatically but has to be organized in some way, i.e. researchers must make sure that they are “up to date” and know new cases and their solutions.

SECI:
CBR mainly covers externalisation, i.e. when a new problem is analysed, and combination, i.e. when old solutions are combined with new ones and applied to new cases.

Ba:
CBR provides a virtual place for knowledge creation and use. A place for knowledge dissemination does not exist, just as physical and mental places have to be provided by the researchers themselves.

<table>
<thead>
<tr>
<th>Total</th>
<th>29</th>
</tr>
</thead>
</table>

Key: Assessment from 1-5
1: not at all applicable
5: fully applicable

Table 4: Assessment of case-based reasoning (source: author)

12.2 Software Agents

The task of defining the term “agent” is not an easy one as the notions and definitions of what an agent is or should be differ widely within the AI (Artificial Intelligence) community. Moreover, since the term has been adopted by marketing, it has turned into a buzzword which is used to describe all sorts of systems and programmes irrespective of whether they fulfil any criteria applied to agents (Foner 1993).

For the purpose of this paper, only software agents are considered (and not, for example, embodied agents) as they are able to work on Wide Area Networks (WAN) such as the Internet. The following definition is used:

Software agents can be defined as computer programmes that autonomously act on behalf of their user. An agent possesses its own profile, is able to autonomously fulfil specific tasks for its user, to cooperate with its user and/or with other agents, to learn, and it may be mobile (Nwana 1996; Wagner 1997).
Today, numerous different agents exist that serve different purposes, such as collecting and filtering information, database replication and coordination for distributed groups, tracking of information dissemination and improving the system’s effectiveness (Malafsky 2003). In the following sections, some of them will be introduced. The emphasis lies with agents that may be useful for knowledge management.

12.2.1 Existing Agent Classifications

Despite the differing approaches as to what an agent is, all agents share some common characteristics. Franklin and Graesser (1996) established a classification based on the agents’ properties. By definition, every agent must fulfil the first four properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Other Names</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>reactive</td>
<td>(sensing and acting)</td>
<td>responds in a timely fashion to changes in the environment</td>
</tr>
<tr>
<td>autonomous</td>
<td></td>
<td>exercises control over its own actions</td>
</tr>
<tr>
<td>goal-oriented</td>
<td>pro-active purposeful</td>
<td>does not simply act in response to the environment</td>
</tr>
<tr>
<td>temporally continuous</td>
<td></td>
<td>is a continuously running process</td>
</tr>
<tr>
<td>communicative</td>
<td>socially able</td>
<td>communicates with other agents, perhaps including people</td>
</tr>
<tr>
<td>learning</td>
<td>adaptive</td>
<td>changes its behaviour based on its previous experience</td>
</tr>
<tr>
<td>mobile</td>
<td></td>
<td>able to transport itself from one machine to another</td>
</tr>
<tr>
<td>flexible</td>
<td></td>
<td>actions are not scripted</td>
</tr>
<tr>
<td>character</td>
<td></td>
<td>believable “personality” and emotional state</td>
</tr>
</tbody>
</table>

Table 5: Agent properties (source: Franklin/Graesser 1996)

Depending on the combination of the characteristics, different agents can be built, e.g. a learning, mobile agent. With increasing numbers of properties that are combined, the agent becomes more complex. The above classification also includes agents that may not as yet exist or may never be built.

Nwana (1996) chooses a different approach by establishing a typology of existing agents and by classifying the agents based on properties of these agents. She distinguishes five dimensions, three of which are explained below as they are useful for knowledge management:
• Mobility: Agents may be able to roam networks. If they are not, they are static.

• Primary attributes: These include
  o Autonomy: This implies that agents can operate on their own without the need for human guidance and are able to meet the user’s needs and act on his/her behalf. “A key element of their autonomy is their proactiveness, i.e. their ability to ‘take the initiative’ rather than acting simply in response to their environment.” (Nwana 1996)
  o Learning: In order to be able to adapt to the user’s needs and preferences, agents must be able to learn and to react according to new “insights” they gain.
  o Cooperation: Agents must be able to communicate with their owners and/or with other agents, so as to be useful.

• Roles: Agents can also be classified by the roles they fulfil, e.g. information or Internet agents that work on the World Wide Web. Their purpose lies in helping the user to cope with the vast amount of information in the Internet.

This typology – as the one by Franklin and Graesser – is not an accepted standard. In fact, there is none. The reason is that the definitions of the different agent types are blurred and partly overlap. Thus, filtering systems, for example, can be viewed either as interface agents or as information agents respectively. The reason for adopting Nwana’s typology is that a) a typology as such is helpful and b) that it is best suited to differentiate the agents with respect to their usefulness for knowledge management.

12.2.2 Interface Agents

Interface agents autonomously perform tasks for their users such as collecting information on the Internet or filtering and selecting incoming information, i.e. they can alleviate the user from tedious or repetitive work. The agent receives the status of a personal assistant, collaborating with the user in the same environment and hence learning and adapting to the user’s preferences. Learning can occur in four situations (Nwana 1996):

• The agent observes and imitates the user.
• The agent receives positive or negative feedback from the user.
• The agent receives explicit instructions from the user.
• The agents asks other agents for advice.

