Dissertation

Knowledge-Based Innovation Management

A Process-Oriented Approach for Integrating External Knowledge in the Front-End of Innovation

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Abstract

Open innovation has become one of the hottest topics in innovation management research since Chesbrough introduced the approach in 2003. A lot of research followed then but what is still requested by many researchers is a model for the open innovation processes as well as solutions on how to identify and select the right external knowledge owner for the given innovation problem.

This work basically focuses on these issues. It provides a framework that considers the selection of the significant knowledge owners and further contributes to the request of having an open innovation process model by introducing a model for the front-end of open innovation. The framework includes a six stage process model for the early stage of open innovation processes and further enriches the process by a set of methods and tools that support the specific process stages. Furthermore, social and cultural aspects are covered within the framework. These are related to internal issues as well as inter-organizational barriers to knowledge transfer. Only little research considered social and cultural issues related to the open innovation process before.

A case study shows the practical relevance of the treated issue. This case has been conducted together with a medium sized Austrian software firm.

Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

Date	Signature

Acknowledgement

It would not have been possible to write this work without the help and support of the kind people around me, to only some of whom it is possible to give particular mention here.

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Contents

1 Introduction

During the past years open innovation grew to one of the most essential success factors for innovative companies. The external orientation in innovation management is not new at all but after Henry Chesbrough (2003a, pp. 35-41) came up with the specific term *"open innovation"*, this approach received closer awareness from researchers and practitioners around the globe.

Innovation is no longer seen as an internal oriented process where all necessary activities and all the knowledge have to come from within. Companies do have to cooperate with external sources of knowledge to remain sustainably competitive. (Gassmann 2006, pp. 223-228)

1.1 Background and Problem Definition

The open innovation approach creates an awareness on external parties as sources of knowledge for the innovation process. This aspect enables a flood of knowledge made available to organizations. One of the central goals of this thesis is to provide a concept on how to handle this knowledge in an effective way, and to deliver answers on how access this external knowledge in a structured way. The central issue consists of the question how to integrate all the external knowledge made available by the open innovation approach, in the innovation process. This question brings up two main barriers to knowledge-based innovation management as shown in Figure 1.1.

In the focus of consideration there is an industrial unit that has a certain *knowledge demand* in relation to a specific innovation problem. Consistent with the open innovation

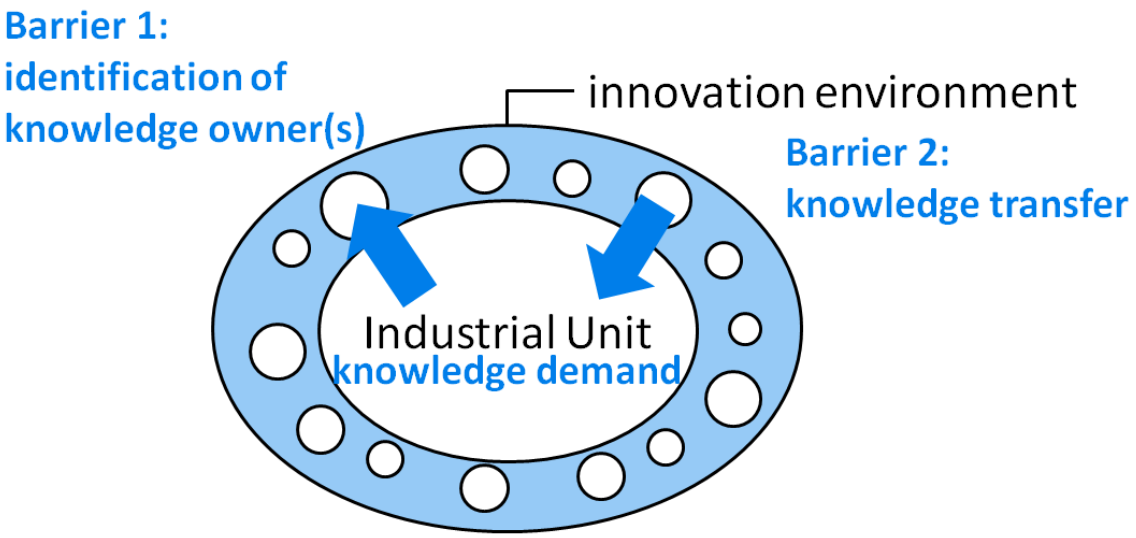

Figure 1.1: Research focus of this thesis - the two main barriers in knowledge-based innovation management (own illustration)

approach, the industrial unit screens external knowledge owners in its environment - which is called the *innovation environment*. Relating to the stated question on how to integrate all this available external knowledge successfully into the internal innovation process, there are two main barriers coming up, which are the *two main barriers to knowledge-based innovation management*. One central barrier is the *identification of the most relevant knowledge owner(s)* within the innovation environment. Which source of external knowledge provides the best benefit concerning an organization's specific innovation problem? The approach developed within this thesis provides a careful approach on how to identify the most relevant knowledge owner.

The second central barrier is the barrier on *knowledge transfer*. How can a successful knowledge transfer from the knowledge owner into the organisation be ensured? How can the external knowledge be integrated into the internal innovation process? Katz and Allen (1982, pp. 7-20) discussed one of the central sub-barriers concerning to this barrier to knowledge-based innovation management which is called the *Not Invented Here (NIH) Syndrome*. This thesis as well provides a concept on how to overcome this second barrier in a structured and efficient way.

Based on the above mentioned aspects, the research focus of this thesis considers following issues:

1. Development of an approach to overcome these two barriers to innovation in order to ensure a quick identification of the right knowledge owner(s) as well as a successful knowledge transfer from outside to inside.
2. Development of an approach that describes how an organization can ensure a knowledge-based innovation management by integrating external knowledge into the internal processes - already at the front-end of innovation.

Relating to the given problem description following section defines the research focus and scope of this work.

1.2 Scope and Relevance of the Thesis

Already several years ago, external sources of knowledge have been recognized as extremely valuable in innovation management. There have been various approaches concerning the involvement of external parties into the innovation processes. Eric von Hippel for example referred to different sources of innovation in his 1988 work "The Sources of Innovation". He outlined the importance of different external sources as innovators. In 1990 Cohen and Levinthal (Cohen & Levinthal 1990, p. 128) claimed that outside sources of knowledge are often critical to a company's innovation activities. They came up with the concept of *absorptive capacity* which is widely known and discussed in literature. Furthermore, the concepts of innovation systems and strategic alliances also have to deal with the management of external parties in innovation management. (Lundvall 2010)

Recent research shows that the concept of opening up the innovation process is still relevant and open innovation is still a concept without a structured process behind. Gassman et al. published a paper on the future of open innovation in 2010 where they made following statements:

> *"... industry is starting to professionalize the internal processes to manage open innovation more effectively and efficiently. Nevertheless, it is currently still more trial and error than a professionally managed process."*
> (Gassmann, Enkel & Chesbrough, 2010, p. 216)

> *"...there is as yet no holistic model of open innovation that includes the innovation process's determinants and industry specifics, as well as the limits to opening it up"*
> (Gassmann, Enkel & Chesbrough, 2010, p. 219)

Moreover, Huizingh (2011) published a paper on the state of the art and future perspectives of open innovation where he claimed, besides some other issues, that there is as yet no *"integrated framework that helps managers to decide [...] with which parties to collaborate, and how to find and select them"*. This is where this thesis focuses on.

Referring to these statements it can be shown that open innovation - even though it is already one of the most researched topics in innovation management - is still no holistic concept with a well-structured process behind. Goal of this thesis is to make a contribution to the development of this claimed process model for open innovation projects.

To provide an integrated knowledge-based innovation management, it is important to start at the beginning of an innovation process with the necessary activities. This is why this research work focuses on the first phase of Thom's model of an innovation process. Thom (1980) introduced the first model of an innovation process concluding three main phases: the idea generation phase at the beginning of each innovation process, followed by the idea acceptance and the idea realisation phase. The research work of this thesis focuses on the first phase - the idea generation as shown in Figure 1.2.

To be more specific about the research focus of this thesis following aspects of the idea generation phase are according to Vahs and Burmester (1999, pp. 137-138) available:

- *Collecting ideas* from already existing information sources.

Figure 1.2: Innovation process according to Thom (1980)

- *Idea generation* as a creativity process where creativity techniques are used to generate ideas systematically.

This dissertation deals with the first aspect of collecting ideas in the early phase of an innovation process based on the premise that there are already a lot of existing ideas in the innovation environment available and combined with these ideas a huge knowledge base exists.

1.3 Research Questions

The research questions focus on the overcoming of the two main barriers of knowledge-based innovation management as described in chapter 1.1. The first research question deals with the definition of the innovation environment. It will be researched, how an innovation environment can be set up and identified, and which knowledge owners can be identified.

Question 1

- Who are the main (external) knowledge owners in open innovation processes?
  - How can the knowledge owners be classified?

When knowing the innovation environment it is important to identify the most relevant knowledge owners concerning a specific innovation problem. The research goal is to find a way how to identify these knowledge owners in the front end of innovation and to define methods and tools to support the identification of internal knowledge gaps and relevant external knowledge.

Question 2

- How can the most significant knowledge owners concerning a specific innovation problem be identified?

The identified knowledge shall be transferred into the organisation and integrated in the internal innovation process. This concludes the knowledge transfer as well as knowledge sharing and knowledge usage and exploitation of external knowledge.

Question 3

- How can the external knowledge be integrated and used within the internal innovation process?
  - How can the external knowledge be transferred into the company?
  - Which barriers to knowledge transfer can be identified?
  - Which knowledge management tools and methods can be used to support the successful transfer of knowledge from outside to inside?

The three research questions build the framework for the research within this topic. The next chapter describes the research design derived from these research questions.

1.4 Scientific Approach

In order to have a clear and structured research process, the approach of this work is based on the research design developed by Wohinz (2009, p. 12). This design gives a clear structure for research works. Figure 1.3 shows the research design of this thesis.

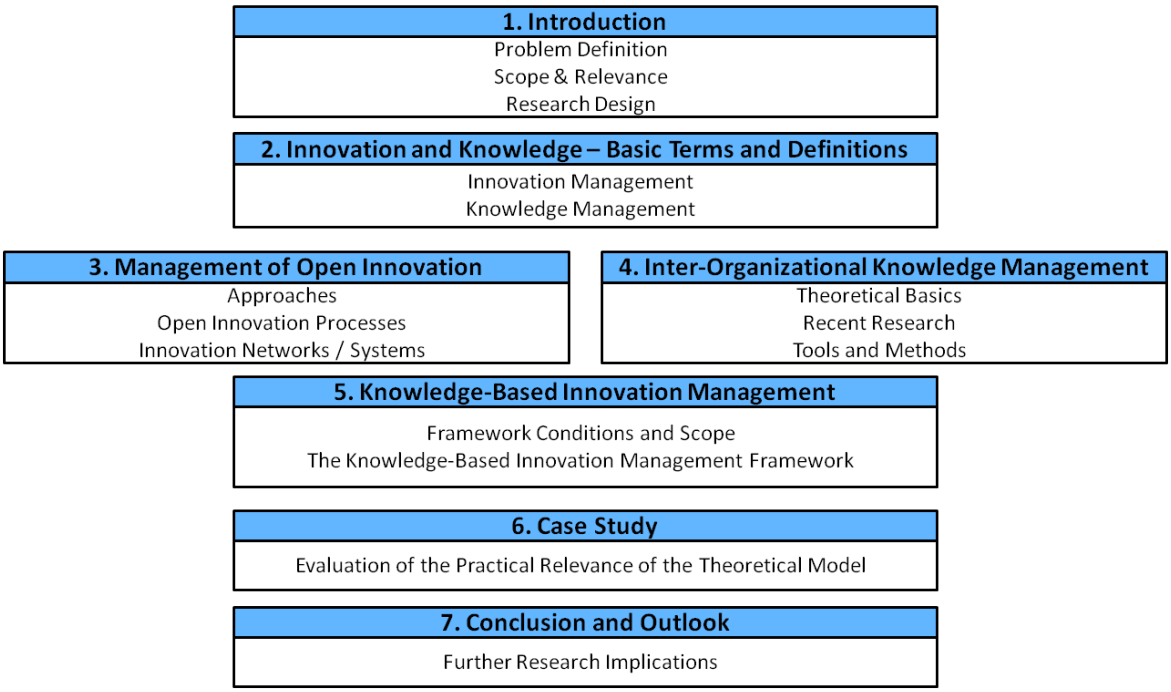

Figure 1.3: Research design according to Wohinz (2009, p. 12)

Chapter 1 - Introduction

The figure shows that the first chapter, the introduction, deals with the description of the innovation problem and the current situation in regard to the research focus. Furthermore, this chapter includes the scientific and practical relevance and the definition of the specific research focus. Besides that, the research questions as well as the scientific approach are covered here.

Chapter 2 - Innovation and Knowledge - Basic Terms and Definitions

Chapter 2 provides an overview about the central terms of this thesis and gives important definitions to gain a common understanding of the most relevant terms for the reader. Basic definitions on the fields of innovation management and knowledge management can be found within this chapter. Different approaches in this two research fields are shown. The chapter concludes with a definition of the *innovation management* term and the *knowledge management* term that are used within this thesis.

Chapter 3 - Management of Open Innovation

The focus of chapter 3 is the management of open innovation based on a literature research. An overview about central process models of open innovation is part of this chapter as well as an overview and a description of the most central knowledge owners relevant for open innovation projects.

Chapter 4 - Inter-Organizational Knowledge Management

The second theory chapter deals with the second thematic priority of this dissertation project which is knowledge management. Chapter 4 deals especially with the inter-organizational of knowledge management which means knowledge management in regard to cooperation with external sources of knowledge. An overview about tools for the identification of (external) knowledge as well as tools and methods for a successful knowledge transfer from outside to inside an organization will be provided here.

Chapter 5 - Knowledge-Based Innovation Management

Within chapter 5 the two main thematic fields of open innovation and external-oriented knowledge management are combined to a theoretical model. The theoretical model provides a solution how to overcome the two main barriers to knowledge integration

into the internal innovation process and introduces the knowledge-based innovation management approach.

Chapter 6 - Case Study

The theoretical model as defined in chapter 5 is evaluated by a single case study. Chapter 6 therefore concludes the empirical part of this thesis.

Chapter 7 - Conclusion and Outlook

Final chapter 7 gives an outlook on future work concerning the research focus of this dissertation.

2 Innovation and Knowledge - Basic Terms and Definitions

Innovation and knowledge are the central terms within this work in regard to the research focuses. To gain an overall understanding, this chapter discusses all relevant terms within the field of innovation and knowledge management and provides a definition of both as used within this thesis.

2.1 Innovation

This section gives an overview about the about the basic terms in innovation management in regard to this dissertation project and the research focus of this work as defined in chapter 1. The first section provides some definitions of the most central terms in innovation management. A classification of innovation follows in the second section. Furthermore, process and system orientation in innovation management are discussed within the following section. An overview about central process models for the innovation management process is provided and the most common innovation system approaches are discussed here.

2.1.1 Definition

The term innovation is often confused by *invention* and *imitation*. There is of course a close connection but within this work these terms should be distinguished.

Invention

> *"invention is the obvious first step towards any new product or process"*
> (Schumpeter 1911, p. 100)

According to Schumpeter (1934, p. liv) inventions are restricted to new ideas while innovations involve activities for the commercial application of any new idea. Moreover, Freeman defined *invention* as

> *"an idea, a sketch or a model for a new or improved device, product, process or system."* (Freeman 1974, p. 22)

According to him, inventions may often be patented but they have to be distinguished from *innovations*. (Freeman 1974, p. 22)

Innovation

Joseph A. Schumpeter was the first scientist who pointed out the importance of innovation in the field of economics. Within his book *"The Theory of Economic Development"* he defined innovation, beside to invention, as follows:

> *"innovation, that is the process of finding economic applications for the inventions"*
> (Schumpeter 1911, p. 129)

The definition of innovation involves, according to Trott (2005, pp. 14-16), the theoretical conception, the technical invention as well as the commercial exploitation.

Freeman (1974, p. 22) defined innovation as the new knowledge to provide a new product or service which concludes the invention and the commercialization. This new knowledge can be technological or market related. Furthermore he posted that innovation is used to describe the whole process involving the technical invention as well as the commercial transaction.

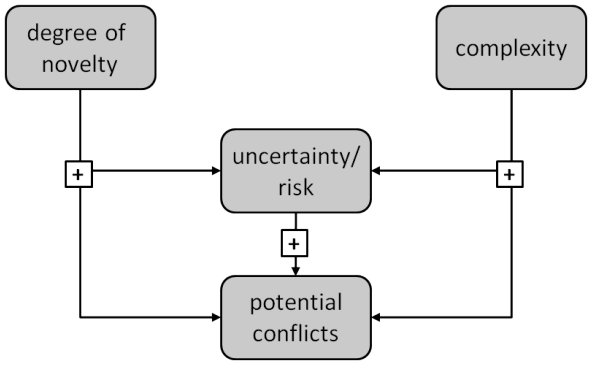

Figure 2.1: Characteristics of innovations referring to Thom (1980, p. 31)

Innovations may, according to Thom, fulfill four characteristics of innovations: the degree of novelty, complexity, uncertainty and risk as well as potential conflicts. Figure 2.1 shows the interrelation between these characteristics. (Thom 1980, pp. 23-31)

The degree of novelty as the first characteristic of innovations may be found in nearly every definition of *innovation*. It is obvious that this factor influences a potential risk, since new issues always go hand in hand with uncertainty, e.g. in regard to market success. The third characteristic of innovation according to Thom is complexity in the sense of two dimensions, the time dimension and the qualitative and quantitative dimension. In regard to these three characteristics, the fourth factor that characterizes innovations is potential conflicts which is influenced by all three mentioned factors. (Thom 1980, pp. 23-31)

Besides the characteristics Thom provided within his work, Rogers defined and characterized innovations based on following criteria (Rogers 2003, pp. 15-17):

- *Relative advantage.* According to Rogers it does not matter what degree of objective advantage an innovation brings up, what matters is the advantage to individuals. Furthermore he posted that the greater the relative advantage of an innovation, the more often it will be adopted.
- *Compatibility.* This characteristic describes the compatibility of an innovation to previous innovations, values, and past experiences. The greater the adoption rate of innovations is, the more slowly it will be adopted.

- *Complexity.* The degree to which an innovation is perceived as difficult to understand and use is another characteristic of innovations in regard to Rogers. The adoption rate is slower if innovations are not comprehended by most individuals.
- *Trialability.* Innovations that may be experimented in a restricted way will be adopted more rapid than those that may not.
- *Observability.* By observability Rogers means the degree to which the result of an innovation are visible to individuals. The more easy it is to access these results, the higher the rate of adoption may be.

To sum up, the greater the relative advantage, the compatibility, the trialability and the observability and less complex it is, the more likely an innovation will be adopted. (Rogers 2003, p. 17)

Innovations are rather complex issues that require a systematic process landscape and as well an organizational framework that is open for innovative activities. The process approach that deals with the organizational requirements of innovations will be discussed later within this chapter as well as the system approach which focuses on providing innovation-friendly structures and systems between various organizations.

Imitation

The third term that is to be discussed within this section is imitation. Schumpeter defined imitation as follows:

> *"imitation, that is the process by which innovation is diffused throughout the industry or economy"*
> (Schumpeter 1911, p. 100)

Schumpeter further argued that imitators can become inventors if they aim to improve on the original innovation. An imitation adapts the invention e.g. in regard to quality improvements. (Schumpeter 1911, p. 100)

Imitator's products are often differentiated by minor technical improvements. These firms may take out a few patents but that is not part of their innovation strategy. These patents are normally just by-products of its central activity. (Freeman 1974, p. 271)

2.1.2 Classification of Innovations

Within this work it should be distinguished between two types of innovation, knowing that there are lots of other classifications. *Product* and *process* innovation are the most relevant categories of innovations to this work and are therefore in focus of this section.

Freeman (1974, pp. 244-245) provided a differentiation between inhouse *process innovation* and open market *product innovation*. According to him, product innovation involves technical uncertainty as well as market uncertainty. Whereas process innovation involves only technical uncertainty.

2.1.2.1 Product Innovation

This work mainly focuses on product innovations. Therefore the different characteristics of product innovations are discussed within this section in more detail. According to Edquist, product innovations are new or improved material goods as well as new intangible services. (2005, p. 182)

First of all we should clarify what a product could be. Crawford and Di Benedetto (2006, p. 12) defined six different categories of products:

1. *New-to-the-world products.* These products are completely new to the world and therefore create a whole new market. Examples for this category are Polaroid camera, Sony Walkman and the Palm Pilot. These new-to-the-world products make up about 10 percent of all new products.

2. *New-to-the-firm product lines.* These products are not new to the world, but to the firm. New-to-the-firm products make up about 20 percent of all new products.

3. *Additions to existing product lines.* Products like e.g. line extensions and flankers to existing products in the firm's current markets make up around 26 percent of new products.

4. *Improvements and revisions to existing products.* As the category name already tells, this category covers improvements to existing products which are about 26 percent of new products.

5. *Repositionings.* These products are not new at all. The field of application and the purpose of the product has changed. A popular example within this category is aspirin who repositioned as a safeguard against heart attacks. This category makes up about seven percent of new products.

6. *Cost reductions.* Products within this category provide the same performance as the already existing products but at lower costs which make about 11 percent of new products.

In that sense, product innovations aim to achieve effectiveness by offering services that fulfill completely new purposes or already existing purposes in a new way. (Hauschildt & Salomo 2011, p. 5)

2.1.2.2 Process Innovation

The second big category of innovation is process innovation. To further define process innovations, the understanding of *processes* in general should be clarified: A process is a series of tasks that may involve several organizational units and which has to be supplied with a defined amount of resources in order to show the required performance.

Freeman mentioned that process innovations may not only result in reduced unit costs but reductions in capital, energy and materials as well. Besides that process innovations may cause higher quality and more uniform products. (1974, p. 43)

The aim of process innovation is to increase the efficiency realized by new combination of different factors that improve the production of a specific good, e.g. in regard to

cost-effectiveness, quality improvements, process reliability or speed. (Hauschildt & Salomo 2011, p. 5)

Summarizing, it is important to take note that this work distinguishes between product and process innovations. In terms of product innovations, innovation management deals with customer-related products or services and therefore market-oriented activities while process innovations mostly occur because of changing or new products. The changing of the product line often requires different inhouse processes and restructuring measures that imply process innovations primarily in regard to the production. (Hauschildt & Salomo 2011, p. 90)

2.1.3 Innovation Management

Hauschildt & Salomo (2011 pp. 29-30) introduced two aspects of innovation management - the process and the system approach. This section gives an overview on the process approach including different innovation process models and, on the other side on the system approach including several models for innovation systems.

2.1.3.1 Innovation Process

The innovation management process is quite complex and involves the effective management of many different activities and organizational units. Within an innovation management process there are interactions within an organisation as well as interactions with the external environment. Researchers within the company cooperate with scientist from universities, research institutes or other firms. Marketing interacts with external market players like suppliers, customers and competitors to understand best customers needs and to ensure that the produced products will fulfill the requirements of the market. Management and business analysts communicate with a variety of firms and other external institutions, such as government departments, suppliers and customers. Based on this understanding the innovation management process is a difficult management process that requires efforts in various fields. (Trott 2005, pp. 26-28)

The section below describes the innovation process according to Thom (1980, pp. 52-53), which in my opinion describes best the important phases of an innovation process. There are several process models available for innovation management processes, two of the most often practice-applied processes are described here.

Innovation Process according to Thom

Thom's innovation management process consists of three main phases: (Thom 1980, pp. 52-53)

- *Idea generation* which concludes the idea generation itself based on creativity techniques and the idea collection where already existing ideas are collected within the innovation environment.
- *Idea acceptance* concludes the decision making procedure. This phase deals with tools and methods introduced to support the decision process of innovation projects.
- *Idea realization* which is the implementation of the idea. Product development and often validation and testing are part of this process phase.

Figure 2.2: Innovation process according to Thom (1980, pp. 52-53)

Figure 2.2 shows the three phases of the innovation process referring to Thom. The first important process step is the generation of ideas where two aspects can be taken into consideration. This step includes the generation of ideas by using creativity techniques for example. Furthermore it considers the aspect of collecting ideas from existing sources.(Vahs & Burmester 1999, p. 137)

Secondly, the idea acceptance stage covers the evaluation of the ideas, the implementation of a business plan as well as the decision making process. Here, the decision is made whether an idea is brought into life or not. (Thom 1980, p. 53 & pp. 79-83)

The third stage according to Thom, the implementation stage, involves all activities in regard to the implementation and market introduction of the ideas. This covers the development stage, in case of product innovation this would be the manufacturing of the product, marketing and sales activities in regard to the market introduction and finally a review concerning acceptance. (Thom 1980, p. 53 & 83-84)

The *front-end of innovation* describes the first phases of an innovation process. While Hauschildt & Salomo restrict their definition to the stages and activities until the problem definition is done, other authors use wider definitons:

> *"We define the front end to include product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning, and executive reviews."*
> (Khurana & Rosenthal 1998, p. 59)

These three phases describe the essential stages of an innovation management best and provides a good overview on the required activities. Chapter 3 discusses more specific process models in regard to opening up the innovation process or open innovation.

Stage-Gate Process developed by Cooper

The stage-gate process was developed by Cooper in 2001 (Cooper 2001a) and consists of several process phases, called *stages*, and decision-making points called *gates*. This process has been applied into practice many times and is therefore mentioned here within this work.

Figure 2.3 provides an overview of the different stages and gates of the process model. Each stage is followed by a decision point that serves as quality control checkpoint where go/kill decisions are made. The stages are cross-functional and involve several parallel activities from different organizational units within the company. At the various gates

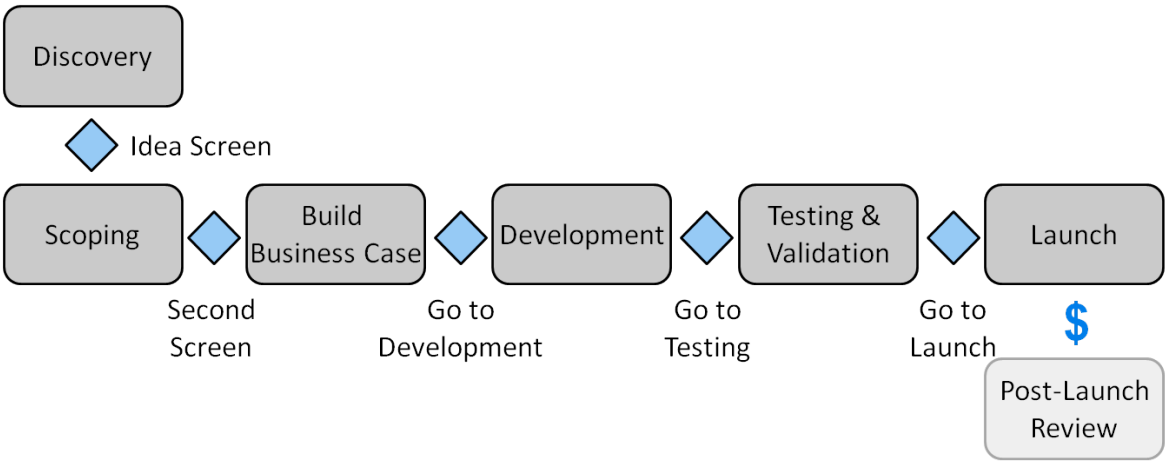

Figure 2.3: The Stage-Gate process referring to Cooper (2001, p. 130)

there are several predefined deliverables, knock-out criteria and outputs that have to be fulfilled. These decisions are most often made by senior managers from different functions. (Cooper 2001a, pp. 130-132)

The first stage, according to Cooper (2001a, p. 133), is called *discovery stage* which includes the idea generation. Activities within in the discovery stage are, besides to fundamental technical research, seeking new technological possibilities, working with lead users to discover their needs and strategic planning issues to identify gaps and opportunities. The discovery stage is followed by the first gate, the *idea screening*. At this gate, as on every other gate, a go/kill decision by the management board has to be made. Predefined must-meet and should-meet criteria, depending on the strategic alignment and project feasibility, have to be fulfilled. Financial aspects are usually not part of this first gate. Besides the discovery stage as a special stage at the beginning of the innovation process, the first stage is the *scoping stage* which starts after an idea had passed the first gate. This stage consists of a little desk research with limited resources. This desk research includes preliminary market and technical assessments. At the second gate, called *second screen*, the project is re-evaluated in the light of the new information gathered in scoping stage. This gate is important because after passing it, resource efforts increase. In second stage, called *building the business case*, the business case is mapped out. This stage is critical because market analyses have to be done properly to ensure the project success in later stages. Besides economic issues, a detailed technical

analysis takes place within this stage as well. The final gate prior the development stage is the *go to development* gate. Then the really heavy spending starts. The decision done here ensures commitment to the product specifications and the project plan. Following, *development stage* includes the implementation of the development plan and the physical development of the product. After development stage, stage-gate process provides a comprehensive testing phase which is initiated after passing *go to testing* gate. Here a post-development review is done and the economic situation is analyzed according to updated financial aspects. The *testing and validation stage* includes the validation of the entire viability of the project which involves the product itself, the production process, customer acceptance and the economics. The last decision point in stage-gate process is the *go to launch* gate. This gate enables full commercialization after passing it. Project can still be killed at this final gate. After passing this ultimate gate, market launch and production starts. As a final evaluation point, stage gate process provides a post-launch review after market introduction where the whole project is evaluated again. (Cooper 2001, pp. 133-138)

The stage-gate process provides a structured process framework for innovation projects. Its focus is mainly on the internal innovation process but the framework is open to adaption in regard to the involvement of external sources in the innovation process.

2.1.3.2 Innovation System

In contrast to the process orientation in innovation management, the system approach deals with the organization of innovation systems in order to single processes as well as the organization of the institution where the processes take place. (Hauschildt & Salomo 2011, p. 29)

Lundvall's defined innovation systems as follows:

> *"... a system of innovation is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge..."*
> (Lundvall 2010, p. 2)

According to Hauschildt & Salomo, the system involves every person that actively provides contributions to the innovation as well as passively involved people that contribute to the success of an innovation by their reactions. Innovation systems may be organized company-wide, through an integrated orientation on innovation, within several departments as specialized tasks, or in the sense of project management. Figure 2.4 shows the different variants of innovation systems. (Hauschildt & Salomo 2011, pp. 57-58)

What's more, innovation system not only focus aspects of organizational structures, in addition it deals with establishing innovation-friendly structures and an open culture within the organization. (Hauschildt & Salomo 2011, pp. 59-60)

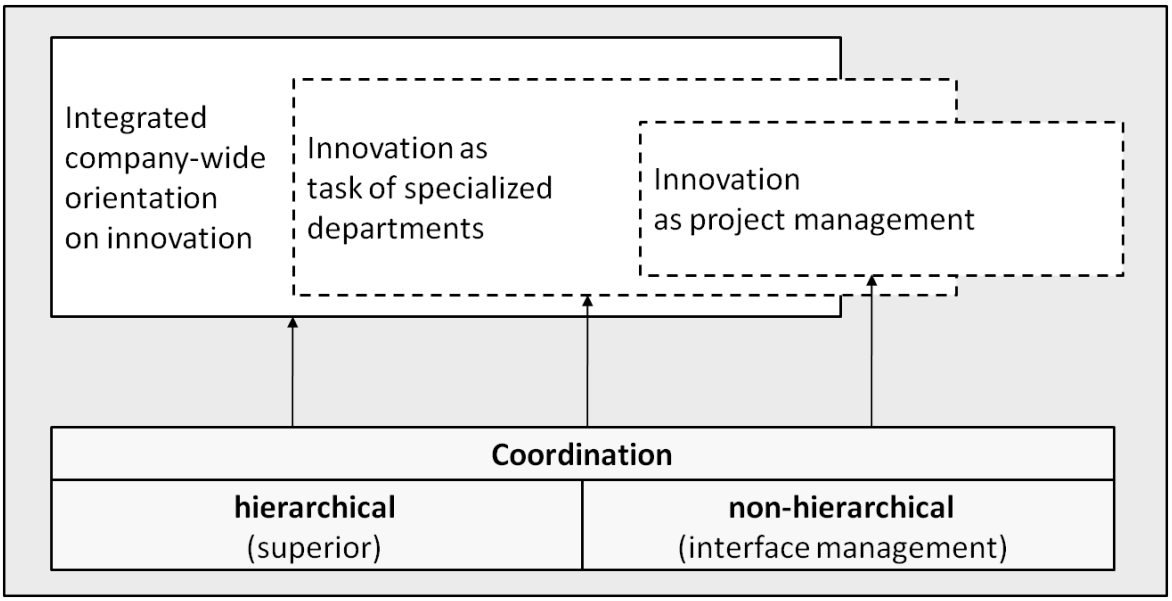

Figure 2.4: Characteristics of Innovation Systems referring to Hauschildt & Salomo (2011, p. 58)

Establishing an organization wide open culture in regard of innovation is one aspect within the system orientation in innovation management. On the other hand, innovation systems may occur between various organizations. This external aspect of innovation systems is discussed in section 3.4.

2.1.4 Innovation Management within this Thesis

Innovation management within this work is based on the process and the system approach. Effective and efficient innovation management requires not only a well-structured innovation process, it as well has to establish organizational structures and has to consider cultural aspects. Because this work deals with open innovation, the external orientation in relation to the process and the system approach are central issues. The theoretical framework developed within this research work considers procedural structures combined with systemic aspects as provided here within this chapter.

2.2 Knowledge

The second main research field of this work is knowledge management. This section therefore provides an overview about the basic terms in the field of knowledge management in regard to the research focus of this dissertation.

The first part of this section deals with the basic definitions of knowledge and relating terms. Second, a classification of the term knowledge is provided. In addition, the topic of knowledge management will be discussed including different management processes as well as the system approach in knowledge management.

2.2.1 Definition

When talking about knowledge and knowledge management a common understanding of the term *knowledge* has to be ensured. Some related terms in regard to knowledge are often confused, at least the concepts of information and knowledge management. To make a clear distinction between the specific terms, North (2011, pp. 36-38) presented the concept of the *knowledge stair*, as shown in figure 2.5.

Following paragraphs describe the different terms presented within the concept of the knowledge stair.

Signs, Data, Information

Klaus North introduced the concept of the knowledge stair to distinguish between the central terms within knowledge management. He defined *signs* as different characters or numbers without any context. At the next level there is *data* which is not-interpreted signs combined with a syntax. Data becomes *information* if it is related to a specific context. This information would be worthless to observers that can not combine this information with current or past stored information. Therefore it is vital to distinguish between *information* and *knowledge*. Firms often talk about knowledge management

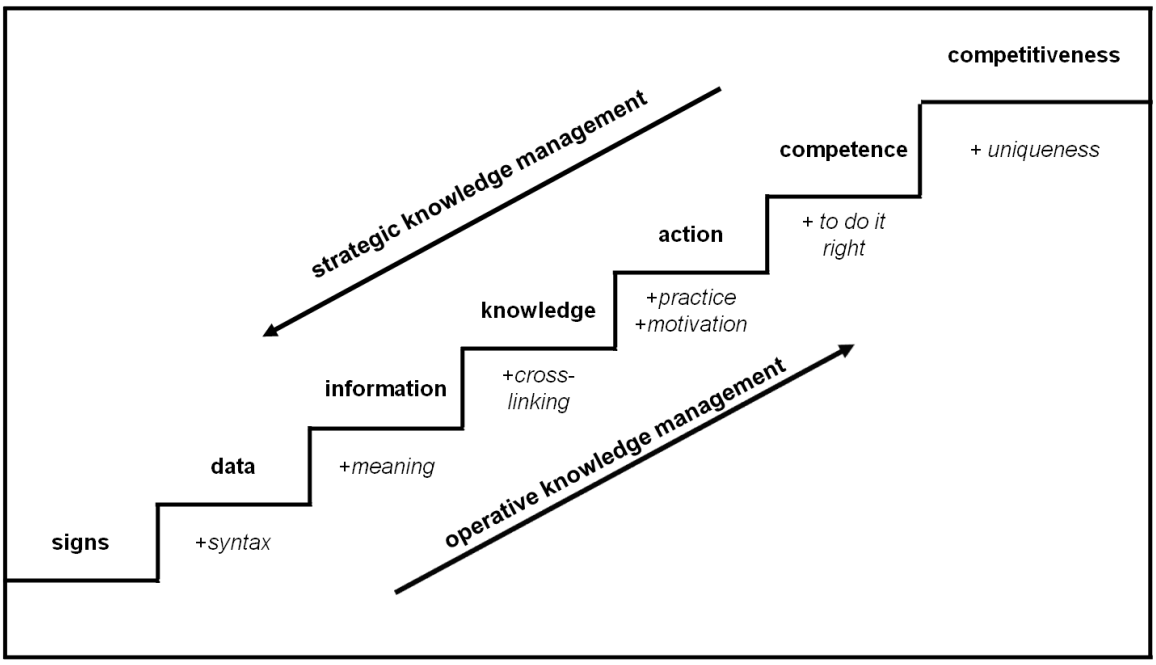

Figure 2.5: Knowledge stair referring to North (2011, p. 36)

when meaning more technical related issues like data and information management systems. (North 2011, p. 36-38)

This differentiation between signs, data and information helps us to substantiate the definition of the term knowledge as provided within the next paragraphs.

Knowledge

Knowledge is defined as the sum of abilities that individuals use for problem-solutions. This includes theoretical aspects as well as practical everyday-rules and instructions. Knowledge is based on data and information, but is always personalized Furthermore, it is constructed by individuals and always represents an individual's expectations depending on cause and effect coherences. (Probst, Raub & Romhardt 2010, p. 23)

North defined knowledge, in relation to the knowledge stair, as convenient cross-linking of information. Knowledge is a result of processing information through consciousness.

Information is therefore the raw material from which knowledge is generated and the way how knowledge is transferred and stored. (North 2011, p. 37)

According to von Krogh, Ichijo and Nonaka's definition of knowledge, knowledge is always based on beliefs of individuals and therefore

> *"construction of reality than something that is true in any abstract or universal way."*
> (von Krogh et al., 2000, p. 6)

Furthermore von Krogh et al. (2000, p. 6) defined knowledge as both explicit and tacit meaning that parts of knowledge can be articulated e.g. by puffing on paper or formulating sentences and other parts of knowledge are internalized and hard to describe to others. A detailed definition of explicit and tacit knowledge is given in section 2.2.2.

Action, Competence, Competitiveness

According to North (2011, p. 38) knowledge is valuable for an organisation if the knowledge, the *know-what*, can be transfered into a *know-how* and this know-how manifests in specific actions. Actions provide measurable results and performance. A person's, organization's, or group's ability to generate knowledge for problem solving can be described as competence. At the top level of the knowledge stairs we find competitiveness, which result from setting up core competencies of an organisation.

2.2.2 Classification of Knowledge

There are various aspects on how to classify knowledge, but most authors distinguish at the level of articulation between tacit and explicit knowledge and on the level of knowledge carrier between individual and collective knowledge. Scheuble (1998) provided an additional dimension for the classification at the level of knowledge intelligence. Figure 2.6 provides an overview about the three dimensions of knowledge classification according to Scheuble.

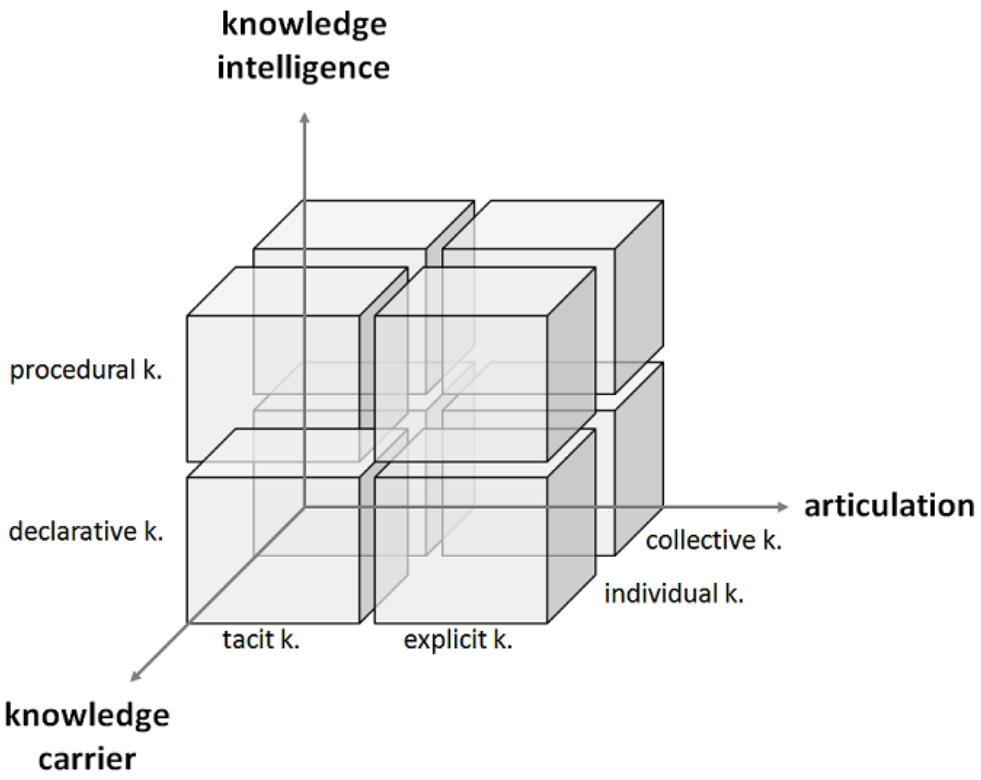

Figure 2.6: Classification of knowledge according to Scheuble (1998)

2.2.2.1 Tacit and Explicit Knowledge

Tacit knowledge is very personal and hard to express in words and numbers as for instance subjective insights and intuitions. (Nonaka & Takeuchi 1995, p. 8) This very individual and specific knowledge is transferred within education. (North 2011, p. 47)

In contrast, explicit knowledge is easy to express. It can be stored and accessed within computer-databases. Knowledge transfer of explicit knowledge is even easier than knowledge transfer of tacit knowledge. Examples for explicit knowledge are all kinds of documentation, e.g., process handbooks and user-guides. (Nonaka & Takeuchi 1995, p. 9)

Nonaka and Takeuchi named the conversion of tacit to explicit knowledge and vice versa as central issues of knowledge management. In that context they introduced four modes:

(Nonaka & Takeuchi 1995, pp. 224-225)

- *Socialization*: from tacit to tacit
- *Externalization*: from tacit to explicit
- *Combination*: from explicit to explicit
- *Internalization*: from explicit to tacit

Tacit and explicit knowledge is one way to classify knowledge at the level of articulation. Further, knowledge is classified at the level of knowledge carrier between individual and collective knowledge.

2.2.2.2 Individual and Collective Knowledge

Individual knowledge is related to an single person, while in contrast collective (or organizational) knowledge is relevant within an organization. Individual as well as collective knowledge can be tacit and explicit. Knowledge management aims to transfer individual, tacit knowledge into collective and explicit knowledge that can be shared and accessed easily within the organization. (North 2011, p. 47 and Glynn 1996, pp. 1093-1094)

2.2.2.3 Procedural and Declarative Knowledge

In regard to knowledge intelligence, knowledge is distinguished between procedural and declarative knowledge. Procedural knowledge considers process know-how. In contrast, declarative knowledge is related to facts. This kind of knowledge is sometimes described as *knowing that*. (Scheuble 1998)

2.2.3 Knowledge Management

Knowledge Management is the process of designing, steering and developing the organizational knowledge base to reach the corporate objectives. (North 2011, p. 177)

> *"Knowledge management then refers to a systemic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that other employees may make use of it to be more effective and productive in their work."*
> (Alavi & Leidner 1999, p. 2)

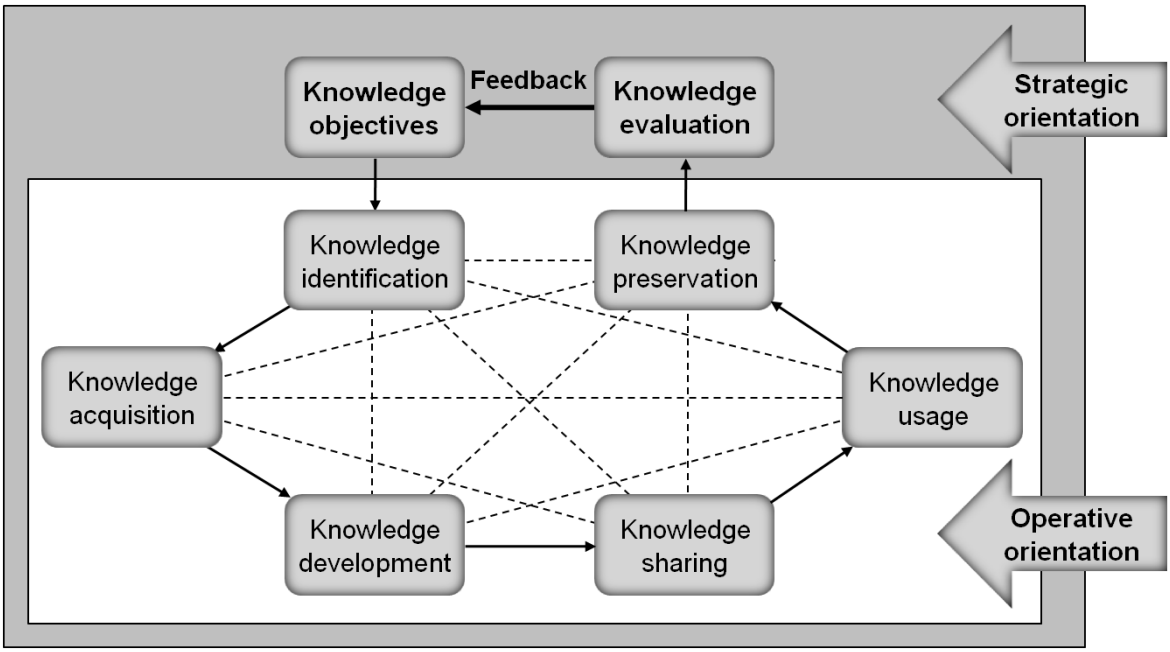

Figure 2.7: Knowledge modules referring to Probst et al. (2010, p. 32)

We distinguish between strategic and operative knowledge management. In strategic knowledge management the knowledge stairs are considered from a top-down approach. This means that strategic knowledge management first defines the competencies and deriving from that which knowledge and skills are necessary to be competitive. Besides that, operative knowledge management considers a bottom-up approach which deals with the cross-linking of information to knowledge, activities and competences. (North 2011, p. 39)

In knowledge management we again distinguish a process approach on the one hand and a system approach on the other. Following sections discuss these approaches in more detail.

2.2.3.1 Knowledge Management Processes

Many authors distinguish between two core knowledge management processes - knowledge exploration or generation and knowledge exploitation or application (March 1991, Argote, Mcevily & Reagans 2003, Grant & Baden-Fuller 2004). Recent literature additionally mentions knowledge retention as core knowledge management process (Lichtenthaler & Lichtenthaler 2009). In German literature, Probst et al. (2010) introduced the *concept of knowledge management modules* that distinguishes between six core processes at the operative level and two on the strategic level of knowledge management as demonstrated in figure 2.7.

The knowledge management process involving knowledge exploration, retention and exploitation can be combined with the concept of knowledge management modules as figure 2.8 demonstrates.

Knowledge Exploration

The first core knowledge process involves activities that increase a firm's knowledge base. March (1991) named this process *knowledge exploration*, while other authors use knowledge *creation* or *generation*. (Grant & Baden-Fuller 2004, p. 64)

One of the central tasks within this process is to provide an adequate transparency about the internal knowledge, to find a way how to deal with the innovation flood and to identify external knowledge as well in regard to benchmarking for instance. This activities are related to *knowledge identification*. Furthermore, decisions about the acquisition of knowledge are made here. Not all the necessary knowledge of an organization can be gathered from internal knowledge sources, sometimes an external expert has to be recruited or alliances have to be formed. (Probst et al. 2010, p. 29)

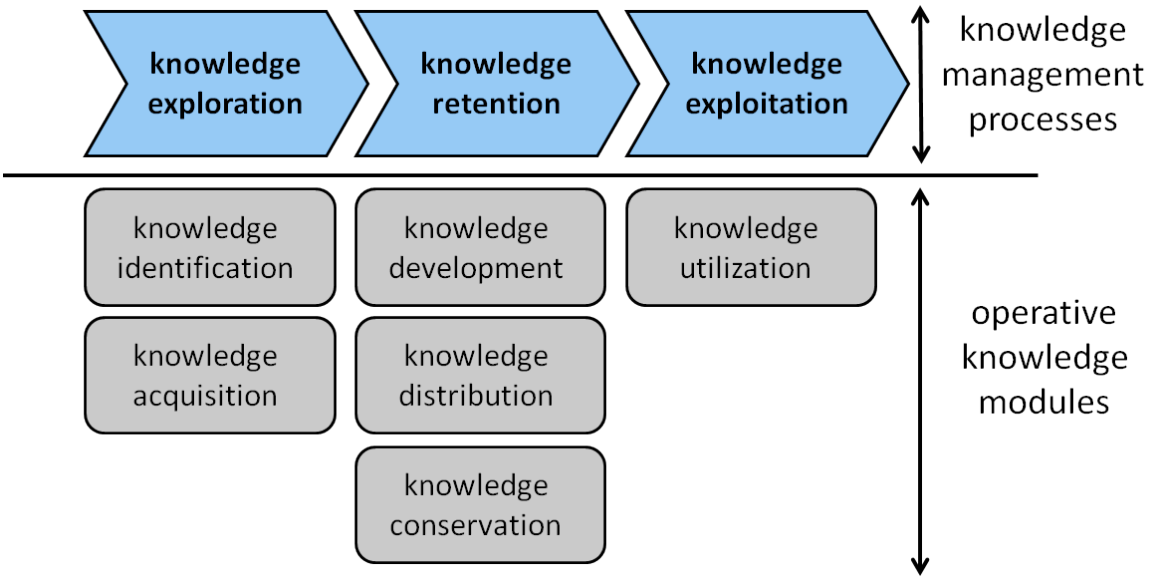

Figure 2.8: Assignment of the knowledge modules according to Probst et al. to the knowledge management processes (own illustration)

Moreover, Lichtenthaler & Lichtenthaler (2009) distinguish between internal and external knowledge exploration meaning the generation of internal knowledge based on research activities. Results of internal knowledge exploration are e.g. inventions. On the other side, the external knowledge exploration aims to acquire knowledge from external sources. (Lichtenthaler & Lichtenthaler 2009, p. 1317)

Knowledge Retention

Secondly, knowledge retention involves *knowledge development*, *knowledge distribution* and *conservation of knowledge*. Development of knowledge is complementary to acquisition of knowledge. Here, new abilities, new products, better ideas and efficient processes are in the focus. Knowledge development concludes several management activities that lead to the production of internal new knowledge bases or internal and external not existing abilities. What's more, the distribution of knowledge deals with questions concerning the knowledge transfer. *How can the right knowledge be transferred to the right location?* Therefore it is essential to identify who has to know what and

in what extend. Knowledge distribution deals with the distribution of already existing knowledge throughout the organization. Additionally, knowledge retention deals with the conservation of knowledge which is related to the utilization of different organizational storage medias for internal knowledge. (Probst et al. 2010, pp. 29-30)

Here as well, Lichtenthaler & Lichtenthaler (2009) suggest a differentiation between internal and external knowledge retention. While internal knowledge retention describes the process of maintaining knowledge over time, the external perspective of knowledge retention deals with knowledge that is maintained in interorganizational relationships. (Lichtenthaler & Lichtenthaler 2009, p. 1317)

Knowledge Exploitation

Finally, the third knowledge management process focuses on value creation of existing knowledge, what March (1991) named knowledge exploitation and others called knowledge application. (Grant & Baden-Fuller 2004, p. 64)

Knowledge exploitation involves the knowledge utilization according to Probst et al. (2010). Aim of this process is, among other factors, the overcoming of several barriers that might hinder an efficient utilization of knowledge. Therefore this process has to ensure a successful integration of internal and external knowledge and to find approaches how to deal with this barriers. (Probst et al. 2010, p. 30)

Exploitation with focus on the external perspective involves the outward knowledge transfer, while the internal exploitation concludes activities in regard to the internal innovation process. (Lichtenthaler & Lichtenthaler 2009, p. 1317)

2.2.3.2 Strategic Knowledge Management

Probst et al. introduced two modules that operate on the strategic level of knowledge management: knowledge objectives and knowledge evaluation. First, the knowledge objectives determine a firm's overall knowledge goals, while the knowledge evaluation comprises the controlling process to evaluate their achievement.

Besides the process approach presented above, knowledge management is often understood as the management of knowledge systems. The next section defines and discusses the system approach in knowledge management.

2.2.3.3 Knowledge Management System

Besides the process approach, knowledge management considers a system approach as well. An organization can be seen as knowledge system that consists of social system elements, e.g. the employees, and technical system elements like the IT infrastructure. Within the knowledge management system, social as well as technical system elements are interacting. (Wohinz 2002, p. 5)

In a more technical context, knowledge management systems are defined as information systems which are designed to *"facilitate the codification, collection, integration and dissemination of organizational knowlegde"* (Alavi & Leidner 1999, p. 3). This systems aim to better integrate individual's knowledge in the organization. (Alavi & Leidner 1999, p. 3)

In respect to this work, it is important to note down that knowledge management systems cover both, social and technical elements that interact with each other. Furthermore it will be considered that knowledge transfer takes place in various dimensions between the social and technical system elements.

2.2.4 Knowledge Management within this Thesis

Knowledge management is the second main research focus of this work. Even though all aspects of knowledge management are relevant for open innovation projects, within this thesis four main knowledge management processes have been selected which set up the main research focus within this field in regard to the scope given in section 1.2.

These four modules of knowledge management are shown in Figure 2.9. Regarding to the two main barriers to knowledge integration given in section 1.1 the first barrier was the identification of the most relevant knowledge owner(s). It is obvious that kind of

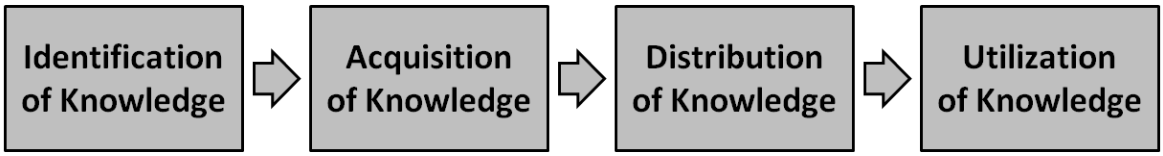

Figure 2.9: Knowledge modules referring to Probst et al. (2010, pp. 32)

knowledge identification has to be done as a basis to provide solutions on how to find the most adequate external knowledge owner. Therefore the module for the identification of knowledge is in focus of consideration here. Further the acquisition of knowledge will play a significant role after identifying the external knowledge owner. One aim of this research work is to integrate the external knowledge into the internal innovation process which requires approaches for the knowledge acquisition as well. Besides that, the distribution of knowledge within the organisation an important module in regard to this approach. All things considered, the internal utilization of knowledge has to be guaranteed sustainably.

Furthermore, it is also worth noting that knowledge management within this dissertation is used within an external-oriented context, as later more specifically defined in chapter 4, in contrast to the more internal and organization-related definition provided here within this chapter.

Concluding Statement

The two main research focuses are innovation and knowledge management. In regard to the specific scope of the thesis as defined in chapter 1 especially the external orientation in innovation management as well as in knowledge management is important. Open innovation involves external parties and aim of this work is to provide solutions on how to integrate and embed the external knowledge gained from these outside knowledge owners.

3 Management of Open Innovation

Open innovation is one of the hottest topics in recent innovation management research. This chapter concludes various aspects of open innovation management. Within this chapter, an overview about the central process models will be provided. Furthermore, the network aspect in open innovation process will be discussed in regard to the system orientation in innovation management.

3.1 Approaches for Opening up the Innovation Process

Henry Chesbrough established the terminology of *open innovation* in 2003. The concept of opening up the innovation process and involve external parties is not new at all. There have been various concepts in past which also pointed out the importance of external sources in innovation management. This section describes some of the most relevant approaches that deal with this issue.

3.1.1 Lead User Approach

Eric von Hippel first introduced the user-centered innovation approach, which later led to the *lead user approach*. He underlined the importance of external sources for innovation activities. Within his work *The Sources of Innovation* (von Hippel 1988) he mentioned users, manufacturers, suppliers and others as potential innovators for innovation projects.

The lead user approach (von Hippel 1988 and 2005a) sets its focus on the customer and user orientation in innovation management. Von Hippel described users, in contrast to manufacturers, as either firms or individuals that benefit from *using* a product or a service. While manufacturers expect to benefit from *selling* a product or service. Furthermore, von Hippel posted that a firm can be both, user and manufacturer in regard to different innovations. (von Hippel 2005b, p. 64)

Lead users are characterized according to two attributes. First, they are leading important market trends due to experiencing needs before many other users do so. Second, lead users often benefit from implementing a solution that fits to their needs, and are therefore motivated to innovate. (von Hippel 2005a, p. 22)

In 2005, von Hippel posted two trends towards democratizing innovation. The first one he mentioned was the improving design capabilities of users due to increasing possibilities of computer hardware and software. Second, the Internet enables individual users to connect and share innovation-related knowledge throughout the web. Users may combine and coordinate their efforts easily. (von Hippel 2005b, p. 64)

3.1.2 Open Source

The involvement of external sources into innovation management works ideal in software industry. Open source projects are quite popular in software industry and therefore often used as showcase examples in open innovation literature.

3.1.3 Open Innovation Approach

The open innovation approach was introduced by Henry Chesbrough in 2003. He expanded the approach of von Hippel and came up with a new terminology. The most often used definition is that open innovation is

> *"the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively."*
> (Chesbrough, Vanhaverbeke & West 2006, p. 1)

In order to describe this new paradigm shift of opening up the innovation processes, Chesbrough (2003b) introduced the *closed innovation* concept which describes the previous and common practice of in-house innovation. Closed innovation means that innovation and all R&D activities take place within the organizational boundaries. Figure 3.1 shows the knowledge landscape within closed innovation firms. Ideas are originally created within a company and the whole innovation process takes place here. No ideas from outside come into the firm and there is no path for ideas to leave the firm. One central strategy for closed innovation companies is to hire the smartest people in their field for a sustainable competitiveness. (Chesbrough 2003b, pp. 21-41)

In contrast, the knowledge landscape in open innovation companies considers external ideas as well and leaves space to involve these ideas into the internal innovation process. Furthermore, internal created ideas can be used outside the company as well. People who created the ideas are often available for hire in contrast to the closed innovation principle. The knowledge landscape of open innovation firms is shown in figure 3.2. (Chesbrough 2003b, p. 43)

The concept of open innovation is not new: many companies already cooperated with external organizations in innovation management. What is new in open innovation is the emphasis of the importance of external sources of knowledge. The open innovation concept delivers principles and tools for a systematic involvement of external and internal sources of knowledge in the innovation process.

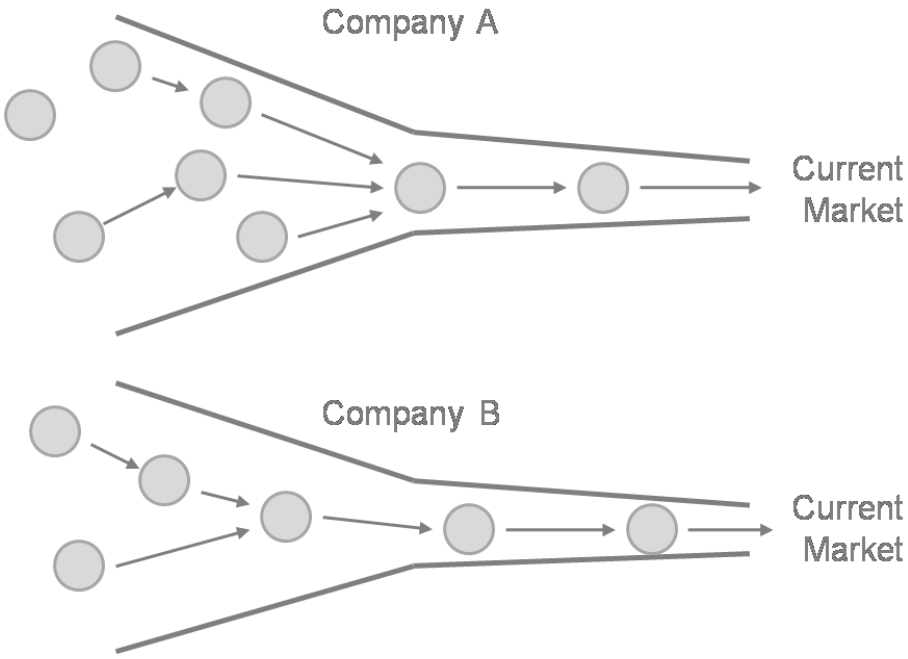

Figure 3.1: Knowledge landscape in closed innovation referring to Chesbrough (2003b, p. 31)

In open innovation process, projects can be launched from internal or external sources and new technology can enter at various stages. Projects can also go to market in many different ways, beside the classical way of in-house innovations. (Fredberg et al. 2008, p. 5) Since there are many ideas already existing outside a firm's borders.