Various types of interface agents exist, e.g. agents that schedule meetings, that guide the user through unknown environments (e.g. programmes, the Internet), that buy or sell on the user’s behalf or that recommend music albums. As far as knowledge management is concerned, users probably benefit most from filtering agents which can be applied in different situations:

• News Filtering Agent: Sheth and Maes developed an agent which helps the user to select articles from Usenet Netnews. Different agents can be created for different areas (e.g. sports, entertainment, financial news) and have then to be trained (e.g. by the user who gives positive or negative feedback) (Nwana 1996).
- **Recommender Systems:** In a first step, they classify whether a particular piece of information is interesting to the user or not. In a second step, recommender systems search for other users who share the first user’s interests. Based on their findings, the system can then recommend to its owner further pieces of information that were interesting to others (Green et al. 1997). This means that the experience and the opinions of other people are taken into consideration by the agent which, in turn, allows its user to indirectly profit from other persons’ knowledge. One precondition is that the users actually do assess the different pieces of information. Problems can arise when the system is new and no user preferences are available. This can be solved – in an initial stage – by either motivating the users to recommend certain items or by the agents making recommendations (Koch 2001b).

- **Match Making:** These systems use the knowledge they have of their users’ preferences to find and suggest other users with similar interests. Unlike recommender systems, match making systems do not recommend documents or other pieces of information but suggest persons whom the owner might contact personally. With the help of his agent, the user can thus build whole networks of acquaintances (Koch 2001a).

### 12.2.3 Mobile Agents

Mobile agents are able to roam Wide Area Networks (WAN) such as the Internet in order to collect information according to the user’s needs. In performing their tasks, mobile agents not only communicate with the user but also with other agents. In comparison to static agents (which do not roam networks), they save time and communication costs. Instead of transferring all information that might be relevant from databases (as static agents do), they access the databases, collect only the required information and return “home”. The user may then accept or refute the information, based on which the agent learns, gets better acquainted with the user’s preferences and can adjust the corresponding profile. In addition, mobile agents can perform their tasks while the user does something different, i.e. the computer is not blocked by the agent; the computer does not even have to be connected (Nwana 1996).

### 12.2.4 Information Agents

As the amount of information appears to be ever increasing, the need for information agents is undisputed since they “perform the role of managing, manipulating or collating information from many distributed sources.” (Nwana 1996, p. 24) The purpose of information agents is to make information search and retrieval as easy and natural as possible, which would be especially useful in the Internet as it is barely structured and the information overload overwhelming. As information agents are autonomous, they cope with this mass by using search engines on the Internet to look for information.
12.2.5 Collaborative Browsing Agents

The agent “Let’s Browse” created by Lieberman, van Dyke and Vivacqua (1999) allows groups of people to jointly browse in the Internet. Even though the agent is still in its experimental phase, it illustrates a very promising approach which may be useful for knowledge management and as an addition to CSCW tools, group work and communities in which the agent could play the role of an active participant.

Lieberman, van Dyke and Vivacqua assume that web browsing will be increasingly done in collaborative settings, i.e. in work groups or at home within a family. The difficulty often lies in determining the interests of the other participants. Under these circumstances, it is the agent’s task to discover the participants’ common interests and preferences and to suggest web sites that satisfy the needs of all or most of the participants.

At present, the agent works as follows: One precondition is that the users are physically present in a specific room where a screen is installed. When the users approach the screen, the system senses their presence which is achieved by an active badge that the users wear. Once the users are registered with the system, the agent searches their user profiles in order to construct an interest profile for the whole group. In the experiment conducted by Lieberman, van Dyke and Vivacqua, the user profiles where established based on the participants’ personal web site or their company’s web site. This saves the users from having to fill in tedious and time-consuming questionnaires. When a new user joins the group or another leaves the room, the common profile is established anew and the browsing of the web re-starts in order to adapt the suggestions to the newly formed group.

Lieberman, van Dyke and Vivacqua also suggest further configurations for their browser to enhance efficiency and applicability:

Another possible configuration for a Let’s Browse system would be to run independent Let’s Browse browsers for each participant, and thus each participant would have control over their own input and profile. The browsers could then get out of sync with each other, but recommendations could still be displayed based on the common profiles. Finally, the most independent possible configuration would be to run completely independent copies of Let’s Browse for each participant. This last possibility would result in another interesting mode of use. By running someone else’s profile on your own browsing activity, you are essentially ‘browsing with another person’s eyes’. Thus the agent is giving you an idea of what another person might have found interesting. In contrast to another person giving you specific Web sites to look at, this kind of browsing allows you to examine Web sites as the other person might, even if they have never seen the page before. For example, if you are not an expert on cars and are in the market to purchase one, it might be helpful to browse car manufacturer’s sites with a profile of a friend who is an expert in the kind of cars you are looking for. This is a new kind of expertise sharing that deserves further exploration. (Lieberman/van Dyke/Vivacqua 1999, p. 430)
The users thus may be able to get to know each other better which might be useful in communities where people often interact without actually having met personally.

### 12.2.6 Evaluation of Software Agents

The strength of software agents lies in their efficient and speedy search for and dissemination of explicit knowledge, such as files, links or any type of encoded information. As software agents can adapt to the user’s preferences, they save the user time and tedious work. However, most of the agents described above also have some drawbacks (Nwana 1996):

- **Interface Agents:** An important point raised by Nwana is that people might not want software agents who look over their shoulders or even watch them (similar to “Big Brother”) to learn from their behaviour and act proactively, i.e. without the user’s intent.
- **Mobile Agents:** The main issue here is security. Just like viruses, mobile agents are able to enter corporate and private networks and do harm. Solutions to this problem must include authentication (i.e. it must be possible to verify that the agent is who it says it is), secrecy (i.e. the agents must maintain the user’s privacy) and security (i.e. protection against viruses).
- **Information Agents:** The problems that may arise with information agents are the same as with interface and mobile agents.
- **Browsing Agents:** As this agent is still in its experimental phase it is difficult to say which problems it might cause. In the experiment conducted by Lieberman, van Dyke and Vivacqua the people involved reacted favourably and the agent even served as an icebreaker between them. However, this must not be true for long-term collaboration or in groups where people know each other (1999).