There are many existing ideas in this environment, not only within each company, but also outside the companies. Chesbrough (2003b) claimed these ideas are available to be used and the people who created them are available for hire.

But why are external sources of knowledge so important in innovation management? Gassmann (2006, pp. 223 - 228) outlined the main reasons and drivers for the integration of external sources into the innovation process. The following enumeration shows the main drivers for a company to choose an open innovation strategy:

- *Globalization.* Enterprises that act in a global industry often favor open innovation models because they can innovate faster and are able to adapt better when considering external sources as well.

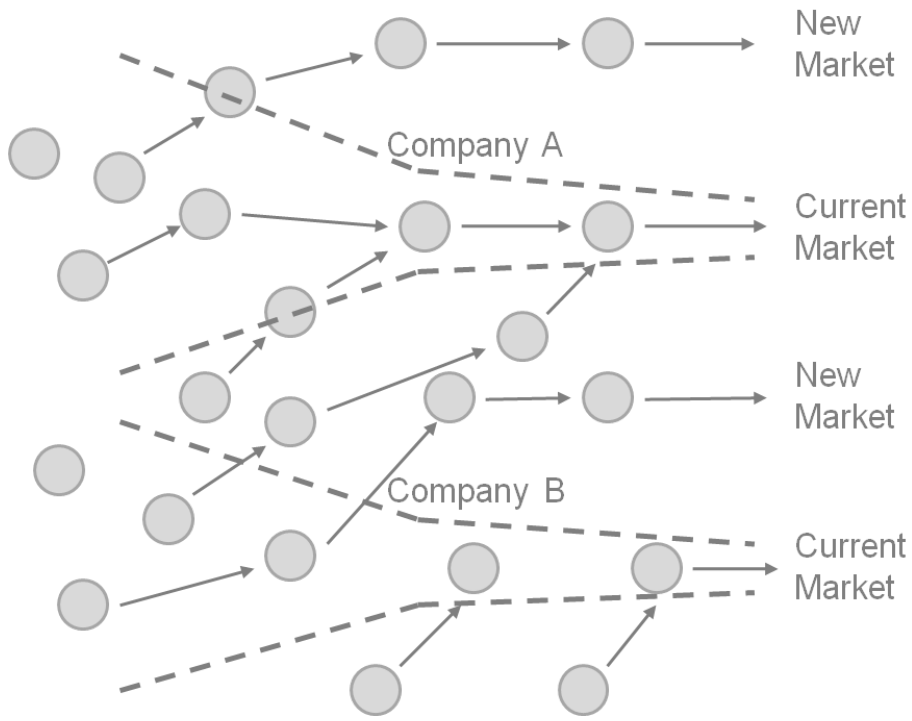

Figure 3.2: Knowledge landscape in open innovation (Chesbrough 2003b, p. 44)

- *Technology intensity.* Especially in high-tech sectors it is unavoidable to cooperate with other companies to support product development in an environment characterized by rapid technological change.
- *Technology fusion.* Technologies are increasing morphing into new fields. The more interdisciplinary research is required, the less a single enterprise can afford it with just the existing capabilities. That is why the propensity to cooperate increases.
- *New business models.* The rapid changing technologies open new opportunities for new business models. New alliances are formed with complementary partnerships. The main motives for these alliances are the sharing of risk, the pooling of complementary competencies and the realization of synergies.
- *Knowledge leveraging.* Within the past years knowledge has become the most important resource for companies. Especially the Internet accelerated the knowledge diffusion process and increased the personal mobility of knowledge workers.

Instead of hiring the best engineers internally, companies cooperate with them which brings up new capabilities and organizational models needed to overcome this new outside-in-thinking.

Closed Innovation	**Open Innovation**
The smart people in our field work for us.	Not all the smart people work for us. We need to work with the smart people inside and outside the company.
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value
If we discover it ourselves, we will get it to the market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to market first will win.	Building a better business model is better than getting to the market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our IP, so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy other's IP whenever it advances our own business model.

Table 3.1: Contrasting Principles of Closed and Open Innovation (Chesbrough 2003b, p. xxvi)

Table 3.1 demonstrates the differences between open and closed innovation strategies.

3.2 Open Innovation Process

Gassmann and Enkel (2006) introduced three concepts for open innovation processes depending on the locus of knowledge and the place of exploitation. Figure 3.3 provides an overview on these three approaches.

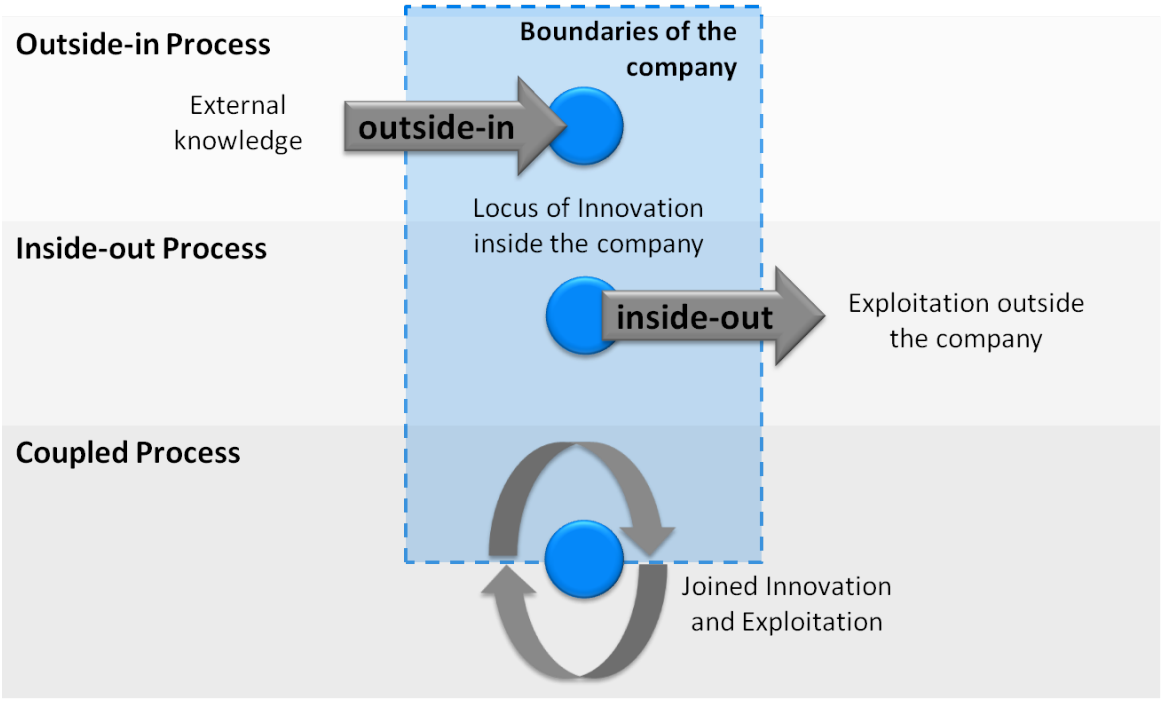

Figure 3.3: Open innovation processes according to Gassmann & Enkel (2006, p. 6)

As shown from the figure, we distinguish between the three types of open innovation processes - the *outside-in* process, the *inside-out* process and the *coupled* process where the first two concepts are combined. This section discusses all three approaches and concludes by pointing out the significance to this research work.

3.2.1 Outside-In Process

The first type discussed here is the outside-in process. Firms that apply the outside-in process choose to invest in co-operation with external sources and to integrate the external

knowledge into the firm's innovation activities. (Enkel, Gassmann & Chesbrough 2009, p. 312) Lettl et al. found that this kind of open innovation process may increase a company's innovativeness (Lettl, Herstatt & Gemuenden 2006, pp. 251-266). According to Gassmann and Enkel, an effective knowledge integration can be achieved by *", e.g., customer and supplier integration, listening posts at innovation clusters, applying innovation across industries, buying intellectual property and investing in global knowledge creation"* (Gassmann & Enkel 2006, p. 7).

Even though customer and supplier integration is not a new concept it is still relevant. Firms may benefit from intense customer and supplier relationships by enhancing their innovativeness significantly. Later within this chapter different approaches of customer and supplier integration into the open innovation process will be discussed. Furthermore, implementing listening posts may be a powerful method in order to get early access to fundamental knowledge, e.g. from universities. This can be realized by installing outposts close to leading universities. (Gassmann & Enkel 2006, pp. 7-8)

The outside-in process requires an increasing awareness of innovation networks as well as new methods of integrating the supply chain. Recently, some new forms have been introduced including, e.g., crowdsourcing. (Enkel et al. 2009, p. 312)

3.2.2 Inside-Out Process

Contrasting, the inside-out process aims to externalize the company's knowledge and innovation. This approach provides the opportunity to bring ideas faster to life than it might be possible through internal implementation. Firms implementing the inside-out process profit by licensing IP and bringing ideas to market. (Gassmann & Enkel 2006, pp. 10-11)

Inside-out means that the *"firm no longer restricts itself to the markets it serves directly. Instead, it participates in other segments using licensing fees, joint ventures, spin-offs, etc."* (Enkel et al. 2009, pp. 312-313). In inside-out processes, the internal ideas are transferred to other companies who bring them into life. The company earns money from selling IP, technology and licensing fees. (Lichtenthaler 2010, p. 1249)

The benefits of this open innovation process are obvious: firms get access to new knowledge-areas, they reduce their capacity problems and may focus on their core competencies. Furthermore Gassmann and Enkel mentioned the sharing of costs as another benefit from outsourcing innovation. (Gassmann & Enkel 2006, pp. 10-11)

3.2.3 Coupled Process

The third type of open innovation processes, the *coupled process*, combines the outside-in process with the inside-out process.

> *"The coupled process refers to co-creation with (mainly) complementary partners through alliances, cooperation, and joint ventures during which give and take are crucial for success."*
> (Enkel et al. 2009, p. 313)

Companies that establish the coupled process often co-operate with other firms within strategic networks. A two-way knowledge transfer has to be ensured for a successful co-operation in regard to the coupled process. Coupling the industrial innovation process can be a strategic option, e.g., when sharing IP within strategic alliances. (Gassmann & Enkel 2006, p. 12)

According to Gassmann and Enkel (2006, p. 6) each company does not apply to all process archetypes to the same degree but each company choses one process as their primary open innovation process. Table 3.2 provides a concluding overview about the three process types in open innovation management.

	Description	Characteristics
Outside-in	• earlier supplier integration • customer co-development • external knowledge sourcing and integration • in-licensing and buying patents	• low tech industry for similar technology acquisition • act as knowledge brokers and/or knowledge creators • highly modular products • high knowledge intensity
Inside-out	• bringing ideas to market • out-licensing and/or selling IP • multiplying technology through different applications	• (basic) research-driven company • objectives like decreasing the fixed costs of R&D, branding, setting standard via spillovers
Coupled	• combining outside-in and inside-out processes • integrating external knowledge and competencies and externalizing own knowledge and competencies	• standard setting (pre dominant design) • increasing returns (mobile industrythrough multiplying technology • alliance with complementary partners • complementary products with critical interfaces • relational view of the firm

Table 3.2: Open Innovation Processes (Gassmann & Enkel 2006, pp. 10-13)

3.3 Innovation Environment

The innovation environment concludes several stakeholders that are relevant for open innovation co-operations, especially in the phase of idea generation. Based on the system approach of innovation management the innovation environment is introduced as the environment that concludes all kinds of stakeholders that may provide valuable inputs for the innovation activities. It concludes several stakeholders that play a significant role in the phase of idea generation. As already mentioned before, the focus of the dissertation project is the idea collection step within the idea generation phase of an innovation process. Furthermore, the innovation environment is based on the network approach in innovation management. Innovation networks have been strong associations for several years now. Within this dissertation project, the network approach is described by using the term *innovation environment*, which includes the different knowledge owner relevant for cooperations in innovation management.

3.3.1 Knowledge Owners

As already mentioned above, the innovation environment consists of several knowledge owners that are relevant for cooperations in innovation management. Figure 3.4 provides an overview about the most relevant knowledge owners in regard to open innovation projects.

Following paragraphs describe the various knowledge owners and their specific interests and motives for co-operations in open innovation projects.

3.3.1.1 Customers & Users

Since innovations aim to fulfill customer's needs and wants, the knowledge owner group of the customers and users are very special and valuable to a firm's innovation activities, especially in the fuzzy front end of innovation. Customers know best about their specific

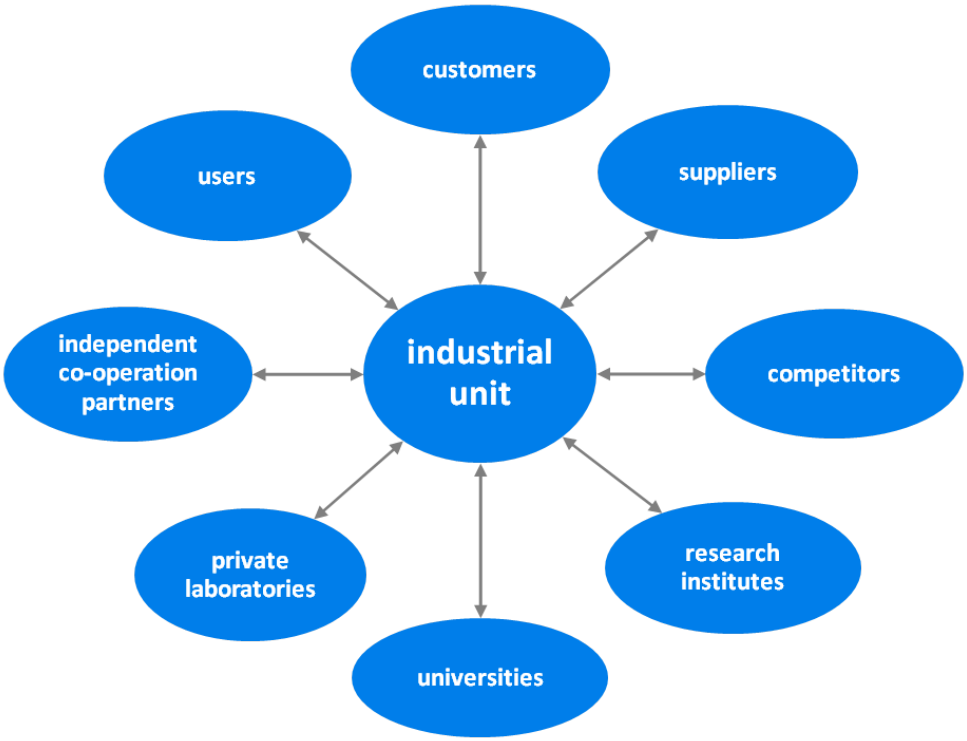

Figure 3.4: External knowledge owners in open innovation referring to Freeman's stakeholder analysis (1984, p. 25)

wants and needs and may therefore deliver fruitful inputs and ideas for new product developments.

A well known approach for user orientation in innovation management is the lead user concept, developed by von Hippel (1988 and 2005a), where he focused on users with special motivation on innovating new products and services or new product features in order to fulfill their unsatisfied needs from existing products. (von Hippel 2005b, p. 66-67) The lead user approach is discussed in more detail in section 3.1.1.

Benefits from Customer Integration

Customers are valuable sources for open innovation because they provide complementary skills and additional knowledge. Furthermore, the involvement of the customers in the

innovation process reduces the risks for the innovation's introduction to the market. Products are developed in close cooperation with the customer and therefore their needs are already considered within product implementation or earlier stages. (Mention 2011, p. 46)

But how do customers benefit from their participation on a firm's innovation process? The most significant benefit for customers might be the (competitive) advantage from co-inventing new products and services. They are the first that get access to the new innovations and it is ensured that the developed solutions fulfill their specific requirements. Further, Gassmann and Sutter (2011, p. 142) have worked out the following motives that induce customers to co-operate:

- *Compensations* or *price reductions* in order to compensate the customer's effort
- *Early access to future developments* which imply advantages to the customer's rivals
- The customer benefits from *additional services* during product launch
- *Publicity* due to engagement for innovation projects

Knowing the customer's motives is an important factor to consider during the co-operation to ensure a good-working partnership. In order to the innovation process there are several ways how to integrate the customer into the process. Following paragraph deals with the various modes of co-operation between customer and industrial unit throughout the innovation process.

Ways of Customer Integration

Gassmann and Sutter (2011, p. 144) discussed different possibilities of customer integration and mapped them to the different phases of an innovation process. An overview about the various customer roles within the innovation process is provided in figure 3.5.

As shown from the figure, in the early phase of an innovation process customers are primaryly idea contributors and informants about ongoing trends and needs. Further

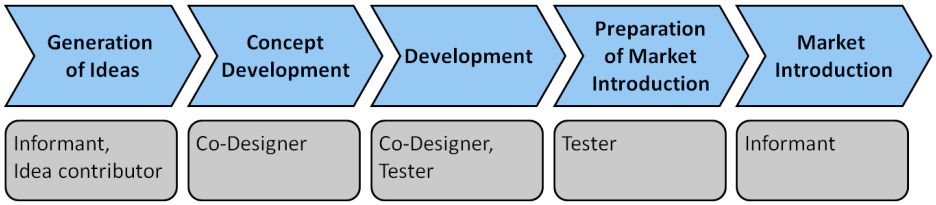

Figure 3.5: Customer roles in innovation process and possible methods referring to Gassmann & Sutter (2011, p. 144)

methods of customer integration in the innovation process would be to involve customers as co-designer in concept development and development phase, as tester within development phase and for the preparation of market introduction. At the last stage, the market introduction, customers are informants again that deliver information concerning further trends that can be involved again into concept and development stages. (Gassmann & Sutter 2011, p. 143) Further, Chesbrough stated that customers are frequently involved into innovation processes as partners or co-producers (Chesbrough 2003b, p. 56).

In a similar vein, von Hippel (2005 and 2007) introduced the concept of *innovation communities* which refers to the system approach in innovation management that has been discussed in section 2.1.3.2. He defined innovation communities as

> *"meaning nodes consisting of individuals or firms interconnected by information transfer links which ma involve face-to-face, electronic, or other communication."*
> (von Hippel 2005, p. 94)

Additionally, von Hippel deals with the terminology of *user innovation networks* which have a great advantage to supply chain based co-operations in innovation management. He provided various approaches on how to integrate customers and users into a firm's innovation activities.(von Hippel 2007, p. 393)

3.3.1.2 Suppliers

Especially in producing industries, suppliers are probably the most essential sources of knowledge and ideal idea contributers in regard to innovation projects. Suppliers often know the buying firm's internal processes and structures and are frequently involved into the innovation activities and processes, which is true especially for the automotive industry. Furthermore, suppliers do have a large impact on costs, quality and technological aspects of the innovations. (Ragatz, Handfield & Scannell 1997, pp. 190-202)

Benefits from Supplier Integration

Suppliers, as well as customers, provide a valuable contribution to open innovation since the integration of suppliers reduces the risks for the market-introduction of innovations (Mention 2011, p. 46). Furthermore, suppliers may enrich a firm's innovation process as well as the product success through contributions of their capabilities (Gassmann & Enkel 2006, p. 7).

Gassmann and Enkel further concluded that supplier integration may provide benefits such as an earlier identification of technical problems, fewer engineering changes, the prototype availability as well as better utilization of internal resources, access to new products and processes, reduced risks in regard to financial and technical aspects, and a reduced time-to-market for new products. (Gassmann & Enkel 2006, p. 8)

One question that needs to be answered is: *Why would suppliers contribute their knowledge to the buying firm's innovation projects?* To describe the benefits from supplier's perspective, I picked out an example provided by Gassman and Enkel on Magna Steyr as supplier to the automotive industry. Magna is integrated into various innovation processes of european OEMs. Though this numerous collaborations Magna's competences increased significantly that Magna is now able not only to produce parts of the car but the whole car themselve. (Gassmann & Enkel 2006, p. 7)

As the example above on Magna shows, supplying firm's can as well profit from such collaborations by increasing their knowledge base and expertise as well.

3.3.1.3 Competitors and Rivals

Within their concept of absorptive capacity, Cohen and Levinthal considered competitors as potential contributors to a company's knowledge base. (Cohen & Levinthal 1990, p. 141) Furthermore, Mention analyzed the influence of knowledge sourcing from competitors to a firm's innovation capabilities. She found that information and knowledge exploitation from competitors does not influence the degree of novelty of innovations. In contrast, it has only a positive impact on firms that pursue an imitation strategy but not on the market-introduction of completely new products or services. (Mention 2011, p. 51)

Benefits from Co-operations with Competitors

Co-operations with competitors only seldom provide benefit for both parties. Firms with higher skills and more success are not motivated to exchange knowledge with their competitors since they would not benefit a lot. (von Hippel 1987) In some cases *co-opetition*, as Brandenburger and Nalebuff (1996) named the phenomenon, makes sense. These co-operations are mostly motivated by risk- and cost-sharing aspects, the quest of synergistic effects due to pooling of R&D resources (Das & Teng 2000 and Huang et al. 2009) or complying with new industry standards. (Mention 2011, p. 46)

Ways of Co-operation with Competitors

Direct co-operation between rivaling firms rarely happens, only in regard to the mentioned motives. What more often occurs is an informal knowledge sharing between engineers from different firms. (von Hippel 1988, pp. 5-6)

3.3.1.4 Universities, Public Research Institutes & Private Laboratories

Motives of public and private research labs for co-operations with firms are more ore less equal to them of universities and will therefore be discussed within this section together. Collaborations with universities can be very fruitful to a firm's innovation activities. Many

ideas are created within research institutes and universities. They do a lot of fundamental research where most companies do not have the money and time to invest. Research institutes are interested in the idea generation phase because of the research they do and often know a lot about future developments and trends.

Benefits from Co-operation with Universities

The primary motive for universities for industry-university co-operations is to receive additional funds from industry for basic research. Secondly, universities benefit by collaborations with industrial partners since students and researchers may gather practical experiences which has an impact on the research work as well. Furthermore, industry placements and internships for students and job opportunities for graduates are other motives for industry-university co-operations. Universities as well may profit from access to applied technologies. According to Santoro & Chakrabarti four components in regard to industry-university relationships have to be considered: (Santoro & Chakrabarti 2001, pp. 157-158)

- *Research support* considers the money and equipment given to the university by a firm. The university is flexible on how to apply this support in regard to upgrading laboratories, initiating new research projects, and providing fellowships to graduates.
- *Cooperative research* may most often occur in informal ways such as personal communication between firm's employees and university personnel. Another type of cooperative research would be co-authoring of research papers.
- *Knowledge transfer* between firm and university may happen in different ways. Beside the personal communication, personnel exchanges and cooperative research programs might be other possibilities of knowledge transfer in industry-university relationships. Consulting is a common way of knowledge transfer between these knowledge owners.

- *Technology transfer* as another component of industry-university relationships includes joint research in regard to innovations. Further activities would be support for entrepreneurs in start-ups, exchanging technical expertise in innovation management belongings, and patent or licensing services.

How do industrial firms benefit from co-operations with universities? Santoro & Chakrabarti explored the motivation, why firms are interested in long-term relationships to universities. First, firms want to strengthen their skills and knowledge to advance both core and noncore technologies. Furthermore, they mentioned universities flexibility in regard to license and patent policies. Personal interactions between university personnel and employees is another valuable factor that influences the knowledge transfer between university and industry. (Santoro & Chakrabarti 2001, p. 159)

3.3.1.5 Independent Co-operation Partners

Enkel and Gassmann (2008, cited in Enkel et al. 2009, p. 312) found out that relevant knowledge sources for open innovation projects can be found apart from customers and suppliers or research institutions. Independent co-operation partners would be consultants, non-customers, non-suppliers, and partners from other industries. This group makes up 65% of external knowledge sources. (Enkel et al. 2009, p. 312)

Ways of Co-operation with Independent Co-operation Partners

External parties that can not be classified within one of the previous described knowledge owner groups are *classified as independent co-operation partners* within this work. There are several ways on how to co-operate with external partners, two often applied ways are discussed later within this chapter - strategic alliances and innovation systems.

In conclusion there are several knowledge owners with different motivations and concerns that have to be considered in open innovation projects. Decisions for co-operation partners should consider all knowledge owners discussed within this section in regard to which knowledge owner is the most valuable concerning the innovation project planned. It

has to be considered, which co-operation brings the most benefit in terms of knowledge-sharing.

3.3.2 Classification of Knowledge Owners

Since the different knowledge owners, as described in previous section, may have similar interests in regard to co-operation within open innovation projects the knowledge owners will be classified into four categories for the further considerations within this work.

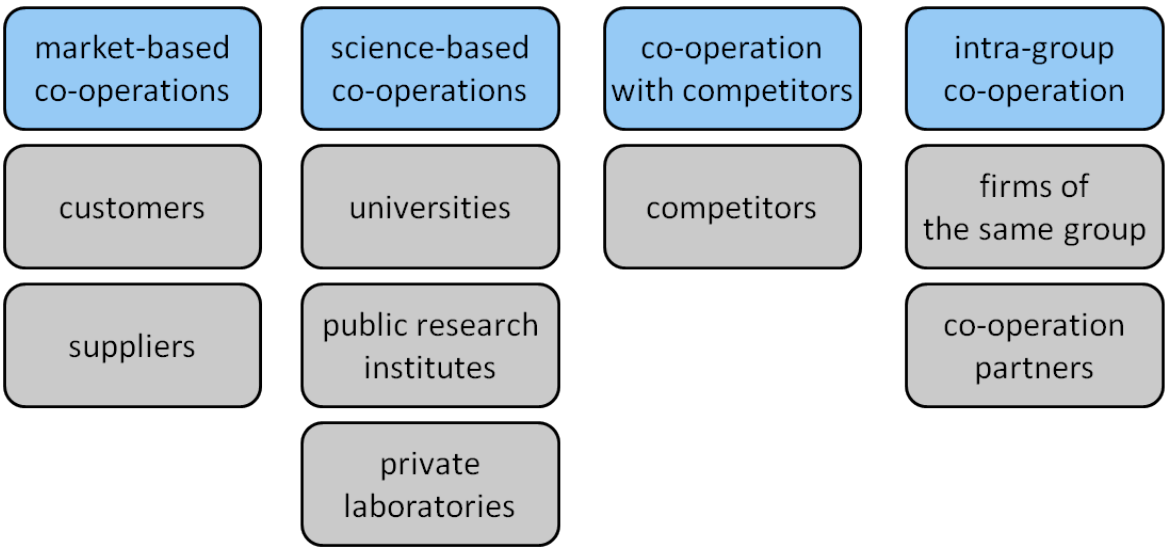

Figure 3.6: Classification of the knowledge owners according to Mention (2011, p. 47)

Anne-Laure Mention (2011, pp. 44-53) provided a useful classification of the stakeholders which will be discussed within this section. Figure 3.6 provides an overview of the knowledge owner groups according to Mention. She distinguished between market and science-based co-operations, co-opetition or co-operation with competitors as well as intra-group co-operations. Following paragraphs discuss the different categories in more detail. (Mention 2011, pp. 44-53)

Market-based Co-operation. Market-based co-operation is characterized by taking a user-centric approach while integrating the innovation proposals coming from suppliers.

(Mention 2011, p. 46)

Science-based Co-operation. According to Mention, science-based co-operations involve universities, research institutes and private laboratories. These knowledge owners are characterized by providing fundamental or applied research, scientific knowledge or training. (Mention 2011, p. 46)

Co-operation with Competitors. Co-operations with competitors are often motivated by the sharing of risks and costs. These relationships simultaneously involve both, competition and co-operation. (Mention 2011, p. 46)

Intra-group Co-operation. Intra-group co-operations allow firms to expand their knowledge-base and achieve economies of scale while avoiding competitive risks. (Mention 2011, pp. 46-47)

This classification according to Mention will be taken into account for further consideration within this work, which involves especially the theoretical modeling within this thesis.

3.3.3 Regional Differentiation

The innovation environment consists of different knowledge owners that are classified within several categories. Globalization makes it possible that the stakeholders can be located everywhere on earth. Within this work, a regional differentiation will be provided since the location of an external knowledge owner may have an impact on the co-operation, especially in the early phase of an innovation process. In idea generation the physical closeness to the industrial unit is often essential for the exchange of ideas. Therefore following regional differentiation will be considered within this work:

- *Regional co-operations* consider relationships spanned within a state of a country. This co-operations benefit from direct and fast communication due to their closeness.

- *National co-operations* involve collaborations within a specific country. Both parties have to consider the same laws and regulations which makes co-operation sometimes easier.
- *Global co-operations* may cover different organizations around the world. Knowledge-transfer within global relationships are characterized by differences in the cultures, the timing of the transfer process, and the nature of the technology. (Afuah 2003, p. 78)

Cohen and Levinthal (1990, pp. 128-152) stated that being physically close to regional centres of excellence enables a firm to increase its absorptive capacity. Global innovation systems as well have their advantages such as the access to the leading parties to work with like international research institutes and competitors already producing a similar product for a different market.

Forming regional networks is especially for young start-ups an ideal chance to combine complementary knowledge from other firms and research institutions in order to be first to the market. These start-ups benefit especially by saving time and money and the pooling of risks. On the other hand, regional networks may hinder the opportunities of gaining additional knowledge from potential global knowledge sources. According to Simard and West, regional co-operations in innovation management concerns are more essential for early stage industries and those with rapid changing technologies or new firms. In contrast, firms with globally dispersed knowledge benefit from knowledge sharing within global innovation networks. (Simard & West 2006, p. 239)

In order to the regional differentiation of innovation systems, following section describes selected concepts of innovation systems that can be applied either at a regional, national or global level.

3.4 External-Oriented Innovation Systems

In regard to the system approach in innovation management introduced in section 2.1.3.2, this section discusses the system approach with special focus on external system elements and external oriented innovation systems.

> *"Systems of innovation can be viewed in several dimensions. One important dimension is the physical or geographical dimension. Sometimes the focus is on a particular country or region which then determines the geographic boundaries of the system. In other cases the main dimension of interest is a sector or technology."*
> (Carlsson et al. 2002, p. 233)

There are a lot of concepts in regard to innovation systems and various terms are used. Following paragraphs provide an overview about two often discussed approaches in terms of innovation systems: strategic alliances and national innovation systems.

3.4.1 Strategic Alliances

The term strategic alliance has been introduced to distinguish long-term, substantial co-operation and collaboration from casual co-operation between firms (Grant & Baden-Fuller 2004, p. 62). Strategic alliances are *"agreements characterized by the commitment of two or more firms to reach a common goal entailing the pooling of their resources and activities"* (Teece 1992, p. 19).

> *"A strategic alliance is an agreement between two or more partners to share knowledge or resources which could be beneficial to all parties involved."*
> (Vyas, Shelburn & Rogers 1995, p. 47)

The partner firms within strategic alliances remain legally independent after forming the alliance. Furthermore, they share benefits and management resources in order to fulfill a given task and within the strategic alliances contributions in one or more strategic

areas are made. This can happen, e.g., in regards of technology or products. (Todeva & Knoke 2005, p. 125)

According to Vyas et al. (1995, p. 47) strategic alliances can reach from simple co-operations between two companies to complex clusters involving several companies in different countries. They differ between following dimensions of alliances: (Vyas et al. 1995, pp. 47-49)

- *Intra/inter-industry alliances.* Main motivations for intra- and inter-industry alliances are the pooling of expertise and knowledge to create synergy and the fulfillment of common regulations.
- *Arena of alliances.* At this dimension, alliances can be split up across national borders or they may involve companies from different countries.
- *Alliances built on relationships.* These alliances come up from (long-term) relationships, e.g. between a firm and its supplier. Alliances built on relationships result often of a high level of trust between the parties.
- *Technology or market related.* Alliances may be formed due to technology- or market-related factors, or in combination of the two.
- *State of technology.* Especially in the early stages of innovation processes, technology transfer is required to generate sustainable competitive advantages. This may lead to strategic alliances as well.
- *Technology fusion.* The last dimension of strategic alliances is the fusion of technology. A partner within the strategic alliances contributes to the knowledge of another member to generate a competitive advantage or to help creating the final product.

There are many motives why firms establish strategic alliances, e.g., to enhance their productive capacities, to reduce uncertainties in their internal structures and external environments, to acquire competitive advantages that enables firms to increase their profits, or to develop future business opportunities that allow firms to command higher market values for their outputs. (Webster 1999 as cited in Todeva & Knoke 2005, pp. 127-128)

Summarizing, strategic alliances are split up between two or more industrial companies, they may be international or within one country and may often root in long-term relationships within the supply chain.

3.4.2 National Innovation Systems

In contrast to strategic alliances, national innovation systems are broadened up to involve not only industries and companies, but also R&D activities. Therefore as well research institutes, universities, government agencies, and government policies can be seen as components of a national innovation system. (Carlsson 2002, p. 236 and OECD 1997, p. 7)

The concept of national innovation systems has first been established by Christopher Freeman. He defined national systems of innovation as

> *"the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies."*
> (Freeman 1987, p. 1)

In addition to the definition of Freeman, Lundvall defined national systems of innovation as social systems where the central activity within the system is learning that involves interaction between people. National innovation systems can be described as dynamic systems characterized by feedback and reproduction. (Lundvall 2010, p. 2) Besides that, he defined national innovation systems as follows:

> *"a national system encompasses elements and relationships, either located within or rooted inside the borders of a nation state"*
> (Lundvall 2010, p. 2)

Concluding Statement

Open innovation as one of the central research fields in current innovation management literature is the first theoretical focus of this work. It is used within this work mainly in terms of integrating external sources into the internal innovation activities, referring to the outside-in process. Moreover, motives of sharing knowledge in the sense of the inside-out process have to be discussed within the work as well since the knowledge owners play a significant role.

Furthermore, the system approach in open innovation management has to be considered as well, since it might be necessary to span networks across the various knowledge owners to being able to successfully co-operate within open innovation projects.

Additionally, the second central research field deals with knowledge management and how to deal with external knowledge in open innovation projects. Therefore the next chapter discusses different aspects of external-oriented knowledge management.

4 Inter-Organizational Knowledge Management

Opening up the innovation process as the paradigm shift in innovation management enables new possibilities of accessing external knowledge in order to achieve sustainable market success. At the same time the systematic management of all the available knowledge is a new challenge companies have to deal with. This chapter outlines the principal challenges in relation to external knowledge management. The major aim of external-oriented knowledge management is to identify the most relevant external knowledge and transfer it successfully into the organization for the purpose of internal or external exploitation.

This chapter is organized in three sections. First, the relevance of external knowledge will be discussed in an overall context by introducing the term *absorptive capacity*. Besides that, the knowledge management processes, will be covered in regard to the external orientation in knowledge management. Third, the chapter concludes by introducing various methods and tools that support the handling of external knowledge with respect to the different knowledge management processes.

4.1 Theoretical Background

Knowledge management research in general is often restricted to internal-oriented management activities in order to ensure an organization-wide knowledge transfer and

knowledge access (Lichtenthaler & Lichtenthaler 2009, p. 1315). Research that considers knowledge within and outside a firm's boundaries is rare. (e.g. Lichtenthaler & Lichtenthaler 2009; Wallin & von Krogh 2000; von Krogh, Ichijo & Nonaka 2000; Grant & Baden-Fuller 2004)

Within his 1999 work on strategic knowledge management, Zack distinguishes conservative from aggressive knowledge strategies. Conservative knowledge strategies focus on the internal exploitation of knowledge while aggressive knowledge strategies aim to explore and exploit the knowledge internal and external - *"without regard to organizational boundaries"*. According to Zack, firms that follow an aggressive knowledge strategy tend to be more successful than their competitors that follow more conservative knowledge strategies over time. (Zack 1999a, p. 139)

4.1.1 Internal vs. External Knowledge

Knowledge sources may lie inside or outside a firm's boundaries. Internal knowledge sources are the employee's individual knowledge, which is embedded in behaviors, procedures as well as software and equipment; stored within documents and computer databases or online repositories. In contrast, external sources of knowledge are, e.g., written publications, universities and government agencies, as well as professional associations, employee's personal relationships, consultants, vendors, knowledge brokers, and members of strategic alliances. Internal knowledge is of special significance, since it tends to be unique and tacit. Competitors cannot imitate it easily and therefore it is of special strategic relevance to the organization. In spite of that, external knowledge enables thinking *'outside the box'*. Zack suggests to combine unique internal knowledge with fresh new thinking from outside to achieve competitive advantages. (Zack 1999a, pp. 138-139)

Argote et al. discussed several views of researchers in the context of how valuable external sources of knowledge are. One opinion is that internal knowledge is more likely to be exploited within the organization since external knowledge exploitation has to deal with, e.g., the overcoming of the Not-Invented-Here Syndrome and several other barriers that hinder the use of external knowledge throughout the organization. In a different vein,

Argote et al. examined other approaches where external knowledge is seen as more valuable than internal knowledge since the employees are less familiar with limitations in regard to external knowledge and therefore may generate more value out of it. (Argote et al. 2003, p. 578)

Especially in regard to the innovation process, external knowledge is being recognized as important factors throughout the past two decades. (Escribano, Fosfuri & Tribo 2009, p. 96)

In terms of external knowledge, a frequently used concept is *absorptive capacity*. Therefore, it is defined and explained in the following section.

4.1.2 Absorptive Capacity

Absorptive capacity has originally been defined by Cohen and Levinthal (1990) as the process of identifying, assimilating and exploiting knowledge from external sources (Lane, Koka & Pathak 2006, p. 833).

In a similar but more specific vein, Lichtenthaler & Lichtenthaler's concept of absorptive capacity is restricted to the acquisition and exploration of external knowledge:

> *"While inventive capacity refers to internally exploring new knowledge, absorptive capacity relates to exploring external knowledge."*
> (Lichtenthaler & Lichtenthaler 2009, p. 1319)

Lichtenthaler & Lichtenthaler (2009) restricted their definition of absorptive capacity to *"utilizing external knowledge inside a firm"*, the definition of Escribano et al. (2009) involves the exploration of external knowledge as well as the application and external exploitation of the gathered knowledge.

> *"Absorptive capacity is defined as the ability to recognize the value of external knowledge, assimilate it, and apply it to commercial ends."*
> (Escribano et al. 2009, p. 97)

In Lichtenthaler & Lichtenthaler's context, absorptive capacity considers knowledge acquisition and exploratory learning. The focus is on the knowledge exploration process as demonstrated in figure 4.1. Therefore, exploitation and commercial application are not included into their understanding of absorptive capacity. To expand the absorptive capacity, companies need a related internal knowledge to understand the context of the knowledge absorbed.(Lichtenthaler & Lichtenthaler 2009, p. 1319)

Innovation has a recursive relationship with absorptive capacity: while absorptive capacity has a positive affect on the speed, frequency, and magnitude of innovation, innovation creates new knowledge that becomes again part of the organization's absorptive capacity. (Lane et al. 2006, pp. 849-850)

4.2 Recent Research on External-Oriented Knowledge Management

Only few research deals with managing external knowledge. This section outlines two recently published works on external knowledge management: the *knowledge management capacity framework* by Lichtenthaler & Lichtenthaler (2009) and a more process-oriented approach, the *five-step model for integrating knowledge in innovation* by Wallin & von Krogh (2010).

4.2.1 The Knowledge Management Capacity Framework

The *knowledge management capacity framework* provides a descriptive framework on a firm's knowledge base. Lichtenthaler & Lichtenthaler introduced six knowledge capacities organizations have to dynamically maintain and consider within its knowledge management strategy. Following paragraphs first outline the different knowledge capacity that are combined within the knowledge management capacity in the second part of this section. (Lichtenthaler & Lichtenthaler 2009)

4.2.1.1 Knowledge Capacities

Lichtenthaler & Lichtenthaler discussed six knowledge capabilities with regard to the three core knowledge management processes exploration, retention and exploitation. (Lichtenthaler & Lichtenthaler 2009, p. 1317)

Furthermore, knowledge management can take place with respect to an internal view and an external focus. Figure 4.1 provides an overview about the six knowledge capabilities in relation to the stages of the knowledge management process.

	knowledge exploration	knowledge retention	knowledge exploitation
internal (intrafirm)	inventive capacity	transformative capacity	innovative capacity
external (interfirm)	absorptive capacity	connective capacity	desorptive capacity

Figure 4.1: Overview of the Knowledge Capacities (Lichtenthaler & Lichtenthaler 2009)

Inventive Capacity

> *"Inventive capacity refers to a firm's ability to internally explore knowledge, i.e. to generate new knowledge inside the firm."*
> (Lichtenthaler & Lichtenthaler 2009, p. 1318)

Derived from the overall knowledge objectives a firm starts to implement knowledge exploration processes to generate new knowledge. This new knowledge can be integrated into the internal knowledge base by setting up links to existing knowledge. Inventive capacity in that context is defined as *"a firm's ability to internally explore new knowledge"*. It involves several activities in regard to the internal knowledge generation and the integration of the new knowledge into the firm's knowledge base. (Lichtenthaler & Lichtenthaler 2009, pp. 1318-1319)

Absorptive Capacity

> *"While inventive capacity refers to internally exploring new knowledge, absorptive capacity relates to exploring external knowledge."*
> (Lichtenthaler & Lichtenthaler 2009, p. 1319)

Lichtenthaler & Lichtenthaler (2009) resticted their definition of absorptive capacity to *"utilizing external knowledge inside a firm"*. In that context, absorptive capacity considers knowledge acquisition and exploratory learning. The focus is on the knowledge exploration process as demonstrated in figure 4.1. Therefore, the exploitation and commercial application is not included into their understanding of absorptive capacity. To expand the absorptive capacity, companies need a related internal knowledge to understand the context of the knowledge absorbed. (Lichtenthaler & Lichtenthaler 2009, p. 1319)

Transformative Capacity

> *"Transformative capacity refers to a firm's capability to internally retaining knowledge over time."*
> (Lichtenthaler & Lichtenthaler 2009, p. 1320)

The process of knowledge retention needs a lot of attention in not loosing skills and routines that are not used anymore. Furthermore, employee's knowledge has to be kept within the firm even if the employee leaves. Transformative capacity involves the process of maintaining and reactivating a firm's internal knowledge base. (Lichtenthaler & Lichtenthaler 2009, 1320)

Connective Capacity

Lichtenthaler and Lichtenthaler defined connective capacity as

> *"a firm's ability to retain knowledge outside its organizational boundaries."*
> (Lichtenthaler & Lichtenthaler 2009, p. 1320)

As connective capacity refers to a firm's ability to retain knowledge in interfirm relationships, it comprises elements of alliance capability and relational capability. Furthermore, it focuses on externally maintaining knowledge and does not assume inward knowledge transfer in contrast to absorptive capacity. Alliances and external networks are in the focus of the activities in regard to connective capacity. Thus, it involves the process

stages of maintaining and reactivating interorganizational relationships and knowledge. (Lichtenthaler & Lichtenthaler 2009, p. 1320)

Innovative Capacity

Innovative capacity can be defined as

> *"a firm's ability to internally exploit knowledge."*
> (Lichtenthaler & Lichtenthaler 2009, p. 1321)

Furthermore, innovative capacity refers to the ability to internally exploit knowledge and comprises the transmutation and conversion of knowledge into new products and services. (Lichtenthaler & Lichtenthaler 2009, p. 1321)

Desorptive Capacity

Finally, desorptive capacity is defined as

> *"a firm's ability to externally exploit knowledge."*
> (Lichtenthaler & Lichtenthaler 2009, p. 1322)

Desorptive capacity is complementary to absorptive capacity and describes the capability of external knowledge exploitation which involves outward knowledge transfer. It comprises activities in regard to identification of external knowledge exploitation opportunities and the knowledge transfer to the recipient. (Lichtenthaler & Lichtenthaler 2009, p. 1322)

4.2.1.2 Knowledge Management Capacity

> *"Knowledge management capacity is defined as a firm's ability to dynamically manage its knowledge base over time by reconfiguring and realigning the processes of knowledge exploration, retention, and exploitation inside and outside the organization."*
> (Lichtenthaler & Lichtenthaler 2009, p. 1322)

Lichtenthaler & Lichtenthaler's framework claims that firms should permanently maintain their knowledge capacities, since they dynamically develop to fit dynamic environments. Knowledge management capacity defines which knowledge is acquired and integrated into an organization's knowledge base. In that context, not only reconfiguring but also realigning the knowledge capacities is of significant relevance. Knowledge management capacity not only refers to connecting the knowledge capacities, it additionally involves transforming the knowledge capacities. The framework furthermore points out the influence of a firm's strategic orientation on knowledge capacities. The development of knowledge capacities and knowledge management capacity has to be aligned with the firm's strategy. (Lichtenthaler & Lichtenthaler 2009, pp. 1317-1325)

4.2.2 A Five-Step Model for Integrating Knowledge in Open Innovation

Wallin and von Krogh established a concept that supports the integration of external knowledge in open innovation projects, which is the first concept introduced in terms of combining knowledge and open innovation. (Wallin & Von Krogh 2010)

Within their definition of innovation they included the aspect of knowledge. They defined innovation as *"a process that covers the creation and use of knowledge for the development and introduction of something new and useful"* and further *"innovation cannot occur without knowledge"* (Wallin & Von Krogh 2010, p. 145) They further provide a process-oriented view on innovation which involves knowledge creation in different contexts.

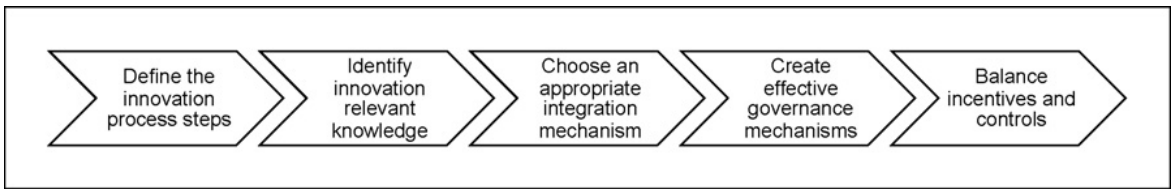

Figure 4.2: A five-step model for integrating knowledge in open innovation (Wallin & Von Krogh 2010, p. 148)

The concept of *integrating knowledge in open innovation* is a five step process which is demonstrated in figure 4.2. This approach includes following five steps: (Wallin & Von Krogh 2010, p. 145)

1. *Define the innovation process steps:* Managers should be aware of the large programmatic impact held by an innovation process definition. Managerial biases and political interests frequently shape the way innovation processes are defined. A possible remedy could be to define the process steps and invite various stakeholders in advance to discuss the pros and cons of opening up each process step to outsiders. Discussion would be an opportunity to gain their commitment to advancing the process.

2. *Identify innovation-relevant knowledge:* Having an outline of the process enables the identification of innovation-relevant knowledge in various domains. Domain definition can be personal; technical; market-based; or geographical.

3. *Choose an appropriate integration mechanism:* Integration of knowledge means specifying how people, teams, and other sources external and internal to the company contribute to various steps in the open innovation process. First, managers can formulate rules for integrating knowledge from the outside. Second, knowledge can also be integrated in open innovation through the sequencing of tasks. Third, routines are patterns of behavior triggered by issues, tasks, or problems. In other words, there are mechanisms built into the innovation process that drive the organization to access knowledge outside its boundaries. The fourth mechanism for integrating knowledge in open innovation is group problem solving and decision-making. This means that external individuals, teams, companies, universities,

and other organizations not only contribute to solving pre-specified tasks in the innovation process but also to defining the steps, tasks, problems, and processes of open innovation.

4. *Create effective governance mechanisms:* It is important to recall that innovation creates value through new knowledge. Since people and institutions outside the boundaries of the company participate, open innovation raises a number of issues related to governance of the process, its results, and assets.

5. *Balance incentives and controls:* There is only few literature on how to deal with incentives for external knowledge sources in terms of open innovation.

Wallin & von Krogh's approach provides a framework that aims to identify the locus of knowledge and to integrate the various knowledge domains in open innovation projects (Wallin & Von Krogh 2010, p. 148). Furthermore, they advise managers to make knowledge integration a central activity in open innovation management (Wallin & Von Krogh 2010, p. 153).

4.3 Operative Management of External Knowledge

Since operative management of external knowledge is by not not a well-researched topic, this section provides an overview about the most common methods and tools in terms of conservative knowledge management (Zack 1999a) and their applicability for the external usage.

In the context of operative knowledge management, this section presents selected tools and methods that are applied in practice to support the different processes in knowledge management. This section further describes various knowledge management tools that are used in organizations. Originally, most of these concepts have been designed for the internal use. This section provides an overview about the most common knowledge management instruments and discusses their applicability in terms of outside oriented knowledge management and external knowledge.

4.3.1 Knowledge Map

Knowledge maps are very powerful methods that provide employees access to an organization's knowledge base (Lehner 2009). It shows where the different kinds of knowledge are located within an organization. The primary purpose of a knowledge map is to provide a quick overview about the organizations knowledge base. Employees can easily identify where to find the specific knowledge experts inside the firm. A knowledge map is structured as a graph with nodes, that represent the various knowledge sources (e.g. employees, departments), and connections which represent the knowledge flows. Smaller firms might plot the knowledge map on a chart, larger ones with many fields of competencies may require a software tool to build up the whole knowledge base of the organizations. Knowledge maps visualize the internal knowledge base which is utilized in a strategic context to analyze a firm's knowledge to adapt the overall knowledge strategy. (Probst, Raub, Romhardt 2010, p. 70; Gordon 2000, pp. 34-48; SDC 2009, pp. 57-61) Further, knowledge maps not include the knowledge itself, they only provide links to the sources of knowledge.

Applicability to External Knowledge Especially in the context of larger firms, knowledge maps become quite complex which is as well the case in terms of making external knowledge transparent. On the other side, this tool might provide a good opportunity to identify knowledge leaks within the organization which would be a good basis to open discussions on sourcing external knowledge.

4.3.2 Yellow Pages

In a similar vein, *yellow pages* or *expert registers* is a tool that supports the internal knowledge identification. Yellow pages are structured like directories including specific knowledge, skills, experiences and interests of each employee. This tool is electronic and provides easy access and search all over the organization. (Swiss Agency for Development and Cooperation 2009, pp. 113-116)

Applicability to External Knowledge Yellow pages are not the best way to structuring data in an efficient way. In that context, knowledge maps have a huge advantage to yellow pages. Therefore, yellow pages are not suitable for the use in terms of external sources of knowledge.

4.3.3 Communities of Practice

A community of practice (CoP) is a network of people with a common interest or problem in a specific field of competence (Swiss Agency for Development and Cooperation 2009, p. 23). Further, communities of practice are informal groups of employees that connected voluntarily to reach a common goal. These networks aim to identify, generate and share knowledge to support one another with individual problems. CoPs are built by employees that belong to different organizational units and different locations that follow a common goal, activity or interest. Since the members of a community of practice are not determined by the management, CoPs are characterized by a high level of trust and very personal, informal relationships. (Lehner 2009, pp. 215-216)

Applicability to External Knowledge In case of involving external sources in new product development or open innovation, communities of practice might be a valuable platform to share not only internal but also external knowledge.

4.3.4 Think Tanks

Traditional forms of think tanks are research and development departments. In recent time, new types of think tanks have been established. Several firms like e.g. Motorola and McDonald's have invested into corporate universities that not only train their employees there, but as well conduct research within their core business areas. (Probst et al. 2010, p. 130)

Applicability to External Knowledge The think tank concept is suitable to the external orientation in knowledge management if not only internal knowledge is transmitted here and the think tank is open for external inputs.

4.3.5 Lessons Learnt

Experiences from past project are systematically analyzed at the end in order to use that experiences in later projects. To successfully involve lessons learnt into new projects, it should be established into the project process. After fixing the project idea, lessons learnt from previous projects should be discussed, and after project realization lessons learnt from the new project are discussed. (Probst et al. 2010, pp. 133-134)

A positive aspect of lessons learnt is that knowledge remains within the organization, even if employees leave the firm. Moreover, a broader use of knowledge is guaranteed. Lessons learnt require a trust-based relationship between employees and management and a high fault tolerance to enable employees to share their experiences and mistakes. (Lehner 2009, p. 189)

Applicability to External Knowledge This tool is relevant for internal as well as external knowledge management projects. Lessons learnt in the context of external knowledge sources are valuable in regard to discussing relationships, problems, and strategies of co-operation. Future projects may benefit from the experiences made.

4.3.6 Best Practice Sharing

In a similar vein as lessons learnt, best practice sharing aims to improving the organizational efficiency in terms of knowledge sharing. Best practice is the best solution for a specific problem. Solutions can be identified within and outside an organization's boundaries. (Lehner 2009, p. 190)

Applicability to External Knowledge Since best practices must not only refer to internal solutions, this knowledge management instrument supports external orientation in knowledge management. External solutions are discussed within the organization to bring up different views from the internal ones.

4.3.7 Knowledge Broker

A *knowledge broker* has fundamental knowledge about an organization's knowledge base. The knowledge broker's job is to bring knowledge owner and knowledge users together, to provide transparency in regard to the knowledge base and to overcome barriers to knowledge utilization of existing knowledge. (Schüppel 1996, p. 201)

Applicability to External Knowledge Knowledge broker can be established to overview the internal knowledge base but on the other hand to overview external sources of knowledge as well. The concept of knowledge brokers can be adapted to external utilization even if it is getting more complex. One possible approach for implementing knowledge brokers that oversee external knowledge is to enable different fields of knowledge. Each

knowledge field has one knowledge broker that overviews the entire knowledge concerning to this field, on the internal perspective as well as on the external perspective.

Most of the knowledge management instruments introduced within this section have originally been developed for the internal use, to manage the internal knowledge base. One research focus of this work is the external orientation in knowledge management which requires some adoptions to existing knowledge management methods and tools. Specific adoptions and applications will be discussed in chapter 5.

Concluding Statement

Especially knowledge management in concerns of external sources of knowledge is not a well-researched topic by now. Open innovation requires this focus on external knowledge sources and therefore this work deals with knowledge outside a firm's boundaries.

Following table provides an overview about the previously discussed methods for operative knowledge management. These tools have been selected since they are often applied in practice. The table shows some but not all possible instruments for successful knowledge management. Further methods and tools are e.g. discussed in Probst et al. (2010) and North's (2011) work.

Management Tools	**Characteristics**
Knowledge Map	graph with nodes; provides a quick overview about the firm's knowledge base; shows only links to specific sources of knowledge
Yellow Pages	electronic tools; provides access to internal experts; extremely useful for the identification of internal knowledge
Communities of Practice	network of people with common interests; supports the identification, generation and sharing of knowledge; might be internally and externally organized
Think Tanks	research & development departments; corporate university
Lessons Learnt	systematic analysis of project experiences; knowledge remains within the organization; broader use if existing knowledge
Best Practice Sharing	internal knowledge sharing; similar to lessons learnt
Knowledge Broker	person that has fundamental knowledge about the firm's knowledge base; brings knowledge owner and user together

Table 4.1: Overview about selected tools for operative knowledge management

Furthermore, Lichtenthaler & Lichtenthaler's framework on knowledge management capabilities provides a good way how to structure the internal knowledge bases. It helps to understand the different aspects of knowledge within an organization. The framework supports the theoretical model presented later in this work.

Wallin & von Krogh's process model forms a good basis for further research on integrating external knowledge in open innovation projects. The approach developed within this research work is based on Wallin & von Krogh's framework with special focus on the front-end of innovation.

5 Knowledge-Based Innovation Management

This chapter describes the theoretical model of this work based on the theory discussed before. The concepts of open innovation and external knowledge management are combined to the *Knowledge-Based Innovation Management Framework*. The first part of this chapter describes the framework conditions and scope of the theoretical model while the second part includes the detailed definition of the framework and its components.

5.1 Framework Conditions and Scope

This section includes a description of one of the basic structure elements of the framework - the *innovation environment*. Especially two different kinds of external knowledge owners will be discussed - *strong* network partners and *weak* network partners.

5.1.1 Focus on the Front-End of Innovation

The provided framework sets its focus on the front-end of innovation. An early integration of external knowledge into internal activities is extremely valuable.

The first stages of the innovation process are often called the *front-end of innovation*. This terminology came up by Smith & Reinertsen (1991) and covers the phases from idea generation to its approval. The front-end of innovation - where this work focuses on - is demonstrated in Figure 5.1.

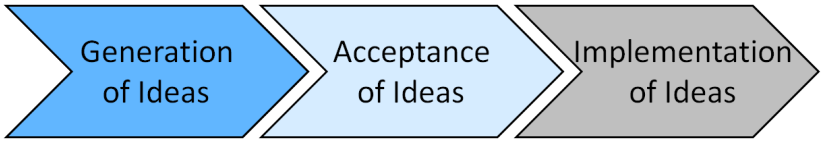

Figure 5.1: Focus on the front-end of innovation

According to Backman et al. the front-end of innovation provides the

> *"greatest opportunities for improving the overall innovation process."*
> (Backman, Börjesson & Setterberg 2007, p. 18)

In this early phases efforts are low and effects to the whole process high. (Backman et al. 2007, p. 18) Therefore, this thesis provides a framework for this early phases of an (open) innovation process.

5.1.2 Classification of Knowledge Owners

The knowledge owners are classified according to Mention's classification as shown in section 3.3.2. Following classification is used for the framework developed within this thesis:

- *Market-based co-operations (without competitors).* This category has been re-defined in order to ensure that competitors (which are in fact market-based) are treated separately and not equal to customers and suppliers.
- *Co-operations with competitors.* Co-operations with competitors are very special and are therefore considered separately within the framework.
- *Science-based co-operations.* The third group includes all co-operation that are science based, e.g. with universities and public or private research institutes.
- *Other co-operations.* Unlike Mention's classification, this category not only deals with intra-group co-operations but widens this category up to other co-operations which not only include firms belonging to the same group but also independent co-operation partners.

Above four categories create the basis for the knowledge owner selection provided in this framework. Furthermore it helps to describe the innovation environment as presented in the following section.

5.1.3 Innovation Environment as an Organization's Network

An *innovation environment* is defined in section 3.3 as a firm's environment in terms of innovation co-operations. It includes all external knowledge owners that may be considered for knowledge sourcing in relation to a firm's innovation activities. It can be seen as a network which consists of long-term partners and other parties being not regular in contact with the firm.

An organization's network is characterized by *wide* and *deep ties* (Simard & West 2006, p. 229). In relation to this work, we are talking about a *strong network*, that includes organization's long-term relationships, e.g. strategic partners. Those relationships are most often characterized by a high level of trust between the two parties. Additionally, an organization's network is also made up by weak ties (Simard & West 2006, p. 229). This network is called a firm's *weak network*. Relationships here are characterized by personal contacts between individuals of both organizations, and those relationships are mostly not long-term relationships between the whole organizations. Single co-operation activities have been done between the two parties but not a deeper and standardized, long-lasting co-operation.

Simard & West suggested to form and consider wide and deep ties. Besides that, it has to be ensured that the knowledge flow into the company is bigger than the knowledge flow to the outside. (Simard & West 2006, p. 229) Taking this into account, the innovation environment for the *Knowledge-Based Innovation Management Framework* consists of two components: the strong and the weak network. A general overview about the innovation environment is provided in Figure 5.2.