For two reasons, software agents are not really suited to conduct case studies: Their contribution to knowledge creation is virtually inexistent (cf. “visibility”, “knowledge creation” and “ba” in the table below). Besides, the data and information are mainly collected in the participating companies (i.e. documents and interviews) and not in the Internet. However, if at a later stage the cases would have to be compared with other studies done in this field, software agents could be used to search for and retrieve these studies. In this context, browsing agents might prove their value by allowing researchers across different fields and locations to collaborate and to profit from each other’s knowledge.
## Software Agents

<table>
<thead>
<tr>
<th></th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comparability:</strong></td>
<td>4</td>
</tr>
<tr>
<td>Once the agent can dispose of an appropriate user profile, it is able to find data and information that is comparable. However, this takes some training.</td>
<td></td>
</tr>
<tr>
<td><strong>Different perspectives:</strong></td>
<td>3</td>
</tr>
<tr>
<td>If the software agent is given different profiles, it searches for different information. Yet, the task of evaluating this data and viewing it from different perspectives remains with the user.</td>
<td></td>
</tr>
<tr>
<td><strong>Accessibility:</strong></td>
<td>5</td>
</tr>
<tr>
<td>Software agents are an efficient and fast way to access data and information.</td>
<td></td>
</tr>
<tr>
<td><strong>Visibility:</strong></td>
<td>1</td>
</tr>
<tr>
<td>This is a task that has to be fulfilled by the researcher as the software agent merely collects information.</td>
<td></td>
</tr>
<tr>
<td><strong>Knowledge creation:</strong></td>
<td>1</td>
</tr>
<tr>
<td>Again, this can only be achieved by the researcher, not by the software agent.</td>
<td></td>
</tr>
<tr>
<td><strong>Knowledge dissemination:</strong></td>
<td>3</td>
</tr>
<tr>
<td>Software agents can easily and quickly disseminate information. However, it has no access to knowledge.</td>
<td></td>
</tr>
<tr>
<td><strong>SECI:</strong></td>
<td>2</td>
</tr>
<tr>
<td>The strength of software agents lies in the combination, i.e. in collecting and disseminating information.</td>
<td></td>
</tr>
<tr>
<td><strong>Ba:</strong></td>
<td>1</td>
</tr>
<tr>
<td>As software agents are not suited for knowledge creation and use, they can hardly be said to represent a type of ba.</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20</td>
</tr>
</tbody>
</table>

**Key:** Assessment from 1-5  
1: not at all applicable  
5: fully applicable

Table 6: Assessment of software agents (source: author)
Part IV: ATLAS.ti

13 Introduction

Similar to concept maps (cf. chapter 11), ATLAS.ti is a knowledge management tool that allows the user to define relations between different terms and pieces of information. However, where concept maps are restricted to single terms, ATLAS.ti allows a qualitative analysis of unstructured data, i.e. data that cannot be analysed by statistical approaches, such as texts, graphics, audio and video data. “It offers tools to manage, extract, compare, explore, and reassemble meaningful pieces from large amounts of data in creative, flexible, yet systematic ways.” (ATLAS.ti 2004, p. 2)

When doing case research, large amounts of texts, interviews, notes and graphics are collected, interpreted and used for theory building. In order to keep an overview, the researcher has to somehow structure this data. ATLAS.ti is aimed at helping the researcher to find his/her path through this jungle. While it offers a broad range of tools to handle the data, it does not excuse the researcher from doing this work, i.e. it does not offer tools that automate these processes and make brain work obsolete.

The main principles of ATLAS.ti are described in the acronym VISE, i.e. visualization, integration, serendipity, and exploration (ATLAS.ti 2004, pp. 3-4):

- **Visualization**: Since ATLAS.ti allows the researcher to draw maps that visualize the relations between pieces of data and information, it gives the researcher similar advantages as concept maps do. On the one hand, the maps comply to the way the human brain works; on the other hand, implicit knowledge and mental models can be made explicit and transferred more easily to other researchers.

- **Integration**: In order to gain an overview over the collected data, it can be integrated into and stored in the overall project. This allows the researcher to look at the data from different perspectives, i.e. the data can be viewed globally or different aspects can be explored in detail.

- **Serendipity**: Serendipity means finding things by chance, without having searched for them, an accidental, yet valuable discovery. Serendipity stands for an intuitive approach to analyse data. “A typical operation relying on the serendipity effect is ‘browsing’. This information-seeking method is a genuine human activity: When you spend a day in the local library (or on the World Wide Web), you often start with searching for particular books (or key words). But after a short while, you typically find yourself increasingly engaged in browsing through books that were not exactly what you originally had in mind.” (ATLAS.ti 2004, p. 4)

- **Exploration**: An exploratory, yet systematic approach helps the researcher to construct meaningful theories based on the data.

ATLAS.ti allows researchers to work on their own as well as in teams. Although it does not include features for synchronous work, asynchronous collaboration and project management can be easily achieved. Specific functions give the researcher the
opportunity to transfer his/her data to others and still know who contributed which data.

ATLAS.ti has been used in a broad range of research areas, such as geography, medicine, architecture, software engineering, linguistics and criminology (ATLAS.ti 2004, p. 5). The ATLAS.ti version introduced here is the latest, i.e. V 5.0.
14 Work Levels

The tools in ATLAS.ti can be divided into three categories: The first is the conceptual level which comprises basic functions such as segmentation of data files, coding texts, graphics, video and audio files, and writing memos. The second is the conceptual level which includes advanced functions such as model building and linking codes to networks. The third category is needed for the management and exchange of data and projects. The most important and most useful tools of these three categories will be characterized in the following sections.

14.1 Textual Level

14.1.1 Codes and Memos

When starting a research project, all relevant items such as files (texts, graphics, audio and video data) – which are also labelled “primary documents” – and later the researchers thoughts in the shape of codes, memos and networks are attached to a so-called “Hermeneutic Unit” (HU). The HU can be considered as a container which structures the project. The term “Hermeneutic Unit” was chosen “to reflect the approach we have taken when building a support tool for text interpretation” (ATLAS.ti 2004, p. 28). It bundles the research project into an entity.

![Figure 11: The object hierarchy inside a Hermeneutic Unit](image)

Once the primary documents (PD) are attached to the HU, the researcher determines the codes by which he/she wants to categorize the PDs. The codes are used to classify

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Knowledge Management from Case Studies with ATLAS.ti
the PDs into different levels of abstractions and to compare them in different ways, i.e. they represent some sort of key words. For this reason, they need to be accurate and short.

The researcher uses the codes to describe and summarize quotations, i.e. shorter or longer segments of the various PDs. The size of quotations can range from a single character to several paragraphs. Quotations consist of an identifier (a unique number) and coordinates which specify the beginning and the end of the quotation.

By capturing the researcher’s thoughts, memos play an important role in theory building. They can contain text, pictures or tables, can be attached to quotations, codes or other memos and can be grouped according to different user-defined types which simplifies their organization. In addition, memos can be turned into primary documents and subsequently coded just like other text files (ATLAS.ti 2004).

14.1.2 Search and Retrieval

Once some codes have been attributed to quotations, ATLAS.ti offers various tools to search the coded texts, to find similarities and dissimilarities, to explore the whole HU or to retrieve specific quotations in order to support theory building (ATLAS.ti 2004):

- **Text search:** This is a simple tool which is restricted to the primary documents and allows matching of text strings. Apart from this standard search, a category and a GREP search can be applied as well.

  - **Category search:** Several search terms can be combined into a category (by using the delimiter “|” which means “OR”) and stored for immediate or later re-use. Additionally, textual variations are handled as well, e.g. the search term “love” not only results in finding the term’s exact match but also variations such as “loving”, “beloved” or “lover”. This is called a search swarm. Both types can be combined to build hierarchical search structures.

    ![](image)

    *Figure 12: Example of a search hierarchy (ATLAS.ti 2004, p. 147)*

  - **GREP search:** “GREP is a well-known tool in the UNIX environment. The original GREP tool printed each line containing the search pattern, hence the acronym GREP: *Globally look for Regular Expression and Print.*” (ATLAS.ti 2004, p. 149, italics as used in the manual) Similar to category search, GREP search retrieves text clusters that match the search pattern and
highlights them on the screen. Thus, numbers, characters or ranges of characters can be found, e.g. all years between 2001 and 2004 (i.e. 2001, 2002, 2003, 2004) or all persons whose surname is “Smith” or is spelt similarly (i.e. Smith, Smijth, Smyth, Smythe).

- **Word cruncher:** This tool counts the number of words in one or several textual primary documents and is suited for a simple quantitative analysis. In an interview, for example, the occurrence of certain terms can be retrieved which might indicate topics that are important to the interviewee. In order to exclude fill words such as “a”, “an”, “the”, “and”, “or”, “of”, etc., a stop list can be applied. For further exploration, the results can be displayed in an Excel sheet (ATLAS.ti 2004, pp. 155ff.).

- **Object crawler:** With the help of the object crawler, not only primary documents can be searched but all text sources inside the HU, i.e. codes, memos, quotations, families or hyperlinks (ATLAS.ti 2004, pp. 158ff.).

- **Query tool:** This is suited for more complex search requests as the search terms are based on combinations of codes. This means that the quotations attached to these codes are retrieved. In the query tool, operands (codes and code families) and operators are used to formulate the search request which results in a list of matching quotations. Three types of operators are distinguished and thus three different types of search algorithms can be applied (ATLAS.ti 2004, pp. 160ff.):
  - **Boolean operators:** Four Boolean operators exist, i.e. AND, OR, XOR, NOT. AND retrieves quotations in which both specified operands occur; OR may result in a long hit list as it retrieves all text segments in which one or both of the two operands occurs; XOR, on the other hand, is more restrictive, i.e. it is an “either-or” request which excludes all instances in which both operands occur; finally, NOT tests for the absence of a specific term.

![Figure 13: Boolean operators and their application (ATLAS.ti 2004, p. 164)](image-url)
Semantic operators: They can be applied in networks which are then traversed hierarchically to retrieve text segments. Thus, the SUB command lists all quotations linked to a certain term, the UP operator the super codes of a specific term. And SIB stands for siblings which means that parents and their siblings are retrieved.

Proximity operators: They describe the spatial relations between quotations and are – unlike Boolean and semantic operators – not commutative. To apply the search request, so-called embedding operators are used which describe the relations of the primary documents with respect to the others. Thus, a document A can be contained WITHIN another (e.g. in the graphic below, A within C results in Q2), it can ENCLOSE a document B (A encloses B results in Q3), it can be OVERLAPPED BY B or OVERLAP it (A overlapped by B results in Q1, Q2; A overlaps C results in Q3). In addition, distance operators illustrate whether a document FOLLOWS or PRECEDES another (C follows A results in Q5; A precedes B results in Q2, Q4), or whether a CO-OCCURRENCE exists, i.e. it includes all proximity operators except FOLLOWS and PRECEDES.
Super codes: In order to store frequently used queries, super codes can be built with Boolean, semantic or proximity operators. Newly coded quotations are automatically retrieved as well, as super codes are not “hard wired” but compute the references anew each time they are executed. Unlike normal codes, however, they cannot be directly associated with quotations.