Simard & West (2006, p. 230) defined a firm's network by wide and deep ties. Both, strong and weak ties show clear advantages. Strong ties are characterized by trust-based relationships resulting from long-term co-operations and therefore provide a quick access

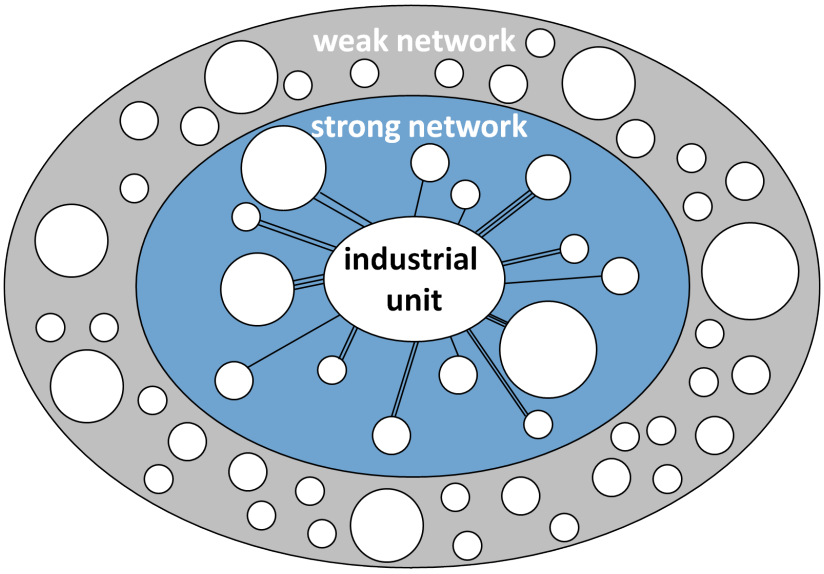

Figure 5.2: Strong and weak network in the innovation environment (own illustration)

to outside knowledge that can be easily activated. On the other hand, weak ties enable access to new information and knowledge which is especially essential in the context of innovation management. In order to the open innovation strategy, Simard & West suggest to *"consider a balance of strong and weak ties"*.(Simard & West 2006, p. 230)

The following paragraphs describe the characteristics of strong and weak networks as used within this framework.

Strong network. A firm needs to maintain it's network resources and may gain competitive advantage by co-operating with those network partners. Firms may create uniqueness by strengthening the ties within their networks. Regular interactions support the trust-base to other network partners. (Simard & West 2006, p. 229)

Weak network. Especially weak ties provide enhanced access to new knowledge and information. Besides that, the biggest advantage of sourcing knowledge from weak network partner is that overembeddedness might be overcome. Weak ties are usually relationships that are not characterized by regular and repeated interactions.

New information and knowledge channels, besides the existing ones to strong network partners, are used to gather the requested knowledge. (Simard & West 2006, p.230)

Outside the organization's network. The open innovation approach is not restricted to existing relationships like strong or weak ties - the open innovation philosophy makes organizations aware about external parties in innovation management and the importance of co-operation with externals in order to find new product ideas. Therefore, knowledge owners outside the corporate network should be considered within this thesis as well. These knowledge owners can be classified again into Mention's categories, as provided in section 5.1.2. Following knowledge owners are potential co-operation partners according to the specific knowledge owner groups:

- *Market-based co-operations:* potential new customers and suppliers
- *Co-operations with competitors:* equal to the previous definition, this group considers competitors - especially those where no co-operation projects have been done before
- *Science-based co-operations:* universities, private and public research laboratories that are not considered within an organization's strong or weak network
- *Other co-operations:* potential independent co-operation partners, e.g. to enter new business fields or markets

This section covered the framework conditions and the scope of the theoretical model. The following *Knowledge-Based Innovation Management Framework* as defined in the next section is further based on the research questions presented in chapter 1.

5.2 The Knowledge-Based Innovation Management Framework

This part of the thesis describes a framework to establish a knowledge-oriented open innovation process. It is called the *Knowledge-Based Innovation Management (KBIM) Framework* and it includes management implications and suggestions for tools and methods to support the innovation activities in order to involve external knowledge in internal processes.

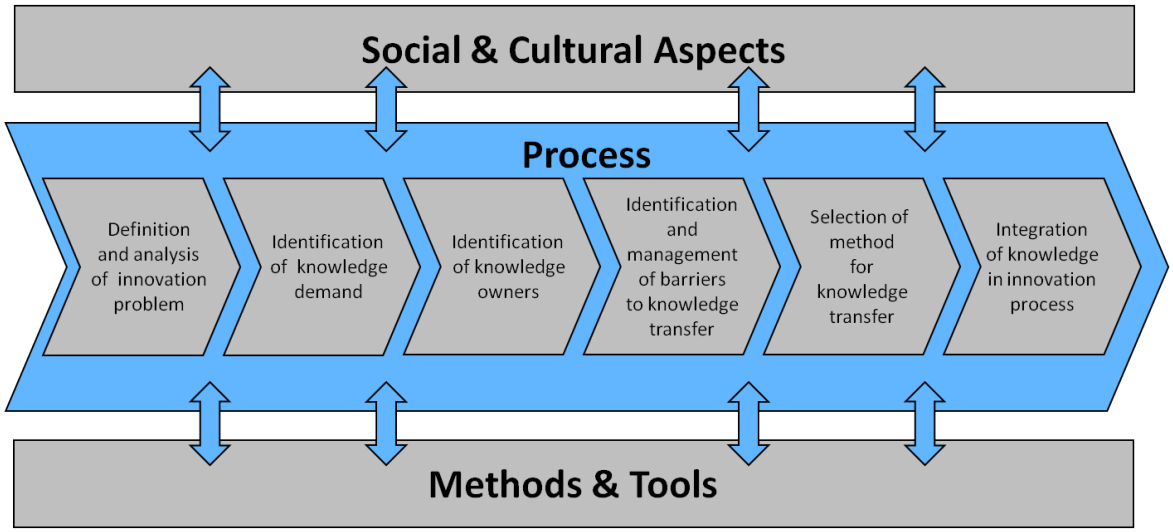

Figure 5.3: The components of the KBIM Framework (own illustration)

Bleicher's concept of integrated management describes three aspects that influence organizational development in correlation with the levels of normative, operative, and strategic management. These aspects are activities, structures, and behaviors. (Bleicher 1999, pp. 81-83) The knowledge-based innovation management framework is based on Bleicher's three aspects. Its basis is a process-oriented approach where activities initially build the structure of the framework. Besides that, at the level of behavior the framework considers cultural aspects - especially in case of open innovation, only few research efforts consider these factors. Additionally, it provides methods and tools that support the different process steps. The basic structure of the Knowledge-Based Innovation Management Framework is demonstrated in Figure 5.3.

To sum up, the *KBIM Framework* consists of three components:

- *Process.* The core of the framework builds the process perspective which describes the procedural structure. This perspective represents Bleicher's level of *activities*.
- *Methods & Tools.* The process level is supported by numerous methods and tools that may be applied to the different process stages. Referring to Bleicher's concept, this level of the framework considers the aspect of *structures*.
- *Organizational Culture.* The third component of the framework considers cultural aspects which links to Bleicher's aspect of organizational *behaviors*.

In a first step, following sections describe the process perspective of the framework by defining each process step in detail. Afterwards, the different methods and tools that support the process are presented in the next section while the final section of this chapter concludes the social and cultural aspects covered within the framework.

5.2.1 Process Perspective

The process level of the KBIM Framework consists of six steps demonstrated in Figure 5.4.

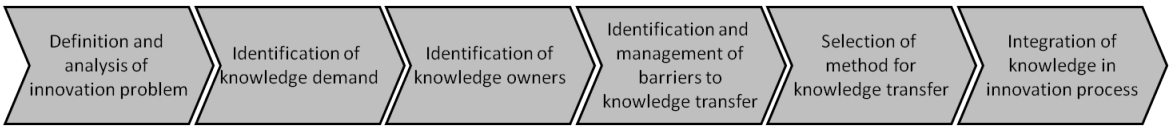

Figure 5.4: The Knowledge-Based Innovation Management Approach

Here, the steps are described briefly, while following sections discuss them more detailed in relation to the three components of the framework:

1. *Definition and analysis of innovation problem.* The first and basic step is the identification of the innovation problem. This problem-oriented approach sets the basis for further steps. A detailed investigation into problem analysis is an essential step in order to ensure the careful execution of the following activities.

2. *Identification of knowledge demand.* After the innovation problem has been defined and analyzed, the next step is to identify the required knowledge. The knowledge demand provides information about deficits within the firm. The demand helps to identify the relevant knowledge owners for the innovation problem.

3. *Identification of knowledge owners.* This step considers activities that support the selection of the most suitable knowledge owners that bring in the best knowledge for the planned venture.

4. *Identification and management of barriers to knowledge transfer.* In many cases, inter-organizational knowledge transfer has to deal with several transfer barriers at different levels (individual, organizational, and inter-organizational). This step of the framework helps to create awareness about potential barriers and provides approaches in order to find solutions on how to overcome these barriers.

5. *Selection of method for knowledge transfer.* After identifying the relevant knowledge owners, knowledge has to be transferred into the organisation. This thesis provides

answers concerning how to transfer the knowledge to the inside with respect to different knowledge owners.

6. *Integration of knowledge in innovation process.* The last step within the activity plan deals with the integration of the gathered knowledge into the internal innovation process.

These six steps build the basic structure of the central element of the framework - the *process level*. Each of the following sections deals with one step and discusses it according to the process perspective as well as cultural aspects. Furthermore, each section includes descriptions of methods and tools that support the specific process step.

5.2.1.1 Definition and Analysis of the Innovation Problem

The first stage of knowledge-based innovation management is the problem definition and analysis. The problem-oriented approach in innovation management as well as the problem analysis related to it have already been covered in literature by several authors. Therefore, this section provides an overview about existing definitions, approaches, and methods in relation to problem definition and problem analysis.

A *problem* in the context of innovation management is defined as *"any kind of situation where we are looking to change something."* (Mann 2007, p. 81) Mann further argues, that a human's brain is better in *solving* problems than in *defining* solutions. He posted that the better the problem is defined, the less effort is necessary to find a solution. (Mann 2007, p. 25) Furthermore, Crawford & Di Benedetto claimed that a problem list of users is much better than a want list since users *"verbalize their wants in terms of current products, whereas problems are not product specific"* (Crawford & Di Benedetto 2006, p. 105). This is why the KBIM Framework builds on a well structured problem definition and analysis.

Besides Mann, other researchers deal with a problem-oriented approach in innovation management. For instance, Hauschildt & Salomo (2011, p. 197) stated the importance of an adequate problem definition in early stages of innovation projects. According to them, a problem definition should not provide the solution but trigger the process of finding the solution. They further defined following aspects that a problem definition has to consider: (Hauschildt & Salomo 2011, pp. 198-199)

- *System.* To define an innovation problem, the system where the solution is developed for, should be defined. This means to define the system borders (e.g. organization, department, project team).
- *Object.* The problem has to be differentiated from non-problems.
- *Time frame.* A problem definition includes a definition of the time frame.
- *Structure.* The problem definition breaks the overall-problem into various sub-problems. It is necessary to classify sub-problems according to their relevance.

- *Capacity.* Furthermore, capacity constraints (e.g. time, personnel, financial) have to be considered in the problem definition phase.
- *Revisions.* Another aspect of an adequate problem definition is to leave space for later revisions and re-definitions of parts of the problem.

Hence, an adequate problem definition is the essential basis for successful innovation processes. Based on the problem definition, following section provides an overview about common methods and tools that are used to analyze the relevance of problems in early phases of the innovation process.

Methods and Tools for Problem Definition and Analysis

This section covers commonly used methods and tools for the problem definition and analysis phase. Besides Cooper et al. (2002), Mann (2007) developed several approaches and methods in relation to this issues. Here, primarily the reverse brainstorming approach according to Cooper et al. is discussed and Mann's methods are not covered here because he already provided a good collection of common used methods within his work. Therefore, a link to Mann's work is provided here without repeating all his findings within this work. Furthermore, Cooper (2001) provided other methods for the front-end of innovation within his Stage-Gate process. Here, selected methods according to Cooper (2001) are presented as well.

Reverse brainstorming. One method for defining and analyzing innovation problems is *Reverse Brainstorming* by Cooper, Edgett & Kleinschmidt (2002) as e.g. introduced by Crawford & Di Benedetto's within their *Problem-Based Concept Generation* approach. Here, participants of an internal workshop prepare a list of problems based on the current situation or concerning current products. Afterwards they prioritize the problems and focus on the most important and relevant ones. Following enumeration explains the general approach: (Crawford & Di Benedetto 2006, pp. 105-112)

1. *Defining the product category.* The product category is e.g. being defined by identifying a use, user or product category dimension and considering it within the problem definition.

2. *Identifying heavy product users or lead users.* Lead users or heavy users mostly have a better understanding of the problems related to the product.

3. *Gathering problems associated with the product category.* This step aims to identify issues related to the problem. An approach to collect those problems would be to first ask users about benefits they expect from the product and then about benefits they actually get. The delta between these two is the basis for the identification of the problems.

4. *Ranking the problem.* A common method for sorting and ranking the problem is to build on the scope of the problem and the frequency of the problem's occurrence. Here primarily problems should be identified that are important to the users.

Even in this early stage of a new product development process, the given problem should be reviewed according to its market potential. Cooper (2001, pp. 180-184) suggests to do an early preliminary market, technical and financial assessment in order to make sure that the problem solution may be profitable.

Preliminary market assessment. A preliminary market assessment aims to evaluate the attractiveness of the market and the market potential, it researches possible product acceptance, and reflects the competitive situation. Even though this investigation is limited in time and money, it is essential to evaluate the market potential in this early phase. Cooper suggested following sources to gather market information: Internet searches, internal libraries and reports, telephone interviews with key customers, focus groups made up of a few customers, competitor's advertisements, interviewing employees, consulting firms, financial houses, government agencies, contacting industry experts, editors of trade magazines, and trade associations. (Cooper 2001, pp. 180-181)

Preliminary technical assessment. The preliminary technical assessment provides a technical feasibility study to identify potential technical risks. It further includes a brief literature and IP search, and a review of competitive literature. (Cooper 2001, pp. 182-183)

Preliminary business and financial assessment. Here, strategic and competitive findings are analyzed. The business and financial assessment further includes an assessment of internal core competences. (Cooper 2001, pp. 183-184) The analysis of internal core competences gives hints on what competences are missing and provides ideas for potential external knowledge owners for open innovation projects. Additionally, a brief financial investigation in part of this assessment (Cooper 2001, p. 183).

This early investigation into problem analysis is essential in order to support the decision weather the problem has potential to be followed or not. According to the stage-gate process, this is one first stop-go decision, followed by several others. These methods and additional others are demonstrated in Table 5.1.

Management Tools	Characteristics	Literature
Reverse brainstorming	method for problem definition and analysis based on an internal workshop	Cooper (2001), Crawford & Di Benedetto (2006)
Preliminary market assessment	method for problem analysis; evaluation of market attractiveness and market potential, and competitive situation	Cooper (2001)
Preliminary technical assessment	method for problem analysis; conducting a technical feasibility study to identify potential risks early in the process	Cooper (2001)
Preliminary business and financial assessment	method for problem analysis; analysis of strategic and competitive findings	Cooper (2001)
Problem explorer	method for problem definition; this method uses e.g. tools like 9 windows, problem hierarchy explorer to define the innovation problem	Mann (2007)
Function & attribute analysis (FAA)	method for problem definition; this method is supported by tools like the function analysis method, the relationship matrix, and cause-effect mappings	Mann (2007)
S-curve analysis	method for problem definition; method that is as well used in TRIZ; analysis of s-curve according to different dimensions (e.g. costs/time, value/time, benefits/time, harms/time)	Mann (2007)
Ideality/Ideal final results	method for problem definition; this method deals with important philosophical issues in terms of problem definition	Mann (2007)
Perception mapping	method for problem definition; this tools was designed to support the emotional complexities when dealing with business problems	Mann (2007)

Table 5.1: Overview about selected tools for the problem definition and analysis stage

Social and Cultural Aspects Related to the Definition and Analysis of the Innovation Problem

Besides tools and methods that support this stage, social and cultural aspects need to be considered here as well. These aspects mainly deal with *intra-organizational* issues.

Open innovation culture. One first aspect that should be covered before starting to implement the process is to reflect the corporate culture. *Is the organizational open for the idea of open innovation?* Only if this question can be answered positively, the framework can be brought to life, otherwise the firm has to change its organizational culture.

Problem solving. Another aspect that has to be considered in this context is that the organization's members have rethink from *defining solutions* to *solving problems*. (Mann 2007, p. 25) Here as well a change of the corporate culture should be attempted.

Potential conflicts that might occur later in the innovation process might be overcome, e.g. by considering change management aspects at this very early stage. Open innovation, when not established within the organizational culture, might raise potential conflicts within the organization. The major aim here is to establish an open, external-oriented culture. Figure 5.5 demonstrates aspects of organizational culture on the level of openness. In contrast to inward oriented organizations, outward oriented firms recognize changes within its environment early and tend to define basic problems according to the environment's needs. (Bleicher 1999, pp. 251-252)

In order to establish this open, innovation-friendly culture, the organization should consider some basic strategies. One general approach is Lewin's change management process that consists of three stages: *unfreezing*, *cognitive restructuring*, and *refreezing*. (Schein 1997) Further, Kotter's eight-stage-process is another relevant model for organizational change processes (Kotter 1996).

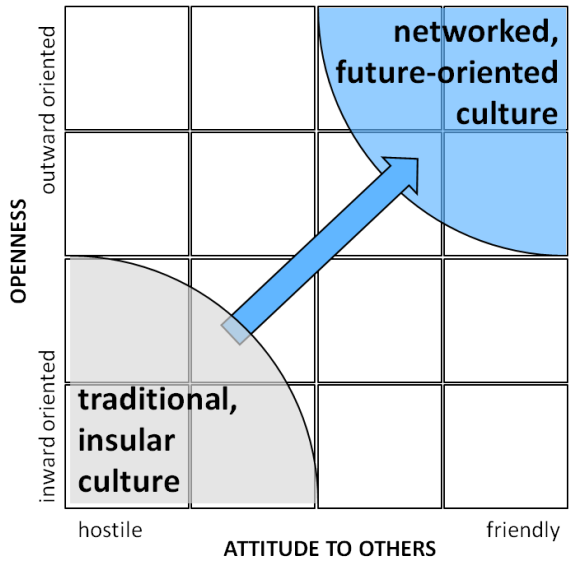

Figure 5.5: Openness of organizational culture referring to Bleicher (1999, p. 252)

Conclusions of Stage 1 - Definition and Analysis of the Innovation Problem

In conclusion of this first stage, the importance of the internal social and cultural aspects need to be emphasized. Only if the organization is open to this approach it makes sense to start implementing the framework.

Further, what is necessary at this stage is an adequate problem definition. Firms should focus on a very specific and detailed problem definition and analysis. This creates the basis for the following activities related to the innovation problem, e.g. for selecting the right co-operation partner. The problem definition gives already implications for the partner selection.

Finally it should be noted, that methods and tools suggested for this stage as well as social and cultural aspects that need to be considered here take place on an intra-organizational level. At this stage it is up to the firm to make the necessary preparations.

5.2.1.2 Identification of Knowledge Demand

According to March's knowledge management process, the next step, after having identified, formulated, and analyzed the innovation problem, is to provide transparency about the internal knowledge base. Therefore, the next stage of the framework, *"Identification of Knowledge Demand"*, includes the screening of the internal knowledge base in order to identify previous problem-relevant internal knowledge. Besides that and based on the existing internal knowledge, gaps are detected which gives hints for further activities related to the innovation problem.

Additionally, this step is related to Lichtenthaler & Lichtenthaler's knowledge capacities. (Lichtenthaler & Lichtenthaler 2009) Since the main activities in relation to this step are internally oriented, the most significant knowledge capacity is the *inventive capacity* which is screened in order to identify problem-specific and already existing internal knowledge. Besides that, thinkings in relation to external knowledge and *absorptive capacities* have to be considered in this step as well. Figure 5.6 shows the relation to Lichtenthaler & Lichtenthaler's framework.

	knowledge exploration
internal (intrafirm)	inventive capacity
external (interfirm)	absorptive capacity

Figure 5.6: Relevant knowledge capacities for the identification of knowledge demand (referring to Lichtenthaler & Lichtenthaler (2009))

Following questions need to be answered at this stage:

- *Is there already problem-related knowledge within the organization?*
- *Have there been previous, similar projects?*
- *Who is the main knowledge owner within the organization?*

- *Is it possible to access this knowledge? Is it still significant?*
- *If there is no adequate knowledge within the organization, what kind of knowledge is demanded?*

The second stage generally consists of four steps demonstrated in Figure 5.7. Besides the screening of internal the knowledge base, identifying previous problem-relevant knowledge and knowledge gaps are in the focus of the second step of the framework. The demanded knowledge is further classified into certain categories in order to enable the responsible people to think about the knowledge demand on a more aggregated level.

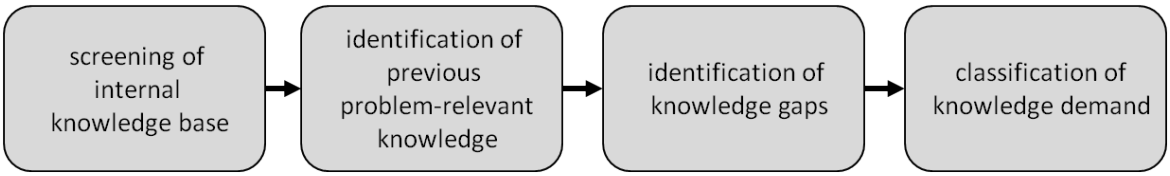

Figure 5.7: Identification of knowledge demand (own illustration)

The next paragraphs describe each of the four steps in detail.

Screening of internal knowledge base. Before analyzing external knowledge sources, the framework considers the analysis of internal knowledge bases. Previous existing knowledge related to the innovation problem should be identified. This step is necessary in order to find out if a similar topic has already been covered within the organization before. A solution for a similar problem might have been realized, in that case it should be known by the project team to incorporate previous findings. If a similar project failed, problems related to it should be made transparent in order not to make the same mistakes again. Therefore this identification of pre-existing internal knowledge related to the innovation problem is an essential step. To ensure a certain level of transparency the internal knowledge base has to be up-to-date and maintained on a regular basis. Section 5.2.2 provides various tools that support the identification of internal knowledge.

Identification of previous problem-relevant knowledge. This step goes hand-in-hand with the previous one. The screening of the internal knowledge base aims to identify previous domain-relevant knowledge that might be useful for the given innovation problem. The screening of the internal knowledge base gives hints about internal knowledge owners that might be contacted in order to get information about related knowledge within the organization.

This step aims to identify existing knowledge related to the innovation problem and to consider it for the further process. Maybe a co-operation with a certain knowledge owner failed due to any reasons - in that case it is better to know it at this phase of the process than later. These experiences are potential influencing factors for the selecting the right knowledge owners later.

Identification of knowledge gaps. Based on the existing problem-specific internal knowledge, knowledge gaps can be identified. Tools and methods, as presented in section 5.2.2, provide the basis for the identification of existing knowledge gaps. In case of open innovation, knowledge gaps have a wider definition - open innovation includes not only basic and technical-related but also market-related knowledge. Sometimes it might seem as if there is already sufficient knowledge available but it is not known that there might be additional knowledge that may only be accessed by involving outside parties into the process.

Classification of Knowledge Demand To make sure what kind of knowledge is needed, a classification of the knowledge demand is provided here in order to support the decision of selection the most suitable knowledge owner.

The knowledge demand can be classified according to Mention (pp. 44-46, 2011) into following categories or motivations for external knowledge sourcing:

- complementary knowledge
- mitigation of development risks
- subsequent cost reduction
- fundamental or applied research
- scientific knowledge
- training

- sharing of risks and costs
- usage of synergistic effects
- increasing the pool of resources
- achieving economies of scale

The classification of knowledge demand is basis for the next stage of the framework - the selection of the most suitable knowledge owner.

The framework's standard process flow considers external knowledge sourcing, since it is an open innovation framework. However, sometimes it makes no sense to follow a specific innovation problem any longer, the framework here leaves space to exit the open innovation process and to either only gather and build up internal knowledge, or to stop following the defined problem. Latter might be the case especially when the problem has been covered within the company (e.g. in another department) before.

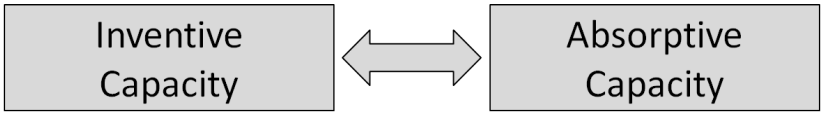

Figure 5.8: Inventive vs. absorptive capacity as basis for the decision of internal and external knowledge sourcing (own illustration)

Again, the focus here is on a firm's inventive and absorptive capacity (see section 4.2.1.1). Organizations need to answer questions like *"Is there a huge potential in building up the required knowledge internally or should it be explored externally?"* A decision about internal or external knowledge sourcing has to be made here. (see Figure 5.8)

Methods and Tools for the Identification of Knowledge Demand

This sections provides an overview about common tools and methods that are established to identify internal knowledge. At this stage, more or less classical knowledge management instruments are used on an intra-organizational basis. Here, only a selection of different methods and tools are given. Further instruments are discussed in knowledge management literature more detailed.

Yellow Pages, Knowledge Maps, Knowledge Matrix, etc. Here, as mentioned above, mainly *classical* knowledge management tools are used. One major aim of this tools is to make the internal knowledge transparent. According to Völker et al. two tools have been well-established in practice: *yellow pages* or *skill profiles*, and *knowledge maps*. Such tools are most often IT-based. One important preconditions to gain valuable outputs of such systems is to keep them up-to-date and maintain data on a regular basis. (Völker, Sauer & Simon 2007, pp. 93-94)

Social and Cultural Aspects Related to the Identification of Knowledge Demand

This stage has to deal with classical knowledge management barriers concerning knowledge transparency.

Potential of arising conflicts due to transparency of individual knowledge. This very classical barrier to knowledge management might occur in that context. Knowledge transparency enables all members of an organization access to information and knowledge owners that was not known before. Employees that already have a good information base might not welcome a knowledge friendly culture since they might fear of losing their power. This aspect need to be considered when introducing platforms that aim to establish a organization-wide knowledge transparency. (Probst et al. 2010, p. 72)

Change in organizational culture. Here as well, the organizational culture is one important precondition for a successful process. Only when the culture ensures a certain level of openness to knowledge transparency this stage will have its effects. Hence, corporate culture has to welcome transparency of individual and collective knowledge.

A knowledge friendly culture has to be established within the organization. Such a culture is characterized by a high level of trust and openness. Knowledge sharing throughout the organization should be supported and mistrust, as well as fear of losing power reduced. (Völker et al. 2007, p. 100) Bleicher as well states that openness of organizations is an

important factor in order to establish co-operations with externals (Bleicher 1999, pp. 251-255).

Conclusions of Stage 2 - Identification of Knowledge Demand

Even tough Wallin & von Krogh (2010, p. 149) suggested to first locate the best knowledge in relation to the innovation problem outside the company, the internal knowledge base should be considered in order to be aware about previous internal knowledge and activities as well as internal knowledge owners related to this topic. Therefore the framework foresees an internal screening of the knowledge bases. Following issues should be omitted by this approach:

- *Double-treatment of certain topics.*
- *Not considering previous knowledge and experiences.*
- *Not knowing about previous co-operations with the desired knowledge owner.*

Therefore, this framework considers as well the internal exploration of previous knowledge as e.g. March (1991) suggested.

⇒ ***Sticking Point:*** The major issue in this stage is not to get stuck to the existing internal knowledge and ideas that are connected to the innovation problem, that would contradict the central idea of open innovation. The screening of internal knowledge bases only has to ensure that pre-existing knowledge is collected and internal knowledge owners related to the innovation problem are consulted in order to get information about what activities have already been done.

5.2.1.3 Identification of Knowledge Owners

When having identified and classified the knowledge demand, the next stage of the framework includes the identification of the knowledge owners. This stage consists of following activities:

1. *Selection of most suitable category of knowledge owners.* Here, a first selection of the most suitable knowledge owner group is made. Mention's classification of the knowledge owners (see section 3.3.2) provides a good basis to restrict the knowledge owners to a certain knowledge owner group.
2. *Selection of most suitable knowledge owner.* When having identified the most suitable knowledge owner group, the knowledge owner within this group needs to be identified. The framework provides support about what characteristics the *right* external knowledge owner needs to have.

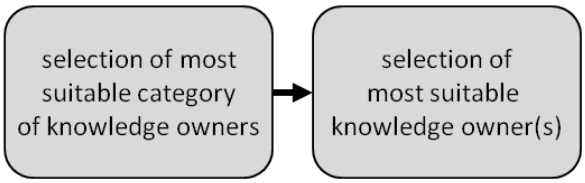

Figure 5.9: Identification of knowledge owners (own illustration)

Figure 5.9 provides an overview about the activities of this stage in order to identify the most relevant knowledge owner. Following paragraphs discuss and describe the different steps more detailed.

Selection of most suitable category of knowledge owners. When having identified the required knowledge and this knowledge has been categorized, the proper knowledge owner group needs to be identified. To support this decision, the mapping of the motivation for the knowledge demand and the knowledge owner groups provides a good structure.

Following paragraphs discuss each knowledge owner group and provides advantages and disadvantages of those co-operations.

Market-based co-operations (without competitors). Market-based co-operations are intended when either complementary knowledge is requested or the organization aims to limit the development risks. (Mention 2011)

Co-operations with competitors. Co-operations with competitors (or co-opetition) are very special co-operations with critical aspects to consider and should therefore be reviewed separately. The relationships to competitors in terms of open innovation activities are at the same level characterized by competition and co-operation. (Mention 2011, p. 46)

Science-based co-operations. Especially when the innovation problem requires fundamental research, science-based co-operations provide the best opportunity to gather the essential knowledge. Another reasons for science-based co-operations is the demand for specific trainings related to the given problem. (Mention 2011, p. 46)

Independent co-operations. The Knowledge-Based Innovation Management Framework is an open innovation framework that does not restrict the innovation activities to the given knowledge owner categories. In some cases it makes sense to consult completely independent parties that are not related to the business activities of the organizations. This creates new perspectives on the existing products. Independent co-operation partners are e.g. potential partners for new business fields in future, firms belonging to the same group (Mention 2011), or organizations that operate in another industry but deal with similar problems there (e.g. automotive and aviation industry).