Snapshot codes: With snapshot codes, the status of super codes can be recorded allowing the researcher to analyse the results of super codes over a specific time span and as work progresses (ATLAS.ti 2004).

Families: In order to structure and group large amounts of texts, families are built. They form clusters of primary documents, codes or memos, i.e. families only contain one type of object and thus differ from networks (cf. chapter “14.2 Conceptual Level”). Interview files, for example, can thus be grouped by the interviewees’ location (Europe, USA, Asia) or by their gender (female vs. male). In connection with the search and query tools described above, specific information can be retrieved and, for instance, differences between female and male employees under 25 years’ of age or cultural distinctions between Europeans, Americans, and Asians can be elicited. These families can be further combined into super families. Families can also be used as filters which means that the primary documents, quotations, codes and memos displayed in the HU are reduced to the family “members” thus giving the researcher a concise overview over certain aspects (ATLAS.ti 2004, pp. 191ff.).
14.2 Conceptual Level

While the textual level is used to code, group, sort and filter texts, graphics, audio and video data, the conceptual level is needed for the interpretation of data and theory building. Two elements support the researchers in their tasks: networks and hypertexts.

14.2.1 Networks

Like concept maps (cf. chapter “11 Concept Maps”), the networks in ATLAS.ti consist of nodes and links which are used to express relations between the nodes which in turn represent quotations, codes, code families, memos, memo families, other network views, primary documents (PDs), and PD families or any combination. The advantages of this approach are the following:

This feature virtually transforms your text-based workspace into a graphical ‘playground’ where you can construct concepts and theories based on relationships between codes, text passages, or memos. This process sometimes uncovers other relations in the data that were not obvious before and still allows you the ability to instantly revert to your notes or primary text selection. Such textual/conceptual modeling is unique to ATLAS.ti. (ATLAS.ti 2004, p. 26)

In contrast with linear, sequential representations (e.g., text), presentations of knowledge in networks resemble more closely the way human memory and thought is structured. Cognitive ‘load’ in handling complex relationships is reduced with the aid of spatial representation techniques. ATLAS.ti uses networks to help represent and explore conceptual structures. Networks add a heuristic ‘right brain’ approach to qualitative analysis. (ATLAS.ti 2004, p. 211)

Certain relations are pre-defined in ATLAS.ti, such as “is-a”, “is-cause-of”, “is-associated-with” but this still leaves the user the opportunity to define his/her own relations. The networks can be stored and, in combination with the query tool, can be used for quick text retrieval. With respect to the layout, two types can be chosen: a semantic and a topological layout. The former depicts the nodes in a network in which an algorithm is applied that attempts to find the optimal position for each node, to avoid overlapping nodes and crossing links. The nodes with the highest connectivity are thus placed in the centre of the network. However, the user is free to manually rearrange the nodes in a more suitable way. The topological layout applies a depth-first algorithm and creates a list of nodes, ranging from the top left to the bottom right corner. The node with least dependences stands at the beginning of the list (ATLAS.ti 2004, pp. 230-231).
The so-called “theory transfer” allows the user to transfer codes and networks into different projects and re-use them. Two strategies can be applied to achieve the transfer (ATLAS.ti 2004, p. 242):

- **Flat Code Migration**: This type of migration is only suitable for codes, not for networks. The selected codes are written into an unstructured list, stored, and can then be imported as a code list into another project. This method is useful for teams where one researcher first defines the codes and then passes them on to the other team members.

- **Semantic Network Migration**: This method allows the transfer of a complete “theory” into new projects. In a first step, the code networks are stored in an external file, and, in a second step, imported into the new project. All nodes and their relations can thus be transferred.

### 14.2.2 Hypertext

In order to link whole texts and quotations, i.e. primary documents, the hypertext function – as known from the World Wide Web – is best suited. Thanks to hypertexts, the user is able to, for example, connect contradicting, supporting or criticizing statements. Similar to networks, some hypertext connections are predefined but the user can create his/her own as well. The linked quotations can be displayed as a network in which the quotations are shown in full length. To complete the picture, other node types like the memos attached to certain quotations, can also be included and viewed thus giving an overview over the linked text segments (ATLAS.ti 2004, pp. 251ff.).
14.3 Additional Features

14.3.1 Collaboration and Project Management

Even though ATLAS.ti does not allow synchronous work, asynchronous collaboration is supported as a simple user management system is implemented. To keep track of the work of different users, every Hermeneutic Unit (HU) is stamped with date, time, and the author’s name. The user can choose between different degrees of accessibility granted to other persons: permission for others to read and write, read only, or private use (i.e. restricted to the author). In addition, the HU can be password protected. For team work, co-authors can be defined who have the same access rights to the HU as the original author. In a next step, the alterations made in the HU can be filtered according to co-authors which is a convenient way to elicit the changes made by different team members (ATLAS.ti 2004, pp. 262ff.).

With respect to project management, ATLAS.ti offers various solutions for single users and teams. HUs, for example, can be merged which facilitates working on different aspects of the same project:

The Merge Tool reunites HUs that were originally divided for analytical or economical reasons. Its main purpose is the support of teams. It links together the contributions of different members of a research team. A common scenario is the analysis of different sets of documents by
different team members, sharing a common code base. (ATLAS.ti 2004, p. 289)

Another possibility is to migrate whole projects from one PC to another by establishing a so-called bundle out of the HU and all data sources attached to it. Bundling can also be used as a backup function to enhance data security.

14.3.2 HTML and XML

ATLAS.ti offers two possibilities to publish and further process projects and results: a HTML (Hyper Text Markup Language) and an XML (eXtensible Markup Language) generator. With a few mouse clicks, a complete HU is turned into HTML code, including networks which can be transformed into web graphics and then be displayed on the World Wide Web. Alternatively, a report of the HU’s content can be printed (ATLAS.ti 2004, pp. 307ff.).

As suggested by Zapata-Rivera, Greer and Cooke (2000) for concept maps (cf. chapter “11 Concept Maps”), ATLAS.ti provides an XML generator to exchange, process and display data in other applications (e.g. on the World Wide Web). Simultaneously, codes in XML format can be imported into the user’s HU. Although this is applicable to whole HUs, codes and memos, quotations are excepted (ATLAS.ti 2004, pp. 304ff.).

Additionally, an XML converter exists which allows the application of different style sheets to the XML files. The HU content can thus be differently represented. Some style sheets are already provided (e.g. to display the HU content in a table, to sort the output by authors or to display the data in different web designs) but of course the user can create his/her own as well (ATLAS.ti 2004, pp. 318ff.).
15 Evaluation

15.1 Advantages

ATLAS.ti shows similarities with two of the tools described above (cf. “Part III: Tools for Knowledge Management”), i.e. with asynchronous tools and concept maps. Consequently, ATLAS.ti also combines the advantages these tools offer the user.

As an asynchronous tool, ATLAS.ti contains means to retrace the work and comments (memos) of different authors which corresponds to meta information of asynchronous tools. As the inputs of the different authors are time-stamped, the history of the whole file can be recorded. Filters to search data are included as well as good search and retrieval functions. The problems of access rights and concurrent processes are solved as well as each team member can work on his/her own Hermeneutic Unit (HU). These parts can later be merged into a single HU combining the results and findings of the whole team. Moreover, tools for user administration (to adapt to the size of the team) exist as well.

In contrast to other asynchronous tools, ATLAS.ti does not possess awareness functions and event services.

ATLAS.ti clearly shows some analogies to concept maps, and consequently, they both share the same advantages: On the one hand, visualizations are better suited than descriptions to gain an overview of complex matters. On the other hand, the networks and maps comply to the function of the human brain which makes them very intuitive to use and interpret. In addition, ATLAS.ti disposes of an XML generator and converter allowing the researcher to exchange his/her data with others and to use them in different applications. This leads to the conclusion that ATLAS.ti is well suited for case studies and fits into the SECI model.

<table>
<thead>
<tr>
<th>ATLAS.ti</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparability:</td>
<td>5</td>
</tr>
<tr>
<td>With the support of the network view, specific parts of a case or whole cases can be compared; and similarities, differences and patterns are easily detected. As the inputs of the single team members can be clearly distinguished, their thoughts and conclusions can be retraced by others. In addition, memos can clarify differing views.</td>
<td></td>
</tr>
<tr>
<td>Different perspectives:</td>
<td>5</td>
</tr>
<tr>
<td>The data can be structured in different networks; nodes and links representing information can be added or deleted at any time. The user can thus test different networks, compare them to the underlying theory, include new insights and adapt them if necessary.</td>
<td></td>
</tr>
</tbody>
</table>
Accessibility:
The degree of accessibility can be chosen by the user, i.e. by attributing reading and writing rights to other team members. Thus, if desired, full accessibility can be granted to others. If memos exist, the information contained in the HU can be easily accessed by persons not involved in the construction of the HU and especially its networks.

5

Visibility:
This is clearly given, since the networks, as mentioned above, are the most powerful characteristic of ATLAS.ti.

5

Knowledge creation:
As ATLAS.ti mirrors the function of the human brain, it is well suited to gain new insights and to create new knowledge which is then represented in the networks.

5

Knowledge dissemination:
ATLAS.ti fulfils this prerequisite in two ways: On the one hand, the different HUs can be exchanged or even merged, i.e. the researchers’ knowledge is distributed within the team. On the other hand, thanks to the XML generator and converter, knowledge can be shared with people outside the team.

5

SECI:
ATLAS.ti actually covers all four SECI stages: By building nodes and connecting them, the researcher’s implicit knowledge is made explicit and can then be discussed with others thus covering externalisation and combination. As ATLAS.ti is also suited to test interrater reliability, it can also be said to cover socialization and internalisation, i.e. individual learning.

5

Ba:
ATLAS.ti mainly represents mental places, i.e. the researcher’s mental model of a specific case in the shape of networks. In addition, ATLAS.ti represents the way knowledge is stored in the brain and can thus allow insights into the researcher’s mind. If memos are considered as well, one might say that ATLAS.ti can also be a virtual place, as the information contained in the memos are exchanged electronically and can be commented in further memos.

5

| Total | 40 |

Key: Assessment from 1-5  
1: not at all applicable  
5: fully applicable

Table 7:  Assessment of ATLAS.ti (source: author)
15.2 Disadvantages

Even though ATLAS.ti is clearly suited for knowledge management in case studies, some disadvantages exist that have to be mentioned as well.