Figure 5.10 concludes the previous findings and provides an overview about the reasons for the co-operations with the various knowledge owner groups. This schema might be used as an orientation for the selection of the popper knowledge owner group. The definite selection of the knowledge owner group should always be analyzed individually.

Selection of most suitable knowledge owner. It is essential to choose the most suitable knowledge owner of the selected category in order to ensure a successful co-operation and knowledge transfer throughout the whole innovation process.

There is only limited research on the topic of selecting the right knowledge owner for especially open innovation projects. Therefore, this section not only focuses on open

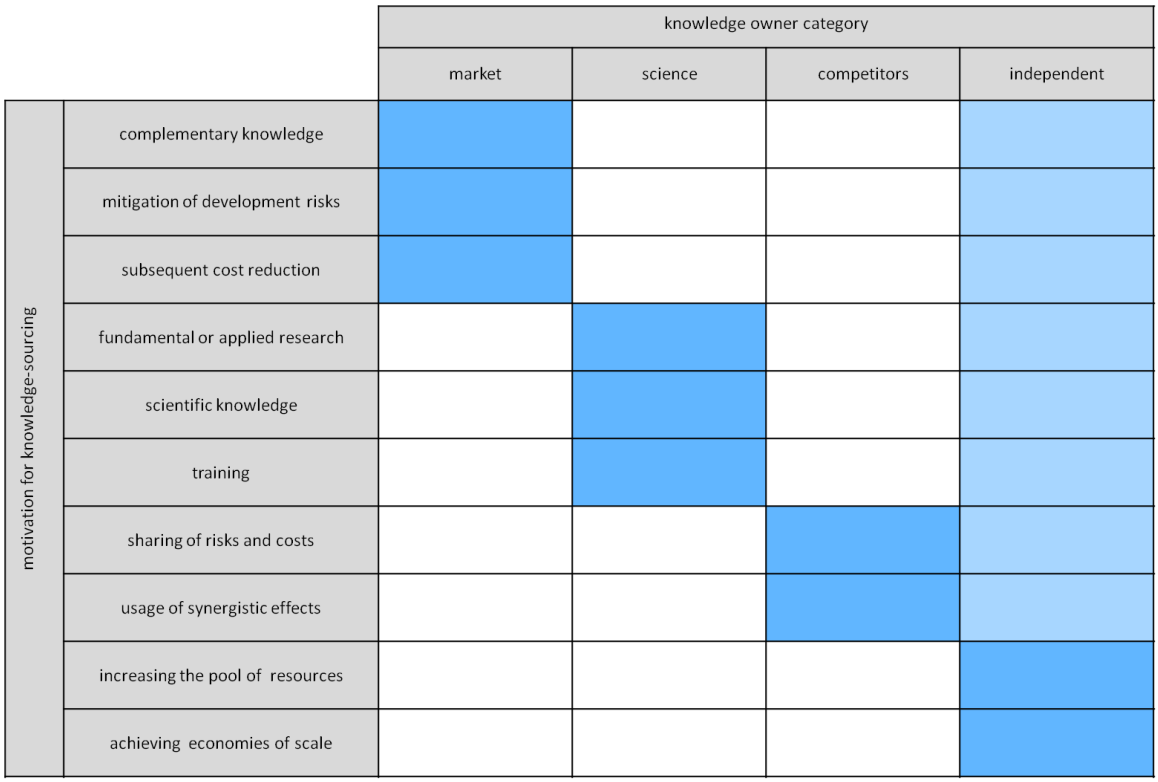

Figure 5.10: Criteria to knowledge owner mapping (own illustration, referring to Mention (2011))

innovation co-operations but also treats the topic of selecting the right partner for building alliances. This section initially illustrates general approaches in order to select the right partner for strategic alliances and then discusses approaches that exist for each knowledge owner group.

Feng, Fan & Ma (2010) recently developed a framework for partner selection of development alliances. They presented an evaluation hierarchy for the partner selection considering two types of attributes, individual and collaborative: (Feng, Fan & Ma 2010, pp. 160-161)

- **Individual attributes**
  - *Technology capability.* There is either an innovative technology or expertise related to the innovation problem.

  - *Financial health.* A good financial situation is another attribute the right partner should have.
  - *Knowledge and managerial experience.* At the individual level, a certain level of knowledge or managerial experience should be given.
  - *Capability to access new market.* Another individual attribute a partner should have is a good relation with local government, or understandings about competitors and customers.

- **Collaborative attributes**
  - *Resource complementarity.* Both partners have complementary technical resources that provide a good opportunity related to the innovation problem.
  - *Overlapping knowledge base.* A similar understanding and similar knowledge base is necessary in order to predict the potential business opportunities.
  - *Motivation correspondence.* Both partners are motivated to co-operate and both are interested in finding a solution for the given problem.
  - *Goal correspondence.* Both partners have a high goal correspondence and similar expectations.
  - *Compatible cultures.* The partners have similar values and expectations among different organizations.

These attributes should be considered for the right partner selection for development alliances. Those aspects are relevant in the case of selecting the right partner for open innovation activities as well.

Methods and Tools for the Identification of Knowledge Owner(s)

This stage is mainly supported by two specific tools that were introduced previously in this section.

Mapping of motivation of external knowledge sourcing to knowledge owner group. As already presented in Figure 5.10 the matrix provides a good basis for making decisions about the right knowledge owner group. Depending on the knowledge demand and the motivation for knowledge sourcing, the potential knowledge owners are limited to a certain category of knowledge owners that is relevant for that purpose.

List of individual and collaborative attributes. Another instrument that supports this stage is the list of individual and collaborative attributes the external knowledge owner and the organization should have. Considering these aspects a successful co-operation between the two parties is well-prepared at the beginning of the process.

Social and Cultural Aspects Related to the Identification of Knowledge Owner

Besides that, on the level of social and cultural aspects related to this stage, especially *inter-organizational* aspects need to be considered. One major issue at this sage is to analyze the relationship to the selected party. In that context, the regional distance to the selected knowledge owner might have a huge impact on the knowledge transfer between the two parties. Even though modern IT systems already provide good opportunities for communication, personal contact is still of high significance.

Further, unexpected barriers to knowledge transfer might occur at any point of the process, but when considering potential barriers to inter-organizational co-operation in this early stages, some of them might be prevented or reduced in advance.

In the same context, Szulanzki identified four fields of barriers that might occur on the organizational level: (Szulanski 1996, pp. 30-32)

- *Characteristics of the knowledge transferred.* Causal ambiguity or unproven knowledge are potential sources of barriers in that context.
- *Characteristics of the source of knowledge.* Here, either a lack of motivation or non-reliable knowledge might be a source of potential conflicts.

- *Characteristics of the recipient of knowledge.* Here again, lack of motivation is a potential source of conflicts. Furthermore, lack of absorptive and retentive capacity are mentioned as other barriers.
- *Characteristics of the context.* These barriers might occur if the organizational context is very fruitless and when the relationship between the two parties is troublesome.

Conclusions of Stage 3 - Identification of Knowledge Owner

As already mentioned before, only little research focused on the partner selection for open innovation activities. The framework provides a basis for the partner selection by first limiting the potential co-operation partners to a certain knowledge owner group and then providing collaborative and collaborative attributes that need to be considered for selecting the right partner within this group. Methods and tools mainly focus on inter-organizational aspects, as well as social and cultural aspects mostly deal with barriers that might come up on an inter-organizational level.

5.2.1.4 Identification and Management of Barriers to Knowledge Transfer

Next, potential barriers to knowledge transfer that might come up during the co-operation with the selected knowledge owner are to be identified. Therefore, the relationship to the knowledge owner should be analyzed and reviewed. Based on that, potential barriers are identified and implications for the overcoming of those barriers can be developed.

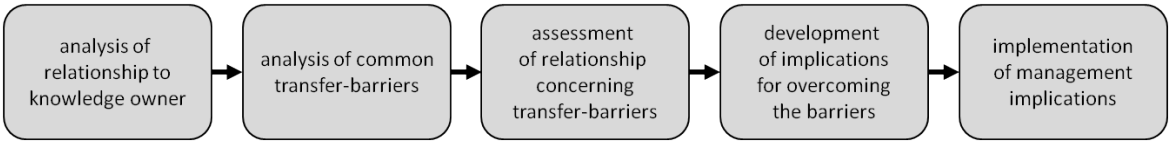

Figure 5.11: Selection of different ways of knowledge transfer (own illustration)

The general approach of this stage is demonstrated in Figure 5.11. This stage consists of four steps that need to be established:

- *Analysis of relationship to knowledge owner.* First, the relationship to the external knowledge owner needs to be analyzed. This step is supported by the visualization of the innovation environment.
- *Analysis of common transfer-barriers.* Based on a list of common transfer-barriers, the relationship to the knowledge owner is analyzed.
- *Assessment of relationship concerning transfer-barriers.* Potential barriers to knowledge transfer are identified based on the previous analysis.
- *Development of implications for overcoming the barriers.* Implications for the overcoming of the barriers to knowledge transfer are developed here.
- *Implementation of management implications.* Finally, the developed management implications need to be realized.

Analysis of relationship to knowledge owner. First, the relationship to the selected knowledge owner is to be analyzed. To do so, the visualization of the innovation environment (as demonstrated in section 5.1.3) provides a good framework. The selected knowledge owner is located within a firm's innovation environment. Based on where it is located, more or less effort is necessary to establish an inter-organizational culture that is open for the planned innovation activities.

One of the most important issues in inter-organizational co-operation is to establish a trust-based relationship. Only then, a successful knowledge transfer can happen. Besides trust, commitment is another issue inter-organizational co-operations should consider. (Nieminen 2005, p. 3)

> *"Trust can be characterized as the parties' ability to believe that the counterpart's behavior will remain consistent in the future, although they may have a possibility to behave opportunistically. In this way they can rely on each other's commitments and open communication."*
> and further
> *"Trust is essentially bound to the past of the relationship and the common experiences with the partner organization and ins individuals."*
> (Nieminen 2005, p. 3)

Simar and West (2006) outlined the importance of trust within an innovation network. They stated that trust is crucial in order to reduce risks associated with inter-organizational relationships. (Simard & West 2006, p. 229)

Further research showed that personal contacts are important means by which professionals share and acquire knowledge from outside sources. (Katz & Allen 1982, p. 7) Therefore, the relationship between the two has to provide a good basis on the personal level for the employees of both parties.

Figure 5.12 provides again an overview about the firm's innovation environment considering the strong and weak network as well as knowledge owners outside the firm's network. Following aspects for the different knowledge owners need to be considered, dependent on where it is located within an organization's innovation environment:

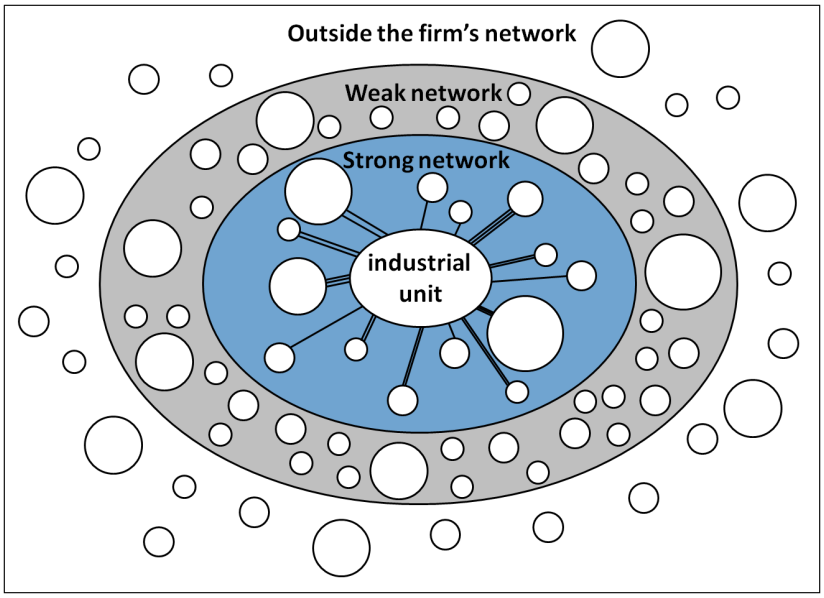

Figure 5.12: The Innovation Environment - an organization's strong and weak network (own illustration)

- **Strong network.** If the knowledge owner is already a strong network partner, it has to be prepared for the planned activities.
- **Weak network.** More effort is required if the selected knowledge owner is within its weak network. The aim here is to make this relationship to a strong network relationship - at least for the period of the planned innovation activities.
- **Outside the network.** The right knowledge owner might as well not exist within a firm's network. In that case, a trust-based relationship has to be established.

Thus, establishing a relationship to the external knowledge owner might cost a lot of effort. The front-end of innovation is the best phase for those efforts. Here the basis for the further process is to be set. At the front-end time is limited, but first relationship-building activities can be set up and considered during the whole process.

Analysis of common transfer-barriers. This second step deals with the analysis of barriers to knowledge transfer that often come up in practice. One big barrier is the *Not*

Invented Here (NIH) syndrome as Katz & Allen introduced in 1982. The NIH syndrome is defined as

> *"the tendency of a project group of stable composition to believe it possesses a monopoly of knowledge of its field, which leads it to reject new ideas from outsiders to the likely detriment of its performance."*
> (Katz & Allen 1982, p. 7)

Katz & Allen mainly discuss the negative impact of the NIH syndrome on a team's performance. The NIH syndrome increases over time and team members separate from external sources the longer a project takes. (Katz & Allen 1982, p. 7)

Besides the NIH syndrome, other barriers to inter-organizational knowledge transfer might come up. These barriers can be classified into *intra-* and *inter-organizational* aspects as following items show:

- *Loss of organization's competitive edge.*
- *Mutual understanding/trust between the two organizations.*
- *Conflicting cultures and values that exist.*
- *No common objective among organizations.*
- *Experiences of past behaviors that hamper learning transfer.*
- *Clash of personalities between the organizations (especially among top management).*
- *Top management directives stifle inter-organizational learning.*
- *Openness to ideas.*
- *Flexibility to change.*

These barriers may occur on an intra-organizational and inter-organizational level. The mentioned barriers and their sources are discussed in more detail within the following paragraphs.

Other authors, e.g. von Krogh et al. in the context of knowledge creation, distinguish between barriers that occur on an individual level and those that occur on the organizational level. Thus, individual barriers involve the ability to deal with new situations, events, information, and context. Barriers on the organizational level four barriers need to be considered: (von Krogh, Ichijo & Nonaka 2000, pp. 18-25)

- *Language.* The conversion of tacit into explicit knowledge is essential in order to provide others access to existing knowledge.
- *Organizational Stories.* Various organizational stories help members to understand the organization's value system.
- *Procedures.* Other barriers are procedures that represent experiences. Existing procedures may hinder the knowledge creation.
- *Company paradigms.* The most fundamental barriers are company paradigms which represent core values of the organization.

Those aspects might also be taking into account on an inter-organizational level. Furthermore, knowledge transfer barriers might occur on an individual level. This is an issue where the classical knowledge management has to deal with at the same level as external oriented knowledge management. Therefore, individual barriers are not discussed in more detail within this work.

Assessment of relationship concerning transfer-barriers. The previous step provided an overview about the most common transfer barriers as awareness-raising to organizations before establishing a co-operation. Following paragraphs, each discuss one inter-organizational barrier on knowledge transfer and gives hints on how to deal with them when identified as potential barriers related to the intended co-operation. Sun & Scott identified following inter-organizational barriers to knowledge transfer: (Sun & Scott 2005, pp. 79-85)

- *Loss of organization's competitive edge.* This barrier to inter-organizational knowledge transfer mainly deals with external knowledge sharing. Organizations are not willing to share their knowledge to outsiders. In case of this framework, this barrier has to be considered in order to understand the external knowledge owner. To omit this barrier, the organization has to deal with questions like *"What could be the motivation for our external knowledge owner to share its knowledge with us?"*, *"How can we fulfill its expectations?"*, and *"How can we motivate the external partner to share its knowledge with us?"*. According to Sun & Scott this barrier sources in *organizational imperative*, that are linked to the management level and often of political nature, *inter-organizational relationships*, which include barriers that are caused by the interaction behavior between the two organizations (e.g. mistrust), and *inter-organizational climate*, meaning the climate between the two parties is not long-term but evanescent.

- *Mutual understanding/trust between the two organizations.* A certain level of trust has to be ensured in order to enable a successful knowledge transformation between the two parties. It could happen that the other party uses internal knowledge to disadvantage the organization (Sun & Scott 2005, p. 85). If the previous step of intensifying the relationship was not successful, the knowledge transfer might have to deal with this barrier. If there is a potential of mutual understanding and mistrust, the organization should re-think if this would be the right knowledge owner. Sun & Scott mentioned that this barrier roots in *inter-organizational relationships* and *inter-organizational climate*.

- *Conflicting cultures and values that exist.* One of the most complex barriers to knowledge transfer is the cultural barrier. Even though both parties are open and willing to share knowledge, the knowledge transfer might be unsuccessful due to conflicting values and cultures. The *organizational climate*, which is either a visible or felt barrier as an artefact of culture and is a major source of barrier in terms of knowledge transfer, and *inter-organizational climate* are the main sources of this barrier to knowledge transfer.

- *No common objective among organizations.* Contradicting expectations and objectives might also be potential barriers to inter-organizational knowledge transfer.

Common goals and objectives between the organizations should be a basis for a successful co-operation. This barrier has its roots in *inter-organizational climate* and *inter-organizational systems and structures*, which are barriers that are caused by the setting of the formal systems and structure between the two organizations.

- *Experiences of past behaviors that hamper learning transfer.* Past experiences when giving information to the external party were negative. This barrier deals with the fear that this might happen again in future. Its sources are *inter-organizational relationships* and the *inter-organizational climate*.

- *Clash of personalities between the organizations (especially among top management).* This barrier hinders an organization's employees to share knowledge with externals, because the management of the other organization is not at all supportive. Here, this barrier might have two possible sources: either the *inter-organizational relationships*, or the *inter-organizational climate*.

- *Top management directives stifle inter-organizational learning.* Management directives hinder the inter-organizational knowledge transfer. Organization's cannot transfer their knowledge to the other since the receiving management established directives in that regard. This barrier has several sources: *organizational climate*, *organizational imperative*, *inter-organizational relationships*, and *inter-organizational climate*.

- *Openness to ideas.* Another, rather simple barrier to inter-organizational knowledge transfer is that one of the organization is not really open to gather new ideas. That culture is hard to change and therefore, the decision for this knowledge owner should be re-thought. Causes for this barrier might be the *organizational imperative* as well as *inter-organizational imperatives*.

- *Flexibility to change.* This last barrier, according to Sun & Scott roots in *organizational imperative*, *inter-organizational systems and structures*, and *inter-organizational imperative*. It links to internal bureaucracy that is hard to overcome as well as strong organizational structures that hinder flexibility. Those relationships should be analyzed again in order to reflect whether this might be the proper co-operation partner for the planned venture.

An overview about the discussed barriers to inter-organizational knowledge transfer and their sources is given in Figure 5.13.

		Sources of Barriers					
		Organizational imperative	Organizational climate	inter-organizational climate	Inter-organizational relationships	Inter-organizational imperative	Inter-organizational systems and structures
Barrier	Loss of organization's competitive edge	■		■	■		
	Mutual understanding/trust between the two organizations			■	■		
	Conflicting cultures and values that exist		■	■			
	No common objective among organizations			■			■
	Experiences of past behaviours that hamper learning transfer			■	■		
	Clash of personalities between the organizations (especially among top management)			■	■		
	Top management directives stifle inter-organizational learning	■	■	■	■		
	Openness to ideas	■				■	
	Flexibility to change	■				■	■

Figure 5.13: Sources for inter-organizational barriers (Sun & Scott 2005)

Development of implications for overcoming the barriers. Depending on the assessment of potential barriers to knowledge transfer, implications have to be developed that overcome those barriers. In order to do so, the various sources of barriers are provided in Figure 5.13 provides a good basis.

Implementation of management implications. Finally, the previous developed management implications need to be brought into life.

Methods and Tools for the Identification and Management of Barriers to Knowledge Transfer

This stage is supported by the catalog of common transfer-barriers and their sources as discussed before. This catalog might be used as a self-assessment instrument to analyze whether certain transfer barriers might occur and why. The major aim of this tool is to create awareness about the various barriers.

Social and Cultural Aspects Related to the Identification and Management of Transfer Barriers

Barriers to (inter-organizational) knowledge transfer most often have to deal with social and cultural aspects. They mostly occur on an individual level which implies that emotions are frequently part of it. At this level, organizations should be made aware about the possible occurance of those barriers and how to deal with them.

Conclusion of Stage 4 - Identification and Management of Barriers to Knowledge Transfer

The fourth stage of the KBIM Framework, aims to to analyze the relationship between the organization and the selected knowledge owner in order to being aware about potential barriers to knowledge transfer that might occur during the co-operation. Here, the essential actions should be taken that are necessary to provide a positive atmosphere between the two involved parties throughout the whole innovation process.

5.2.1.5 Selection of Method For Knowledge Transfer

The next stage of the *Knowledge-Based Innovation Management Framework* supports the decision of selecting the appropriate method for the knowledge transfer. Therefore, different approaches for the various knowledge owner groups are discussed here according to their specific application fields. At this stage two major steps are essential: the *identification and evaluation of possible knowledge transfer methods* and the *selection of an appropriate method* as demonstrated in Figure 5.14.

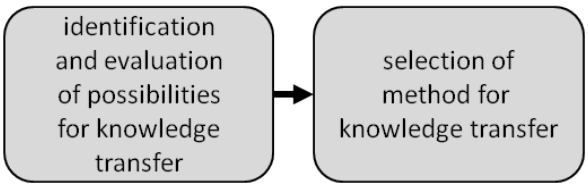

Figure 5.14: Selection of different ways of knowledge transfer (own illustration)

Figure 5.15 provides an overview about the various knowledge transfer methods for each knowledge owner group. Following paragraphs each discuss the potential knowledge transfer methods for the specific knowledge owner group.

Market-based co-operations (without competitors). Originally the first approach that later was combined with other approaches to *open innovation* was Eric von Hippel's lead user theory and his findings in how to co-operate with customers, users and suppliers. Customer and supplier co-operation has been done for several years now and many different approaches turned out to be valuable. Following concepts may be useful methods for the knowledge transfer for market-based co-operations:

- *Lead Users.* The lead user theory has been covered in section 3.1.1. Suitable users are co-operating with the organization as lead users, in order to bring in new knowledge. Firms co-operate with innovating users that are leading important market trends in order to develop solutions that fulfill unknown needs of other potential users. (von Hippel 2005a, p. 22)

- *Focus Groups.* Focus groups are commonly established to explore current requirements and needs directly from customers, as e.g. Henkel implemented it (Gassmann & Enkel 2006, p. 8). Often, the focus group method is outsourced to external agencies that have the knowledge and experience of how to conduct these tests. This brings the advantage of gathering objective results that are not influenced by internal thoughts. (Wallin & Von Krogh 2010, p. 150)
- *Co-Developing & Co-Innovating.* Especially in the service sector (e.g. IT-support service, business consultancy, technical engineering) customers and suppliers are working together to innovate new services. (Cowan, Soete & Tchervonnaya 2001, p. 7)
- *User Manufacturing.* A rather new approach is user manufacturing. By using a new infrastructure, users are becoming manufactures. The necessary infrastructure (e.g. an easy-to-operate design software, open repositories of design, easy-to-access manufacturing technology) has to be provided in order do ensure a successful user manufacturing. (Piller 2010, p. 45)
- *Providing equipment that embodies new knowledge.* This is especially the case with suppliers. A major knowledge transfer channel is that suppliers provide additional equipment that enables the organization to generate new knowledge. (Cowan et al. 2001, p. 11)

Linking to the innovation environment in conclusion of this knowledge owner group, it has to be added that some of the market-based co-operation partners are often already located within a firm's strong network. Following the open innovation thoughts it might as well be valuable to not only focus on those market-based co-operations that already exist but also on those that are not part of the firm's innovation environment. This enables new possibilities and opens new perspectives to the organization.

Co-operations with Competitors. Generally, and in the context of open innovation as well, competitors are very special co-operation partners. One major motivation for co-opetition is the sharing of risks and costs during the research and development phase (Mention 2011). Resulting from that form of co-operation the *sharing of IP rights* is

another way competitors might co-operate. *"Co-operation among competitors is analyzed and argued to be advantageous in that firms resources and capabilities can be combined and used in competition with others."* (Bengtsson & Kock 2000, p. 412) One precondition for co-operation with competitors is that both parties want to achieve the same goals. If the actors are involved into a win-win relationship they are more willing to contribute to the value created during this co-operation. (Bengtsson & Kock 2000, p. 416)

Often, co-opetition takes place not on an organizational level, but on the level of business units. Co-operations on the level of business units are more relevant to co-opetition. (Reiss 2012, p. 46) Bengtsson & Kock further found out that co-opetition mainly takes place on two dimensions. First, co-operation between competitors may be related to the structure of the value chain where it is based on functional aspects. Second, co-opetition can be related to different business units or product areas. Here, competitors co-operate in certain markets or product fields while they compete in others. (Bengtsson & Kock 2000, p. 416)

Summarizing co-operation methods with competitors it should be mentioned that such relationships are most often related to a high level of risk. Competitors are not willing to share their knowledge without profiting from the co-operation itself. The motivation of pooling risks and costs are main drivers for co-opetition and firms have to ensure that the benefits they get are higher than theirs losses and risks they calculate with.

Science-based co-operations. One quite well researched knowledge owner group in that context are science-based co-operations. Many firms force co-operations with universities and other research laboratories. Brennenradts et al. concluded several methods for the knowledge transfer within science-based co-operations: (Brennenraedts, Bekkers & Verspagen 2006, p. 4)

- *Publications.* One, and probably the most common method are publications. This might either be scientific publications firms publish, co-publications between firms and universities, or the consulting of scientific publications by firms.

- *Participation in conference professional network & boards.* Furthermore, another way of knowledge transfer between industry and academia is to send firm's members to conferences and participate there as part of the conference board.
- *Mobility of people.* The mobility from public knowledge institutes to industry and vice versa is another very successful way of university-industry knowledge transfer. Especially in relation to open innovation this approach might be very promising.
- *Other informal contacts/networks.* This factor should be considered in any case. Many inter-organizational relationships are based on informal contacts and networks. In the context of science-based co-operations this means maintaining friendships from university and visiting alumni societies or other boards.
- *Co-operation in R&D.* There are several ways of co-operating in R&D, e.g. joint R&D projects. the presentation of research, supervision of a trainee or Ph.D. students, as well as financing of Ph.D. research (programs) and the sponsoring of research.
- *Sharing of facilities.* What is already standard in the US and already practice in Europe is the sharing of laboratories, the common use of machines and locations or buildings between firms and research institutes. This as well provides a good platform for knowledge transfer.
- *Co-operation in education.* Knowledge exchange might also occur during education - students might bring in new ideas for innovative products. On the other hand, retraining of employees is another method firms might benefit from those co-operations. Furthermore, firms try to influence curriculum of university programs, they are providing scholarships to selected students and sponsor education.
- *Contract research and advisement.* Contract research and advisement is another method for knowledge transfer for science-based co-operations.
- *Intellectual property rights.* This knowledge transfer method includes applying for patents, information via patent, co-patenting, emitting licenses, acquiring licenses, sharing of copyrights and other forms of intellectual property.

- *Spin-offs and entrepreneurship.* Science-based co-operations might result in spin-offs or start-ups.

Co-operation with universities or other public or private research institutes are valuable sources for innovations. Therefore, they are considered here as well. Selecting the right method for the knowledge transfer is most often obvious. Here, an overview about the knowledge transfer methods for science-based co-operations should be provided in order to consider the various methods for the preparation phase of open innovation projects.

		Methods for Knowledge Transfer	
Knowledge Owner Group	market-based (without competitors)	• co-developing • co-innovating • lead user • user manufacturing • crowdsourcing	• focus groups • provide equipment that embodies new knowledge
	competitors	• co-developing • co-innovating • intellectual property rights	
	science-based	• publications • participation in conference professional network & boards • mobility of people • other informal contacts/networks • co-operation in R&D	• sharing of facilities • co-operation in education • contract research and advisement • intellectual property rights • spin-offs and entrepreneurship
	other	different methods of other knowledge owner groups	

Figure 5.15: Knowledge transfer methods for each knowledge owner group (own illustration)

Other co-operations. As this framework is an open innovation framework, it will not limit its co-operation possibilities to the given categories. Therefore *"other co-operations"* are part of the framework. Methods for these independent co-operations are more or less a mixture of the previous mentioned ones. Firms belonging to the same group,

consultants, and totally independent co-operation partners should as well be considered here.

Conclusion of Stage 5 - Selection of Method For Knowledge Transfer

One very critical issue in this fifth stage is to identify the most valuable method for the knowledge transfer. This section provided an overview about common knowledge transfer methods according to different knowledge owner groups. Figure 5.15 demonstrates the various methods in relation to each knowledge owner group.

This framework provides a guideline and presents several factors that have to be considered in order to make a decision, e.g. about the right co-operation method with the selected knowledge owner.

5.2.1.6 Integration of Knowledge in Innovation Process

Wallin & von Krogh (2010) referred to Grant's (1996b) four mechanisms to ensure the integration of knowledge. Grant generally discussed the integration of specialized knowledge, while Wallin & von Krogh later tried to break down his findings to the open innovation approach. The four mechanisms according to Grant are following: (Grant 1996, pp. 114-115)

1. *Rules & directives.* According to Grant, rules & directives provide a tool that supports the conversion of tacit knowledge into comprehensible explicit knowledge. In many cases it makes sense to define certain rules than to teach every employee everything that is necessary to understand the process.

2. *Sequencing.* Another effective mechanism, especially in order to minimize communication efforts and continuous coordination, is the sequencing of production activities that each input may occur independently within the specified time-slot.

3. *Routines.* The big advantage of routines is that they have the *"ability to support complex patterns of interactions between individuals in the absence of rules, directives, or even significant verbal communication."* (Grant, 1996b)

4. *Group problem solving and decision making.* Even though some tasks need a framework that requires rules and directives, sequencing, and routines - others require a more intensive form of communication that is more personal. Personal contacts e.g. in meetings are an important mechanisms for the integration of knowledge.

Wallin & von Krogh substantiated Grant's four mechanisms for the case of open innovation. *Rules & directives* are made up by managers, e.g. to define when to in- or out-license a product technology component or in which case an external consultant has to be contacted. The second mechanism, *sequencing of tasks*, means to define the specific steps of the open innovation process in advance. This relates to the innovation process, while rules & directives are addressed to specific events. Specifically, this means to define e.g. to do focus groups studies before introducing a new product to the market, or

to involve lead users into specific steps of the open innovation process. Third, *routines* should be implemented which means e.g. to typically involve research laboratories into the innovation activities and in the case of unexpected results to widen this collaboration end involve more scientist into this problem. Finally, *group problem solving and decision making* in the case of open innovation means to involve external parties not only into single work packages but also into defining the steps of the open innovation process. This interaction leads to 'more costly knowledge sharing'. (Wallin & Von Krogh 2010, pp. 149-150)

5.2.2 Methods and Tools

This section summarizes the previously discussed methods and tools related to each stage of the KBIM-Framework's process. An overview about the various methods and tools is provided in Table 5.2. Here, it is demonstrated that especially at the beginning of the process, the supporting methods and tools are related to an *intra-organizational* use while later stages mainly deal with *inter-organizational* issues.

5.2.2.1 Intra-Organizational Methods and Tools

Within the first process stage problem definition and problem analysis mainly deal with organizational issues. First, an adequate problem definition has to be prepared. As presented in the previous section, the methods and tools that might support this stage are *Reverse Brainstorming* or *Problem-Based Concept Generation*. Those methods support especially the phases of problem finding, problem definition and problem analysis. For a more detailed investigation into problem analysis, the *Knowledge-Based Innovation Management Framework* suggests *preliminary market* and *technical assessments* as well as *preliminary business* and *financial assessments*. These assessments were suggested by linking to Cooper's stage-gate process (Cooper, Edgett & Kleinschmidt 2001).

Even though external sources are to be considered within this stage (e.g. when defining the problem, or in problem analysis phase), the activities and therefore the related methods and tools are more internally oriented. These previously mentioned methods and tools are essential, to deepen this activities and establish a higher quality of the output of this stage, an overview about additional instruments is provided here.

Darrell Mann, e.g., discussed the problem definition phase very intense. Within his work on systematic innovation, he presented following tools that support the problem definition process:

- **Problem/Opportunity Explorer.** The Problem Explorer, as Mann defined it, consists of four components: benefits analysis, identification of resources, identification of constraints, and identification of 'Sore Points'. The benefits analysis deals with

Stage	Methods & Tools	intra-org.	inter-org.
Definition and analysis of innovation problem	Reverse brainstorming/Problem-based concept generation	x	
	Preliminary market assessment		x
	Preliminary technical assessment	x	x
	Preliminary business and financial assessment	x	x
Identification of knowledge demand	Yellow pages	x	
	Knowledge map	x	
	Expert registers	x	
	Knowledge matrix	x	
	Classification schema of knowledge demand	x	
Identification of knowledge owners	Mapping of motivation for external knowledge sourcing to knowledge owner group	x	
	List of individual and collaborative attributes	x	x
	Visualization of innovation environment	x	x
Identification of knowledge transfer barriers	List of common barriers on inter-organizational knowledge transfer		x
Selection of Method for Knowledge Transfer	Co-developing, Co-innovating		x
	Lead user		x
	Focus groups		x
	User manufacturing		x
	Crowdsourcing		x
	Providing equipment that embodies new knowledge		x
	Publications		x
	Participation in conference professional network & boards		x
	Mobility of people		x
	Other informal contacts/networks		x
	Co-operation in R&D		x
	Sharing of facilities		x
	Co-operation in education		x
	Contract research and advisement		x
	Intellectual property rights		x
	Spin-offs and entrepreneurship		x
Integration of knowledge in innovation process	Rules & directives	x	x
	Sequencing of tasks	x	x
	Routines	x	x
	Group problem solving and decision making	x	x

Table 5.2: Overview about Methods and Tools of the Knowledge-Based Innovation Management Framework

questions like *'Who is involved in the problem?'*. This method clarifies the requirements of the involved parties and tries to answer questions about the desired vision. The second part of the problem explorer (identification of resources) deals with the identification of resources in and around the system. (Mann 2007, pp. 81-94)

- **Function & Attribute Analysis (FAA).** Another essential element of Mann's problem definition step is the FAA, based on Miles' (1961) thoughts on Value Analysis and Value Engineering. Function and attribute analysis is a method that supports the analysis of the detailed workings of a system. (Mann 2007, pp. 95-116)
- **S-Curve Analysis.** A third tool for the problem definition that Mann introduced is the s-curve analysis. Here, the stages 'conception', 'birth', 'infancy/growth', 'maturity', and 'retirement' are considered. At any event the s-curve can be interpreted. It has to be analyzed if the system is at the beginning or at the mature end of the s-curve. This step supports the problem definition stage enormous. (Mann 2007, pp. 117-130)
- **Ideal Final Result.** Another tool introduced by Darrell Mann is the ideal final results methods. Here, starting point for innovations is not the current situation but the *ideal final result*. Depending on the definition of the aimed situation functions can be achieved without cost or harm and intermediate solutions in relation to that. (Mann 2007, pp. 131-148)

Another approach that is based on a problem orientation is the *Theory of Inventive Problem Solving - TRIZ* (abbreviation for the Russian phrase *"Teoria reschenija isobretatjelskich sadatsch"* which means *Theory of Inventive Problem Solving*. TIPS is the English abbreviation which is also commonly used). (Altshuller 1994) Here, problems are the source of inventive activities. All these above mentioned methods, tools and instruments presented within this work are listed here as as support for the specific process stage one of the *KBIM Framework*.

Even the second stage of the framework, as the first one, mainly deals with internal related issues. As already described in section 5.2.1.2, the framework suggests to use very classical knowledge management instruments here. These are discussed within the next paragraphs more detailed according to their application within the organization.

- **Yellow Pages, Expert Registers & Knowledge Matrix.** Yellow pages or expert registers are effective methods to create knowledge transparency throughout the organization. Besides that, knowledge matrices include the same information by a matrix visualization. Besides providing access to experts within specific fields, this method furthermore enables access to different disciplines that are especially in this early and creative phase of an innovation process extremely valuable. (Völker et al. 2007, p. 95) Yellow pages and expert registers create insights into a firm's knowledge capabilities since these tools represent a powerful information source. (Criscuolo, Salter & Sheehan 2007, p. 1616)

- **Knowledge Map.** The knowledge map is kind of a visual representation of expert registers and yellow pages. It enables the transparency of the knowledge and provides an easier access to a firm's knowledge resources. (Völker et al. 2007, p. 96) An example of a knowledge or skills map is provided in Figure 5.16.

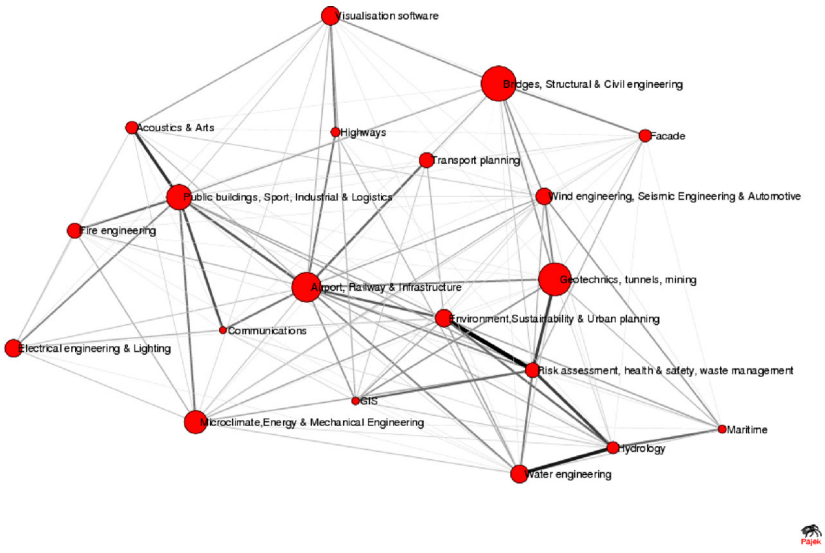

Figure 5.16: Example of a knowledge map (Criscuolo et al. 2007, p. 1611)

This previously mentioned tools mainly aim to identify the internal knowledge base and create transparency about it. To explore the internal knowledge base, most often IT-based solutions are implemented, since they provide a quick access to an organization's knowledge base. Modern IT and Internet technologies support each phase of the

innovation process to store, collect and share data internally and with external partners. (Völker et al. 2007, pp. 106-108)

The third stage of the *Knowledge-Based Innovation Management Framework* as well has to deal with *intra-organizational* aspects. Additionally, here inter-organizational aspects have to be considered. These aspects will be discussed more detailed in the next section.

While this section was mainly related to intra-organizational related methods and tools of the KBIM Framework the next section provides an overview about those tools that not only deal with aspects related to the firm's internal activities but additionally deal with issues in relation to the firm's innovation environment.

5.2.2.2 Inter-Organizational Methods and Tools

Well, in contrast to the first two stages of the framework, the third one is not only related to organizational issues but as well to the firm's environment. Here, besides internal issues, the environment of the organization is very significant for this stage. External knowledge owners are either already part of the firm's innovation environment or not. However, since they are not part of the firm, *inter-organizational* perspectives have to be considered in this phase as well. This stage is basically supported by some theoretical issues about the specific knowledge owner groups. The framework provides information about when which kind of co-operation makes sense and when which knowledge owner group should be contacted. The motivation for knowledge sourcing is mapped to the specific knowledge owner groups as provided in section 5.2.1.3.

Furthermore, the framework provides a list of individual and collaborative attributes that should be considered for the knowledge owner selection. All those attributes, or at least most of them should be given in order to ensure a successful co-operation.

Finally, this third process stage, identification of the knowledge owner, is further supported by a visualization of the innovation environment. The framework suggests to maintain the innovation environment on a regular basis - either paper-based or IT-based.

In the same way, the fourth stage of the *Knowledge-Based Innovation Management Framework*, identification and management of knowledge transfer barriers, deals with issues related to the whole innovation environment. Supportive tools of this stage are first the list of common transfer barriers that give a good overview about the most common barriers in that context. This aims to raise awareness about potential conflicts that might come up during the co-operation between the two parties. When selecting a knowledge transfer method, several basic conditions have to be considered, e.g. the specific knowledge owner group and the selected knowledge owner.

Again, the next stage of the *KBIM Framework* basically has to care about inter-organizational issues. The focus here is the selection of a method for the knowledge transfer between the organization and the external knowledge owner. This selection has to be made in dependency on the selected knowledge owner group and the specific knowledge owners. Section 5.2.1.5 provides a more detailed overview about the specific methods for the inter-organizational knowledge transfer. In this section they are discussed according to the knowledge owner groups and the motivation for knowledge sourcing.

Finally, for the integration of the gathered knowledge into the organization the framework suggests these four mechanisms according to Grant (1996) that Wallin & von Krogh (2010) further concretized for the open innovation approach. In that context, these mechanisms not only have to be established within the organization but as well at the external knowledge owner that is planned to be the co-operation partner during the further process. Of course, the focus of the activities is within the organization, but all those mechanisms have to be defined and implemented together with the selected external knowledge owner.

5.2.3 Social and Cultural Aspects

In addition to the methods and tools discussed before, the framework further considers social and cultural aspects. This section therefore summarizes the social and cultural aspects, starting with the very first phase of the framework. These aspects are concluded into those that are related to organizational issues that have to be covered within the industrial unit. Furthermore, aspects that are related to the co-operation between the organization and the selected knowledge owner are covered separately. So, social and cultural aspects of the *Knowledge-Based Innovation Management Framework* are either *intra-organizational* or *inter-organizational*. An overview about all social and cultural aspects that occur in the framework is given in Table 5.3.

Since especially intra-organizational aspects are related to the organizational culture, first a definition of the corporate culture is given here. Edgar Schein defined *culture* as

> *"A pattern of shared basic assumptions that the group leaned as it solved its problems of external adaption and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems."* (Schein 1997, p. 12)

Changing an already established and stabilized culture requires a lot of effort and time (Schein 1997, p. 12). Following section mainly discusses intra-organizational aspects especially related to the corporate culture and provides solutions on how to establish changes there.

5.2.3.1 Intra-Organizational Aspects

Especially at the beginning of the Knowledge-Based Innovation Management process intra-organizational aspects have to be considered. The first issue here is to establish an open-innovation friendly culture which might require a change in the corporate culture.

Before introducing the *KBIM Framework*, some necessary prerequisites in terms of social and cultural aspects need to be established. First, an *open innovation-friendly culture* has

Stage	Social & Cultural Aspects	intra-organizational	inter-organizational
Definition and analysis of innovation problem	Establishing an open innovation culture	x	
	Rethinking from defining solutions to problem solving	x	
Identification of knowledge demand	Potential arising conflicts due to transparency of individual & collective knowledge	x	
	Establishing a corporate culture that is open to knowledge transparency	x	
Identification of knowledge owners	Rejection of open innovation approach generally	x	
Identification of knowledge transfer barriers	NIH syndrome		x
	Loss of organization's competitive edge		x
	Mutual understanding/trust between the two organizations		x
	Conflicting cultures and values that exist		x
	Experiences of past behaviors that hamper learning transfer		x
	Clash of personalities between the organizations		x
	Top management directives stifle inter-organizational learning		x
	Openness to ideas		x
	Flexibility to change		x
Selection of Method for Knowledge Transfer	Regional distance hinders direct communication		x
	Occurrence of unexpected barriers to knowledge transfer		x
Integration of knowledge in innovation process	NIH syndrome	x	
	Rejection of external knowledge	x	
	Knowledge owner is not willing to share knowledge		x

Table 5.3: Overview about Social and Cultural Aspects of the Knowledge-Based Innovation Management Framework

to be ensured as the basis for the successful introduction of the framework. This might require an organizational change. Within his work, Schein (1997) discussed Lewin's (1947) three phases of organizational changes that need to be considered in order to change a firm's corporate culture. Those phases are *unfreezing*, *cognitive restructuring*, and *refreezing*. (Schein 1997, pp. 298-303) Another approach that is discussed below is Kotter's (1996) eight stage process.

In order to prepare the organization for the introduction of the *KBIM Framework*, the aim is to establish an open, external-oriented culture. This culture is characterized by a permanent performance situation to externals. In that context, Bleicher distinguishes between *inward* and *outward* oriented organizations on the axis of *openness*. Inward oriented firms focus mainly on internal processes and structures. Those firms recognize environmental changes late. Decisions about future developments are mostly reactive. Opposite, outward oriented organizations define basic problems according to customer's requirements and needs. Environmental changes are considered within the organization's development and part of strategic decisions. Further, on the axis of the *attitude to others* it is to be distinguished between *hostile* and *friendly* organizations. (Bleicher 1999, pp. 251-252)

Breaking down Bleicher's findings to this research work, one aim is to establish a networked, future-oriented culture that is open to co-operations with externals. Such a culture provides the best basis for establishing this framework within an organization. This development is as well demonstrated in Figure 5.5.

Secondly, another change related to the corporate culture of an organization has to be established. Innovation management activities should start with problems instead of ideas. This requires a re-thinking from *defining solutions* to *solving problems*.

Both previously mentioned aspects require a change of the corporate culture. This as well might be established according to change management approaches. In addition to the previously mentioned approach introduced by Lewin, Kotter's (1996) eight stage process should be named here as well. Even though not all organizations require a huge change, several of Kotter's steps should be considered here in order to anchor this new

way of thinking in the organization. An overview about the eight stages according to Kotter is provided in Figure 5.17.

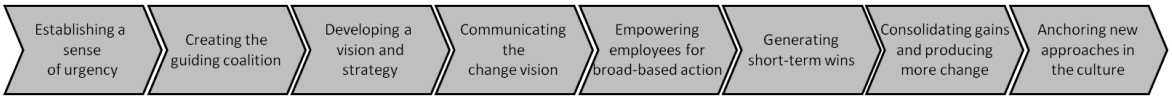

Figure 5.17: Kotter's Eight Stage Process (Kotter 1996, p. 21)

Social and cultural aspects related to the first step of the *Knowledge-Based Innovation Management Framework* are not crucial to the overall success of the framework. In this stage we do not have to deal a lot with emotions and potential conflicts. What is necessary in relation to the stage of formulating and analyzing the innovation problem is to ensure a corporate culture that enables people to think in a different way. Now, the employees should be aware of the specific problem definition before finding ideas and solutions without having defined the specific problem.

The essential question in stage two is if employees are willing to share their knowledge internally or not. As mentioned in previous section when discussing the methods and tools that support the framework, classical knowledge management instruments should be used in order to create transparency about the internal knowledge base. This only works if internals are willing to share their knowledge throughout the organization. Lee & Ahn (2006) listed several barriers that might come up internally in that context. One first barrier is that employees usually see their unique knowledge as powerful basis to secure their position (Zack 1999b, Ba, Stallaert & Whinston 2001). Further, sharing knowledge does not only cost time but as well energy and both are limited resources to a firm's employee. (Szulanski 1996) To overcome this barriers, Lee & Ann (2006, p. 939) suggest to reward intra-organizational knowledge sharing, e.g. as management consulting firms already do that by considering knowledge performance in reviews and by determining bonuses and promotions. Factors that enable employees to share their knowledge internally are e.g. a trust-based organizational culture that is further characterized by high-care relationships among the employees (Nonaka & Takeuchi 1995). This aspects again have deal with changes of the corporate culture, if the organizational culture does not support this aspects so far.

5.2.3.2 Inter-Organizational Aspects

Inter-organizational aspect deal with social and cultural issues that may be caused by the collaboration with an external party. These aspects only occur in an inter-organizational context. As Table 5.3 already showed before, especially the last stages of the framework have to deal with issues that either are related to the relationship to the selected knowledge owner or the firm's innovation environment generally.

Many of these aspects have already been covered in section 5.2.1.4. Several barriers to *inter-organizational* knowledge transfer have been discussed there. This section therefore provides an overview about the barriers mentioned before and further provides an overview about additional barriers that might as well occur on the *organizational* level. In that context, Szulanski identified following barriers: (Szulanski 1996, pp. 30-32)

- **Characteristics of the knowledge transferred.**
  - *Causal ambiguity.*
  - *Unprovenness.*
- **Characteristics of the source of knowledge.**
  - *Lack of motivation.*
  - *Not perceived as reliable.*
- **Characteristics of the recipient of knowledge.**
  - *Lack of motivation.*
  - *Lack of absorptive capacity.*
  - *Lack of retentive capacity.*
- **Characteristics of the context.**
  - *Barren organizational context.*
  - *Arduous relationship.*

Relationship to the external party. We distinguish between aspects that are related to the knowledge owner groups and those that are especially related to the relationship to the selected knowledge owner.

- *Aspects related to the knowledge owner group.*
- *Aspects related to the specific knowledge owner.* This aspects mainly deal with the relationship between the two parties.

Within stage five, *selection of methods for knowledge transfer*, further aspects should be considered. What might be relevant here is, that if a knowledge owner was selected that is located regionally close to the organization, this might be fruitful for the knowledge transfer, while in contrast, with knowledge owners that are located far away, knowledge transfer might be problematic due to not having personal contact. What's next is that unexpected barriers to knowledge transfer might occur that have not been considered before.

Finally, when defining integration mechanisms for the gathered knowledge, especially the NIH syndrome needs to be considered. Internals might reject the external knowledge. Further, externals might not be willing to share their knowledge with the organization, even though the necessary individual and collaborative attributes are given as discussed in section 5.2.1.3. These aspects again might result from a lacking organizational culture as already discussed before. Therefore, it is essential to establish an open and co-operation-friendly culture before implementing further steps.

Conclusion

While especially the first stages of the KBIM process aims to establish a sense of urgency of the necessary preparations that have to be done at an *intra-organizational* level, later phases already deal with *inter-organizational* issues, e.g. the co-operation with external parties and barriers that might be caused due to the co-operation. So the main focus at the beginning of the process is the organization itself. In later stages even the potential co-operation partner is analyzed in order to create ideal framework conditions for the specific open innovation activities.

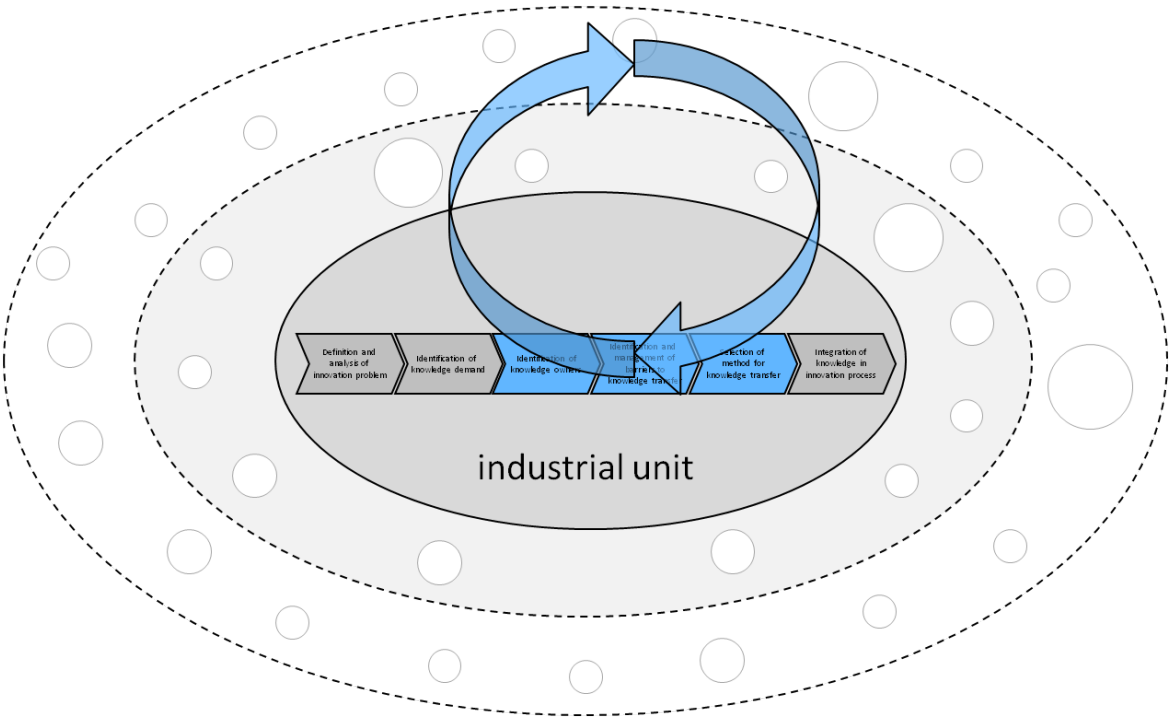

Figure 5.18: Intra- and inter-organizational aspects of the KBIM Framework in relation to the process (own illustration)

6 Case Study

This case study aims to evaluate the practical relevance of the developed framework as presented in chapter 5. This case study has been conducted together with an IT service firm located in Graz, Austria.

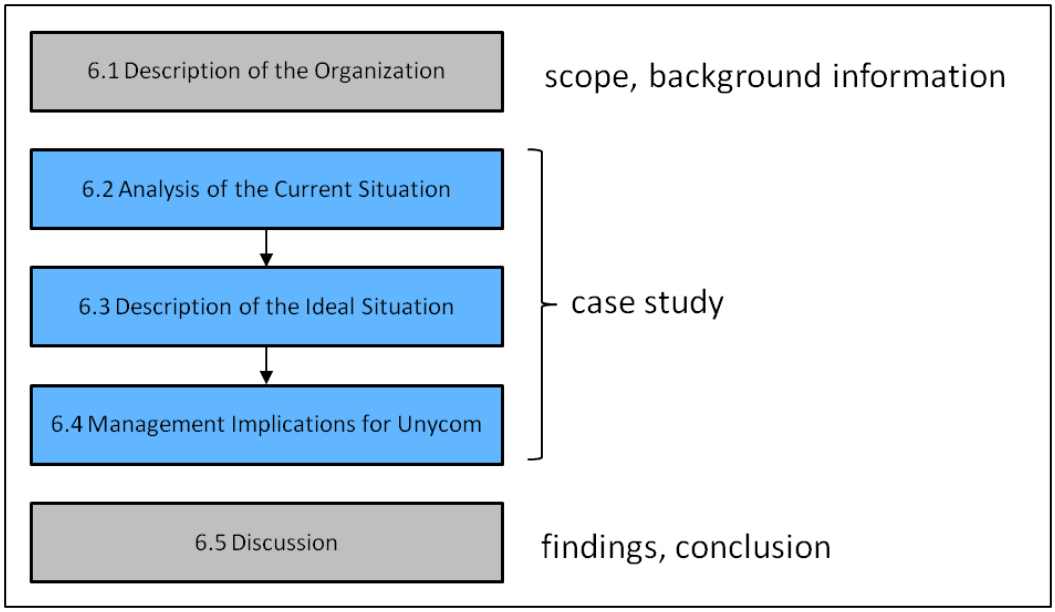

Figure 6.1: Structure of this chapter (own illustration)

The case study is structured into five parts (see Figure 6.1). The first part provides an overview about the company and its competences. Secondly, the current situation related to the scope of this research work is analyzed. Here, the firm's front-end of innovation is presented and discussed with special focus on their current co-operations in innovation management. Further, based on the analysis of the initial situation, an ideal situation considering the findings of this research work is to be developed. This

ideal situation not only contains the process-oriented structure but also further methods and tools that may support this process and further social and cultural aspects the organization has to consider when introducing the framework. The case study concludes by giving management implications that should be considered in order to overcome the gap between current situation and defined ideal situation. Finally, the given results are discussed.

In addition to the case study, this chapter concludes by discussing strengths and weaknesses of the *Knowledge-Based Innovation Management Framework* based on the experiences of the case study. Figure 6.1 demonstrates an overview about the structure of this chapter.

6.1 Description of the Organization Unycom

Research object of this case study is an organization called *Unycom GmbH* located in Graz, Austria. The firm was founded in 2000 and by now it has around 75 employees. Unycom expects to grow rapidly in near future and to double its size within the next two years. The organization is specialized in the field of intellectual property (IP) management and offers enterprise software solutions in that area.

The analysis of the current situation is based on several interviews that have been conducted together with some members of Unycom (Hans-Jürgen Wels, COO, 2012-04-26; Joachim Kräuter, Head of Product Management and Design, 2012-04-27; Wolfgang Themessl & Birgit Wiegisser, Key Account Management, 2012-05-04; Heinrich Schlünken, CEO, 2012-05-14).

6.1.1 Organizational Structure

The structure of Unycom is demonstrated in Figure 6.2. There are three big departments at Unycom which are *Professional Services*, *Product Management and Design*, and *Software Development*. The *Professional Services* department is the main interface

to the customers. Then, the department of *Product Management and Design* collects all the problems and ideas gathered internally and externally and defines the features for the next release of the product. Further, the *Software Development* department is responsible for the implementation of the defined functionalities.

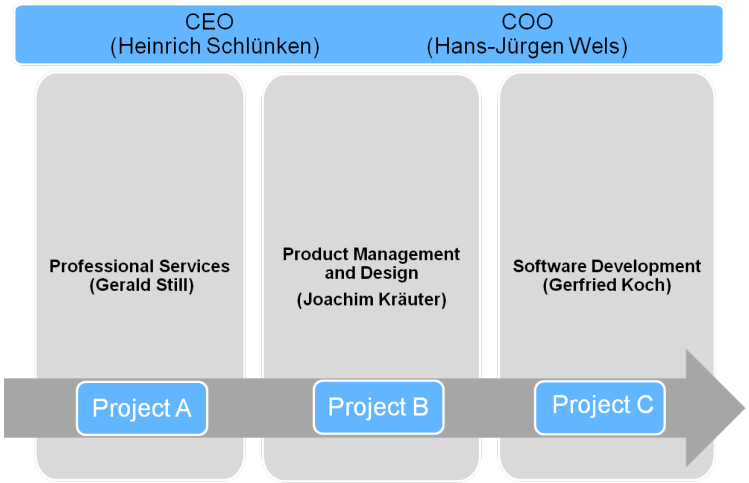

Figure 6.2: The organizational structure of Unycom (Source: Unycom)

Besides these three departments there are several supporting departments like *Human Resources*, *Administration*, *Infrastructure*, etc. that are not directly involved into Unycom's core business.

6.1.2 Characteristics of the Software Industry

The software industry is characterized by being very knowledge-intensive. The main competitive advantage of a software firm is its knowledge base. Software products are specific in two ways; first, in contrast to classical industrial products, they are kind of intangible good, and further, software products are often sold in combination with service contracts. Especially in the business-to-business area, service contracts are an essential part of the product.

The research object of this case study is a software company and as already mentioned before, it sells not only the product itself but a service contract that ensures a certain sup-

port level as well. Unycom acts in the business-to-business area and its core customers are interested in gaining value out of their intellectual property.

In the case of Unycom, two main products are sold: IPAS and IPMS. Both products are standard products which means that the source code for any customer is the same but the different functionalities and modules can be individualized according to the specific needs of each customer by several parameters.

6.2 Analysis of the Current Situation

Figure 6.3 demonstrates an overview about the 2007 developed innovation management process. (Manninger 2007) This case study mainly focuses on the *input management* stage and considers all activities until the development-decision is made.