Ironically, the main disadvantage of ATLAS.ti lies in one of its most powerful features, the XML converter. It requires the installation of Microsoft’s MSXML v.3 XML parser which, in turn, requires the Internet Explorer 5.5 or a later version to be installed (ATLAS.ti 2004, p. 319). The problem is that MSXML “includes the XMLHTTP ActiveX control, which allows web pages rendering in the browser to send or receive XML data via HTTP operations” (Microsoft 2003). ActiveX controls are very powerful as they have full access to the Windows operating system. This means that ActiveX controls can access resources on the user’s computer and can thus also damage any of these resources. Even though Microsoft introduced signed controls (they contain the programmer’s digital signature), they are no guarantee against damages. This leads to the conclusion that “safe ActiveX controls do not exist” (Schmidt 2003).\(^5\) Microsoft implicitly acknowledges this fact as it constantly publishes security bulletins informing on newly detected vulnerabilities (Microsoft 2003; 2004).\(^6\)

Another disadvantage connected with the XML converter is that no quotations can be extracted. However, they contain vital information on the project which is thus lost and cannot be used in other applications (ATLAS.ti 2004, p. 307).

In addition, some minor disadvantages exist which, if eliminated, could make the user’s life easier. One of them is that neither Word nor PDF files can be used as primary documents but have to be converted into TXT files which is a rather boring and – especially if the files contain graphics which have to be stored in JPG format – also a time consuming task.

Even though ATLAS.ti offers no tools for synchronous work – such as shared screen – this is not really a severe disadvantage as the asynchronous tools that are provided compensate this lack and allow efficient team work.

15.3 Further Aspects

With respect to knowledge management, it might be useful to embed additional features into ATLAS.ti. The first to consider is a discussion platform. Even though memos can be used to exchange ideas and insights, this may work well for small groups but is probably cumbersome for medium-sized or large ones. Besides, a discussion platform might offer researchers the opportunity to open their discussion to other research groups and to thus exchange and accumulate additional knowledge.

Another aspect worth taking into consideration is to open ATLAS.ti to different operating systems such as Apple Macintosh or Linux. This would on the one hand

\(^{5}\) For further information on problems concerning ActiveX controls cf. for example [http://www.heise.de/security](http://www.heise.de/security) where a collection of related articles can be found.

enhance opportunities to exchange results within the scientific community. On the other hand, it would reduce security risks such as the ones described above.
Part V: Conclusion

16 Summary

Knowledge management becomes increasingly important for firms as today’s knowledge is obsolete tomorrow which means that it has to be continually updated, adapted and newly created. Firms are not restricted to their employees’ knowledge but – with the strategic approach of the stakeholder view – can also use extra-organizational networks to profit from novel insights. The stakeholder view is based on reciprocal relations between the firm and its stakeholders from which both parties can benefit. With the support of their stakeholders, firms are able to create organizational wealth and gain sustainable competitive advantages. A particularly important type of organizational wealth are intangible assets, especially knowledge. If the firm succeeds in establishing and nurturing mutually beneficial stakeholder relations, it may also benefit from its stakeholders’ knowledge and thus create resources that are difficult to imitate for competitors (Post/Preston/Sachs 2002).

Knowledge and its management are not just important for corporations but to the same degree for research teams. This was illustrated by the example of a team doing research based on comparative case studies on questions of successful stakeholder management.

In addition, knowledge management in case studies asks for further conditions that need to be fulfilled, especially with regard to the data and information on which the knowledge creation is based. They must be comparable, viewed from different angles as well as easily accessible; the results must be clearly visible and provide for knowledge creation and dissemination.

Knowledge is an elusive good and difficult to define. Of the numerous attempts, the one by Nonaka and Takeuchi (1995) was chosen as the basis of this thesis. In order to clearly distinguish knowledge from information, they add a dynamic aspect by considering knowledge as a flow of information tied to a person’s beliefs and commitment and therefore related to human action.

Commonly, a distinction between implicit and explicit knowledge is made which is not merely useful but – with regard to case studies – also particularly important. Explicit knowledge can be easily reproduced and transmitted by words or figures which means that it can be expressed by language. According to Polanyi, implicit knowledge is characterized by the fact that “we know more than we know how to say” (1958, p. 12). This means that it contains a personal quality which makes it difficult to formalize and to pin down as it is tied to a person and is interwoven with the person’s actions and experiences in a certain context. As the case studies aim at deriving good practices of stakeholder management, it is important that the researchers’ implicit knowledge can be turned into explicit and thus made accessible for firms.

Knowledge management requires a model which allows the integration of various aspects of knowledge: First of all, the model must distinguish between implicit and explicit knowledge and offer solutions to bridge this gap. Second, the model must also
differentiate between individual and organizational learning which are indispensable prerequisites for knowledge creation. Third, the model must allow to combine a firm’s internal and external knowledge. Fourth, the model must be applicable to research projects and especially to case studies. And finally, it must also provide solutions for efficiency in knowledge management, i.e. the integration of IT systems.

In this thesis, different models were evaluated with respect to the above mentioned criteria. Argyris and Schön (1978) stress the difference between individual and organizational learning. They distinguish three levels of learning, i.e. single loop, double loop and deutero learning. Organizations as a whole only learn when the last two levels are applied. In the case of single loop learning, individuals learn but their knowledge is not transferred to the firm. To March and Olsen (1988) learning means that individuals and the organization adapt to their environment by influencing each other and by reacting to these influences. However, a number of obstacles exists which prevent successful learning and to which March and Olsen offer no solution. In a next step, Kim (1993) introduces shared mental models which on the one hand explain how people and organizations operate in the real world and on the other hand illustrate how individual is transferred to organizational learning.

In addition to the above mentioned models which stress individual and organizational learning, two others exist which do not concentrate on knowledge creation as such but on the retention, dissemination and use of existing knowledge. One was developed by Probst, Raub and Romhardt (2003), the other, which is basically an adaptation of it combining human beings, organizations and technology, is the so-called Munich model (Winkler 2004). In both models, knowledge management is considered as a concept to design and shape organizational knowledge. It has to be applied consciously and systematically in order to achieve a purposeful and specific use of knowledge within the organization.

While each of these models only concentrate on a specific aspect of knowledge management, the SECI model by Nonaka and Takeuchi (1995) succeeds in combing all of them, i.e. it distinguishes between implicit and explicit knowledge, it integrates individual and organizational learning, it solves the problem of knowledge dissemination and use and – unlike the other models – it integrates knowledge creation as well. In short, it is the most comprehensive and complete of all models. Additionally, the concept of ba allows the representation of physical, virtual and/or mental places for knowledge creation and dissemination (Nonaka/Konno 1998).

In a next step, the different models – knowledge management, stakeholder management and case studies – were combined with the help of a suitable IT tool which, in turn, had to fit into the SECI model.

These requirements also affect the IT tools used for knowledge management in case studies, i.e. the tools must be intuitive and comprehensive, yet flexible. Different IT systems were analysed in order to evaluate whether they fit into the chosen knowledge management model (SECI) and whether they cover the demands of case studies. Similar to the knowledge management models, most of the considered IT tools comply only in parts. Besides, not all of them can be fitted equally well into the SECI model.
While both, CSCW tools and communities, are advantageous for knowledge creation and dissemination, CSCW tools serve the needs of small and medium-sized groups but lack the opportunity for social interaction, a key element in knowledge creation. Communities are better suited in this respect but are mainly useful for large groups or organizations, i.e. not for small research teams. As far as comparability and visibility are concerned, concept maps are the best solution as complex knowledge can be grasped at one glance. Their main advantages lie in externalising knowledge and in their structure which is analogous to the human brain. The strengths of solutions based on Artificial Intelligence, such as Case-Based Reasoning and software agents, are their adaptability and the quick accessibility they grant the user to vast amounts of information. A considerable drawback, however, and especially compared to the other tools, is that Artificial Intelligence solutions do not fit into the SECI model and do not provide spaces for knowledge creation and dissemination, i.e. no ba.

The conclusion that has to be drawn from the statements made above is that of all the tools described in this thesis, ATLAS.ti is best suited for knowledge management in case studies. It meets all eight requirements and can be easily combined with SECI and ba. The reason for this is mainly that ATLAS.ti combines several concepts and advantages of other IT tools for knowledge management, particularly those of (asynchronous) CSCW systems and concept maps. ATLAS.ti is a very intuitive and flexible tool thanks to its network function with which knowledge structures can be depicted in a way which corresponds to those of the human brain. Thanks to this combination, ATLAS.ti fits well into the SECI model and not only covers most of its stages but also offers different types of ba for knowledge creation and dissemination.
17 Future Research

Knowledge management is a broad field and consequently many unexplored areas still exist. With regard to ATLAS.ti, the most important task would be to find a way to reduce the security risks (cf. chapter “15.2 Disadvantages”).

Another aspect to consider is which additional features might be included to further advance ATLAS.ti. One might be to allow synchronous work, especially by introducing shared screens. Another is if Case-Based Reasoning (CBR) could be meaningfully combined with ATLAS.ti. As the number of cases increases continually in the above described research project, sooner or later the problem of keeping an overview will have to be solved. Besides, if new people join the group, they will need to be introduced to existing cases quickly and efficiently. Under these circumstances, Case-Based Reasoning might be a valuable addition as it offers the researcher the opportunity to compare different cases, to find similarities and differences. When doing such comparisons, it might also be useful to establish networks not just within one Hermeneutic Unit (i.e. within one case) but over several or all cases to display the general picture of the research topic.

Just as in the case of ATLAS.ti, XML could be used to eliminate proprietary files, to exchange data between different CBR systems and even to integrate maps and networks into CBR. This would not only allow the exchange of data and information within a single research group but with other researchers doing work on the same or on related topics. And of course, data can be easily published in different formats, e.g. as a report just as well as on the Internet.

A further aspect of knowledge management worth investigating more deeply is connected with the different systems: Are tools that attempt to mimic the function of the human brain (e.g. concept maps, ATLAS.ti) better suited for knowledge management than those concentrating on communication and social interaction (e.g. communities)? In other words: Is an intuitive approach more important than virtual communication? Or can the two approaches be combined to meaningfully complement each other? Which role does the size of a group play when deciding which tool is used?

In order to improve concept maps and networks, specific features might be added. Thus, it might be useful to introduce a third dimension – apart from nodes and links – which indicates the importance or the weight of a certain node within the network compared to the others. This could result in a three-dimensional graphic of the network. Hence, ideas can be better structured and important topics can be perceived at one glance while less important nodes are slightly moved to the background.

As this corresponds to the way that certain neural networks operate, it might be worthwhile to analyse which role they can play in knowledge management. Neural networks have several advantages which could be useful in this context: First of all, they are explicitly designed to “copy” the function of the human brain. Therefore, as is the case with human beings, learning (and thus adaptation) is an intrinsic property they possess and which makes them valuable. Secondly, neural networks can
categorize which means that new terms and concepts are “attracted” by similar existing ones (Pfeifer/Scheier 1999). This results in a network in which associations can be easily made and which builds the basis for further learning and expansion of the network. And thirdly, depending on the importance and the frequency of a specific term, the networks build three-dimensional, adaptable structures (Spitzer 2000).

As the question of whether neural networks can be put to productive use for knowledge management is a rather comprehensive one, it implies further research not only in Artificial Intelligence and neural networks but probably also in neurology and/or neurobiology.
Bibliography