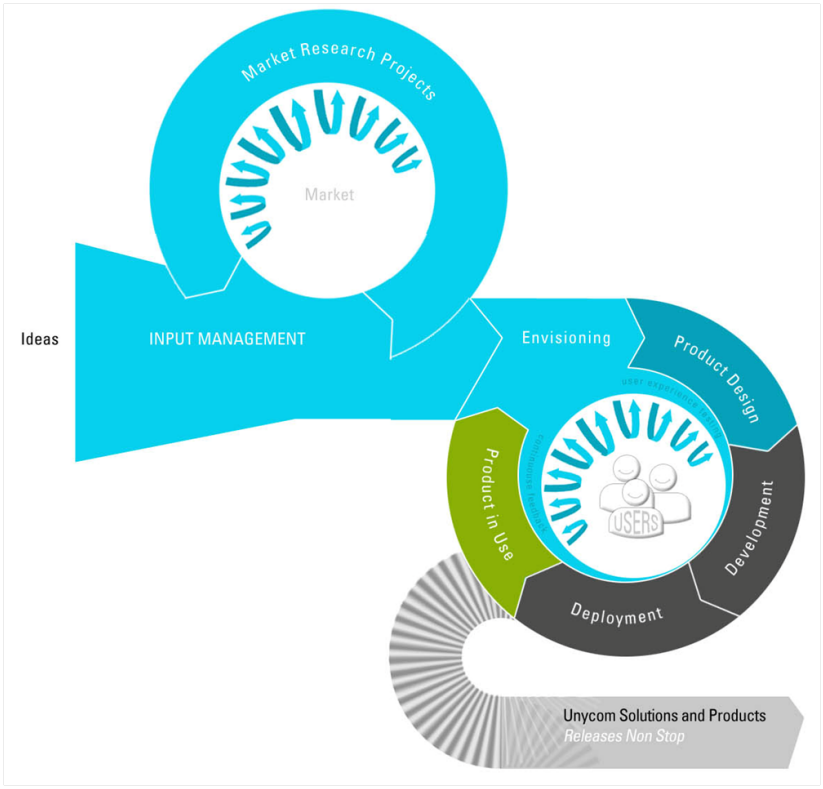

Figure 6.3: The innovation management process at Unycom

The following subsections describe the current situation at Unycom by first presenting the organization's network and then discussing the process perspective of the front-end of innovation there. Further, already existing methods and tools are presented and social and cultural aspects that are considered at the moment are discussed in this section.

6.2.1 Current Co-Operations at Unycom

Unycom is already co-operating with externals, in the field of innovation as well as in several other business areas. This section provides an overview about the co-operations that have been established so far.

Customers. One core group of externals Unycom is co-operating with are the existing customers. Unycom distinguishes between three customer perspectives:

- *Unycom as supplier.* Customers, that see Unycom as supplier are essential to the organization but no customers that want to share and bring in their knowledge to develop new solutions together with Unycom.
- *Unycom as partner.* Further, there are customers that see Unycom as their partner. These customers are open to define new functionalities together with Unycom.
- *Unycom as advisor.* Finally, there are customers who see Unycom as advisor. Those customers are similar to von Hippel's *lead users*. They contact Unycom to solve their business problems together.

Other partners. Furthermore, Unycom is co-operating with externals in other fields:

- *Business Consultants.* Unycom has a close co-operation with business consultants, especially in the field of strategic business consulting and in human resources strategy and recruiting issues.
- *Complementary Knowledge.* Another co-operation that takes place is conducted together with a payment service in the field of IP. This co-operation is especially fruitful since both partners bring in complementary knowledge.
- *Technical Infrastructure.* One of Unycom's long-term partners is a supplier of the technical infrastructure.

Currently there are no *strong* partnerships with universities or other science-based organizations.

The next section gives insights into Unycom's front-end of innovation. This includes a description of the current process and the way how Unycom is now selecting its external co-operation partners and how these co-operations are conducted.

6.2.2 The Front-End of Innovation at Unycom - Process Perspective

Innovations at Unycom may have several sources, depending on what kind of innovation it is related to. By now, there has not been established an *open innovation process*. Several innovation co-operations are already conducted at Unycom, as already mentioned above, but the process of selecting the external party and the co-operation method itself has not been defined before, co-operations take place on a very individual and intuitive way at the moment. However, before discussing the co-operations in terms of innovation in more detail, the different types of innovations and new product development at Unycom should be discussed. In general, there are three different types in that context:

- *Improvements and change requests.* These issues represent Unycom's daily business and are mainly driven by the customers themselves.
- *New functionalities and modules.* This type is another part of Unycom's daily business. In contrast to improvements and change requests, new functionalities and modules are initiated by more than one customer and/or prospective customers. They are more complex than improvements and change requests and require a detailed problem analysis and design phase. Apart from that, new functionalities may have two main areas, visible functionalities and hidden functionalities that are related to background activities of the product (e.g. performance, database functionalities).
- *Business development.* The third field of innovation is new business development which was been established only a few months ago and by now there have been

only few activities related to this field. Therefore, no structured process for that area has been developed by Unycom so far.

Figure 6.4 shows how the previously mentioned aspects are related to the product-market portfolio. (Ansoff 1965, p. 109)

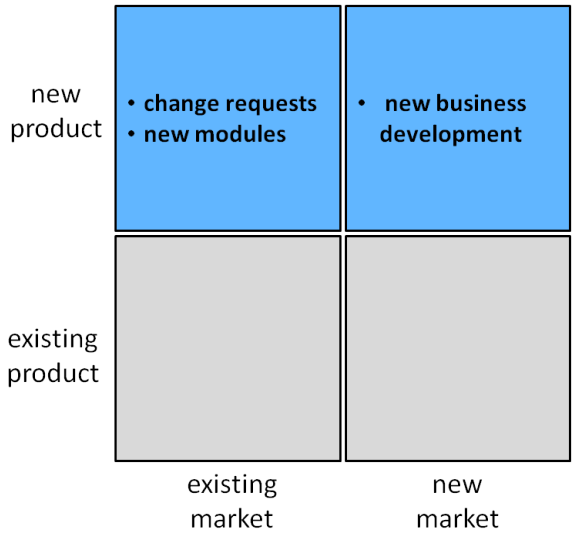

Figure 6.4: Categories of innovations at Unycom (own illustration according to Ansoff)

The figure shows that *change requests*, *improvements*, and the *development of additional new functionality* are innovations, or new products, that are introduced at the existing market while *new business developments* are intended to be introduced at new markets.

Sources of Innovation. At Unycom there are several sources of innovation, depending on the above mentioned types. Main drivers for improvements and change requests are the customers. Most of the problems related to this field occur during direct contact with the customers. Either the customers report their problem to their consultants at Unycom directly, or the consultants collect several problems reported by different customers. On the other hand, new business developments may be initiated by several sources. Sometimes they occur during strategy meetings, in other cases, externals try to find a partner for a specific problem (an open innovation process initiated by external partners).

Furthermore, other externals like consultants bring in their ideas to the organization. An overview about the different sources in relation to the specific field of innovation is demonstrated in Figure 6.5.

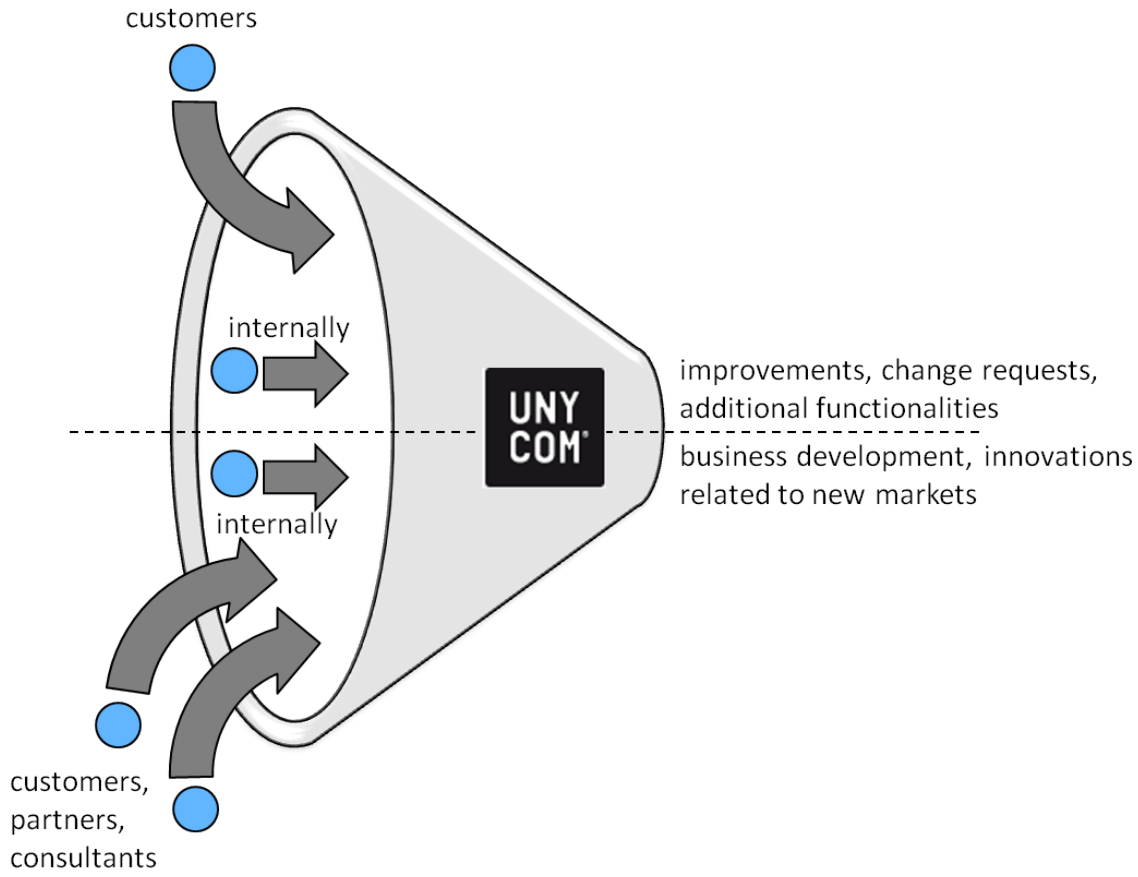

Figure 6.5: Unycom's sources of innovation (own illustration)

6.2.2.1 Improvements and Change Requests

Improvements and change requests may have two sources: either customers report problems to their internal contact person, or internal employees report problems to the internal problem tracking system. These smaller product developments are not considered within this case study in more detail, since they cannot be treated like classical *innovations*. They are Unycom's daily business and the solutions are always either requested by the customers themselves or by internals.

6.2.2.2 New Functionalities and Modules

Major sources for these innovations are again the customers and internal staff, which is in frequent contact with the customers and therefore knows about the customers' concerns and requirements. However, ideas and problems are generally reported during individual *customer meetings*, which are scheduled annually with each customer. Here, the main needs for action regarding the individual customer can be identified. Problems that have been reported by several customers have a higher priority. Furthermore, these innovations can be initiated by internals as well. Innovations in that context, as well as the previously mentioned improvements and smaller change requests, are always related to the existing products, *IPAS* and *IPMS*. This means it is necessary to develop additional functionalities or modules to the already existing features.

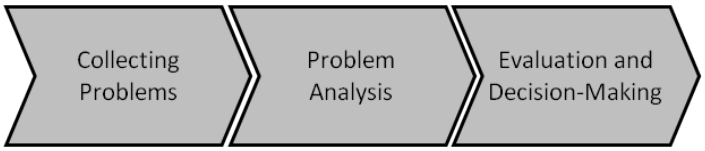

Figure 6.6: Unycom's front-end of innovation (own illustration)

Figure 6.6 provides an overview about Unycom's front-end of innovation. It consists of three stages. First, problems that occur either internally or externally are collected. Then, the reported problems are analyzed by conducting a preliminary assessment and finally, a decision about the implementation is made. Each of the next paragraphs describes one of the three stages in more detail.

Collecting Problems

External sources are either customers or prospective customers. In both cases, the problem is again reported to the internal project tracking system *Jira*. All problems reported are collected at the department of *Product Management and Design*. The following sources for innovations in that category have been identified:

- *Annually customer meetings.* As already mentioned above, the annually customer meetings are one major platform for reporting problems and ideas in that field.

- *Regular customer visits.* Unycom's consultants visit their clients on a regular basis. During these visits often problems come up. The consultant reports these problems internally by documenting it within the internal project tracking platform *Jira*.
- *Customer requests.* Another way, how problems and ideas are reported is that customers call or e-mail their problems to their consultants.
- *Internal sources.* New functionalities or modules may be initiated by internal sources as well. Every employee may post his or her ideas to the internal platform. In most cases, the consultants, which are in frequent contact with the customers, report problems and ideas.

All the reported problems are collected within the internal project tracking system *Jira*. Here, all the previously reported problems can be tracked. The big advantage of this system is that several categories can be defined and the product managers can make decisions about future topics based on the entries in the systems when defining the product road map.

Problem Analysis

To analyze the specific problem situation in more detail, preliminary assessments are conducted together with the customers. The preliminary assessment consists of following components:

- *Customer interviews.* Customer interviews are in any case initiated by the department of product management and design and either conducted directly by members of this department or by internal consultants. Customer interviews are conducted together with one or more customers that are selected by different factors. Especially customers that reported the problem, or customers that are identified as lead users by the organization are of great interest.
- *Analyze current functionalities.* Further, the already existing functionality is analyzed in order to make concepts for future functions based on the existing ones.

- *Understand customers' problems.* To understand the customers' problems, focus groups are established by the department of product management or by external consultants.
- *Determine new functions.* It is to be analyzed, which functions are demanded and how those can be integrated into the existing product.

The above mentioned customer interviews are often conducted with several customers to get different perspectives. Sometimes, Unycom is co-operating with an external consulting firm that is involved into Unycom's business activities. The customers with whom this pre-assessment is carried out are selected by several factors. Either they have already reported a demand in that area before and signalized that they are willing to spend money and time on the development of this new functionality, or so called lead users are contacted to co-operate in that belonging.

Evaluation and Decision-Making

Previous findings are then evaluated based on an evaluation sheet that considers different criteria in the field of *market*, *effort*, and *importance*. All the functionalities defined before are evaluated according to the evaluation matrix by the management board. The management board defines the so called *product roadmap* once a year. Here, the main topics for the next period are defined. The evaluation of the different problems is done by the department of product management and design.

6.2.2.3 Business Development

This field is quite new and has been established as a new business area a few months ago. Therefore, innovations in that context are rare at Unycom and no structured innovation process has been introduced so far. These innovations are, as already demonstrated before in Figure 6.4, related to opening up new markets. What's more, business development innovations are always connected to Unycom's core competences.

In contrast to the previously discussed types of innovation at Unycom, related to the already existing market and products, here no *problem collection* phase takes place at the moment. Problems and innovation triggers either occur internally or externally. They are not collected within the internal project tracking system. Major sources for business development innovations are especially strategy meetings of the management board, the marketing department and the consultants that are in frequent contact with the customers. External sources are prospective and existing customers.

Figure 6.7: Unycom's business development innovation process (own illustration)

The innovation process for business developments is demonstrated in Figure 6.7. The front-end of innovation is basically part of the first phase, the *design* stage. Here, the decision about the realization is made by considering several gates, similar to the stage-gate process. However, as already mentioned above, the procedure in this stage is not well-defined. One aspect that is always part of the business development process is to involve externals as co-developers into the innovation activities. Unycom uses the lead user approach in that context.

The next paragraph describes the way how Unycom selects its lead users for business development innovations. Furthermore, criteria for decision-making is discussed here as well.

Criteria for selecting the lead users. Lead users are identified according to following criteria:

- *Fit to market segmentation.* As one of the first steps Unycom always carries out a market segmentation. Those firms that fit into the defined market segment are considered as potential lead users.

- *Part of Unycom's (weak) network.* In most cases, external organizations are considered as potential co-operation partners if they are already known by Unycom. This means that they are either part of Unycom's strong or weak network or that there has already been contact to the external before.
- *Willingness of the external to co-operate.* The external partner has to be co-operative and motivated to take the risk and spend time on co-developing new solutions.
- *Common cultural basis.* On the cultural level there has to be a common basis in order to ensure a successful co-operation. This aspect is very notable to Unycom.

These criteria are not clearly defined as part of Unycom's business development innovation process but the organization is always considering these criteria when selecting a lead user for their business development innovations as lived practice.

Criteria for decision-making. The business development innovation process is a kind of stage-gate process and during the *design phase* a decision about the realization has to be made. One approach Unycom follows here is based on IDEO's ideas on human centered design as demonstrated in Figure 6.8 (IDEO 2012, pp. 5-7).

In Unycom's interpretation of IDEO's model, desirability is the most significant issue at the beginning of the innovation process. At this very early stage the main focus should be on gaining desirability of the new product or service without taking care about viability and feasibility. Only if the desirability is given, the economic and technical aspects are taken into account.

In the case of business development, there is no structured process by now, since this area has been established a few month ago. Only few innovations have been developed since then. This section therefore includes a description of the activities that have already been conducted in that context and tries to identify a *common process* for all those innovations. The final decision about the realization of the problem is made by Unycom's management board.

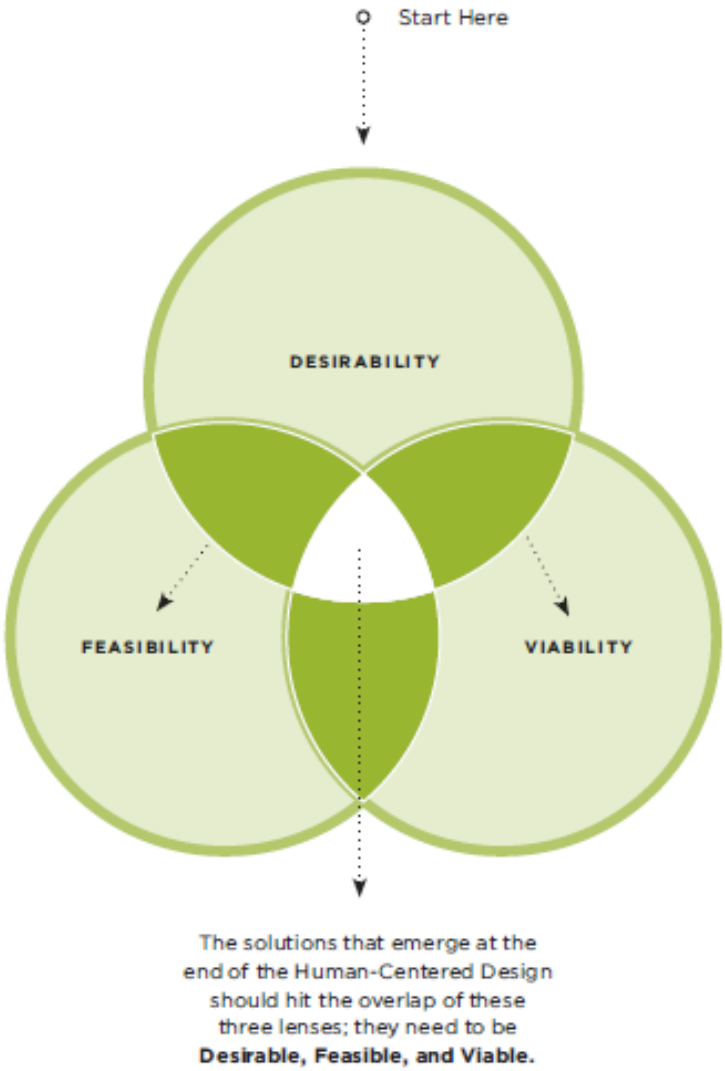

Figure 6.8: The three lenses of human centered design by IDEO (IDEO 2012, p. 6)

6.2.3 Methods and Tools that Support Unycom's Process

Currently, few tools are used that support this very first stages of the innovation process. Table 6.1 demonstrated an overview about the methods and tools of the *Knowledge-Based Innovation Management Framework* that are already in use at Unycom.

Stage	Methods & Tools	Functions & Modules	Business Development
Definition and analysis of innovation problem	Reverse brainstorming/Problem-based concept generation		
	Preliminary market assessment	x	x
	Preliminary technical assessment	x	x
	Preliminary business and financial assessment	x	x
Identification of knowledge demand	Yellow pages		
	Knowledge map		
	Expert registers		
	Knowledge matrix		
	Classification schema of knowledge demand		
Identification of knowledge owners	Mapping of motivation for external knowledge sourcing to knowledge owner group		
	List of individual and collaborative attributes		
	Visualization of innovation environment		
Identification of knowledge transfer barriers	List of common barriers on inter-organizational knowledge transfer		
Selection of Method for Knowledge Transfer	Co-developing, Co-innovating	x	x
	Lead user	(x)	x
	Focus groups	x	
	User manufacturing		
	Crowdsourcing		
	Providing equipment that embodies new knowledge		
	Publications		
	Participation in conference professional network & boards		
	Mobility of people		
	Other informal contacts/networks		
	Co-operation in R&D	(x)	(x)
	Sharing of facilities		
	Co-operation in education		
	Contract research and advisement		
	Intellectual property rights		
	Spin-offs and entrepreneurship		
Integration of knowledge in innovation process	Rules & directives		
	Sequencing of tasks		
	Routines		
	Group problem solving and decision making		

Table 6.1: Overview about used methods and tools of the KBIM Framework at Unycom

Lead User Approach. Unycom already established the lead user approach within their innnovation activities. They identified three general lead users that are open to bring in their knowledge to innovate in the context of intellectual property management.

Jira. Jira is a project tracking system, that supports the complete software development process. Here, all problems, requirements, change requests, etc. are collected. This is especially true for improvements & change requests and new functionalities & modules.

Knowledge Database. Unycom is already planning to implement a knowledge database that provides access to the different knowledge experts within the company. This knowledge database will be necessary especially when the organization is growing as fast at it is currently expected.

Conclusion

As already discussed before, there are only few methods and tools that support Unycom's open innovation process. The major reason is that Unycom by now has not implemented an open innovation process. Open innovation is part of their lived practice but not anchored as fix part of their innovation process. Another reason is the size of the organization which does not require a lot of tools to support the internal activities. Many tools might have a negative impact on the innovation culture of the organization.

6.2.4 Social and Cultural Aspects at Unycom

The organization already considered social and cultural aspects in innovation management. They already established an open-minded corporate culture that enables employees to think outside the box and to observe new trends in different areas. Unycom tries not to involve all of their employees into this open organizational culture, since it past experience showed that it is sometimes better not to do so. Therefore, they mainly involve top and middle management and selected departments (e.g. product management) into these activities.

Intra-organizational level. On the organizational level, Unycom already established an open culture. Previous experience showed that it is sometimes more useful to involve externals into the innovation process than to develop everything internally. So the employees are open to this new approach of innovating at Unycom.

Inter-organizational level. Customers are motivated to bring in their knowledge about certain business processes to get the optimized solutions to their demand. They are further motivated by financial aspects. The big benefit for customers that are willing to co-operate is that they might get this solution that fits to their specific business processes and that they do not have to adapt to other processes. Therefore, Unycom had no problem to find customers that are willing to bring in their knowledge before.

Furthermore, the firm has to consider several barriers of inter-organizational knowledge transfer that might come up during a co-operation. If collaborating in future with other external parties than before, the firm should reflect the relationship to the external in order to establish a good atmosphere between the two parties. The innovation environment and the external's localization within the innovation environment should be considered. If the selected external party is part of the firm's weak network, or if it is located outside the firm's network, more effort might be necessary on relationship-building than if it is already part of the strong network.

6.3 Description of the Ideal Situation

Within this section an ideal situation for the organization is developed based on the findings of this research work and considering the parameters at Unycom.

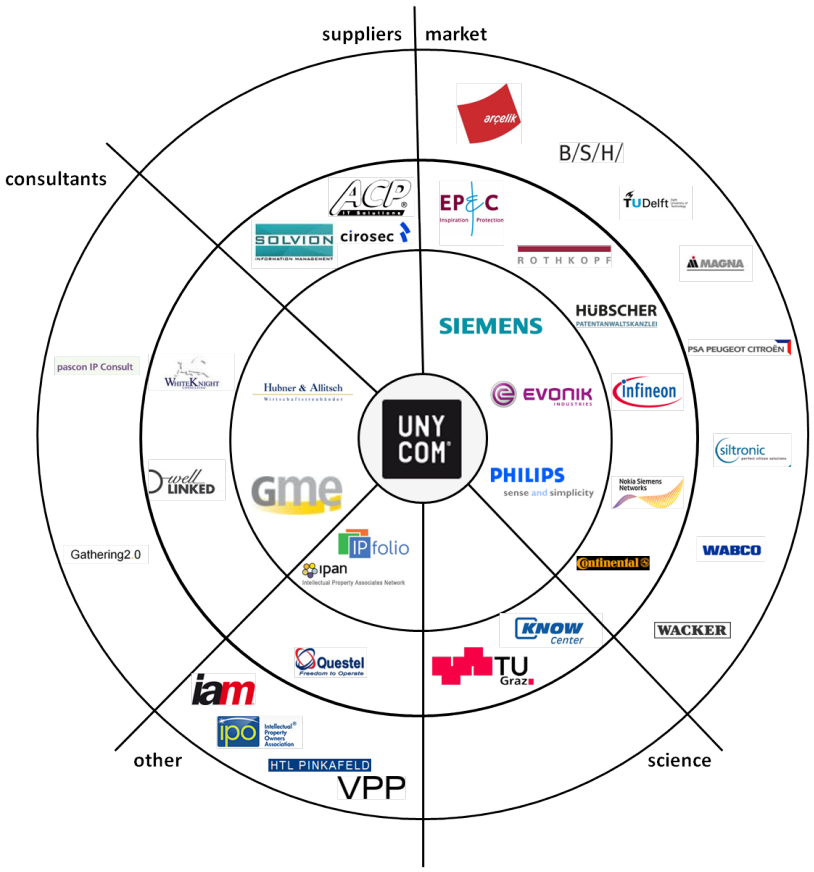

Figure 6.9: Unycom's Innovation Environment (own illustration)

6.3.1 Unycom's Innovation Environment

By now, as already discussed in section 6.2.1, Unycom is already co-operating with externals in various fields. This section provides an overview about the already existing network of Unycom, considering the strong and weak network approach as part of the *Knowledge-Based Innovation Management Framework*. An overview about Unycom's innovation environment is demonstrated in Figure 6.9.

Unycom already distinguishes between three types of customers (see section 6.2.1), therefore the innovation environment of Unycom consists of three levels of external co-operation partners in contrast to the suggested two levels, *strong* and *weak* network, of the *KBIM Framework*:

- **Powerful, strategic network.** This is the inner area of the innovation environment. Relationships here are characterized by a strong, trust-based, strategic, and long-term partnership.
- **Strong network.** The strong network as well consists of long-term partnerships. Although these partners are open to co-operating in innovation belongings, they are not willing to take as much risk as the members of the previous category.
- **Weak network.** The third part of Unycom's networks, which is not complete in the visualization since it includes as well all personal contacts of Unycom's employees, consists of *weaker* business contacts, where no active previous co-operation in terms of innovation management happened.

As the figure above shows, Unycom's external knowledge owners can be classified into following categories:

- **Market-based co-operations (without competitors).** Market-based co-operations in the case of Unycom does not include the suppliers, since they are actually acting in totally different markets. This group includes and distinguishes between *current customers* and *prospective customers*.
- **Co-operations with suppliers.** In contrast to the knowledge owner groups suggested by the *KBIM Framework*, suppliers are not part of the group of market-based co-operations. As mentioned above, Unycom's suppliers are not acting in the same market as Unycom does. They are acting in several different markets that do not have to deal with intellectual property management solutions but more generally in the field of software engineering and IT.
- **Science-based co-operations.** At present, only few science-based co-operation exist at Unycom. There is little co-operation with schools but at the moment this

is more related to recruiting issues than to innovation activities and therefore mentioned in the group of *other partners*.

- **Co-operation with competitors.** Up to now, there has not been any (innovation) co-operation with Unycom's competitors. This group is mentioned here, since the organization's environment as well considers its competitors as potential co-operation partners for future innovations.
- **Consultants.** Unycom co-operates with several consultants in different belongings. Consultants either bring in their knowledge related to the software development process or on a strategic level by taking part at strategy workshops etc.
- **Other partners.** As well Unycom's innovation environment considers other partners. These partners are for example firms that provide complementary products.

Besides these above mentioned co-operation partners, Unycom's innovation environment further covers personal contacts of the firm's employees. Here, some but not all of their potential co-operation partners are covered. The innovation environment as demonstrated in Figure 6.9 builds the basis for Unycom's open innovation activities.

6.3.2 Process

This section includes the description of the suggested process for Unycom. Here, especially two perspectives should be considered:

- *New functions and modules.* This innovations are related to the existing products and in most cases already ordered by customers is advance.
- *Business developments.* Innovations related to the field of business development are in some way independent from the already existing product. Here, as well the market might be different to the existing market. Therefore, these innovations are to be treated differently.

Even though there are currently two different processes for the two aspects of innovations at Unycom, the solution here tries to combine both to one overall process. Of course, the different steps might vary in detail, but the general approach should be somehow the same. The next sections describe the stages of the framework and, if necessary, discusses differences between the two types of innovations in terms of the process.

6.3.2.1 Problem Analysis

The first stage for Unycom's open innovation framework includes an investigation of the given problem. This stage provides different solutions for the two aspects (as mentioned above).

New functions and modules. For new functionalities and modules no detailed market assessment is necessary, since most of these problems have been reported by customers or prospective customers that are willing to spend money on that new feature. Therefore, the main focus is on the definition of the existing problem.

Unycom already elaborated a good basis for reporting problems that belong to this innovation category. A problem definition has to include following components:

- *Issue Type.* Is it a bug, a change request, or a request for a new feature.
- *Summary.* Short description of the problem.
- *Reporting Person.* Customer or internal consultant.
- *Affected Version(s) & Affected Component(s).*
- *Description.* Detailed description of the problem.
- *Attachment.* e.g. a screenshot

These requests are mainly driven by one or more customers. To analyze the potential of the problem, if reported by only one customer, the internal consultants can be contacted. Since they are having an intense contact with the customers, they know if this problem is also relevant to their customers. If not, they might contact their customers to make a quick-check if they would be interested in finding a solution for the given problem. Following IDEO's approach (see Figure 6.8), technical issues are not evaluated in this stage more detailed.

Business development. In contrast to the previous innovation type discussed above, problem definition and problem analysis in the field of *business development* need to be treated in a different way. Here, a wider investigation is necessary.

The first step is to conduct a *preliminary market and technical assessment*, whereas the technical evaluation at this stage is not as important as the market evaluation (here again following IDEO's approach). These assessments should not be time-intense and therefore e.g. a simple desk research is enough at this stage. Major sources for the preliminary assessments at this stage are e.g. the Internet, short interviews with external domain experts and potential customers, and contacts with potential co-operation partners.

In both cases, *business development* as well as *new functions & modules*, this stage includes a preliminary investigation of market and technical issues, while a more detailed analysis takes place after selecting a suitable knowledge owner for the given problem. At the end of this stage a stop-or-go decision is to be made.

6.3.2.2 Identification of Knowledge Demand

After a rough analysis of the problem situation, the knowledge demand in that domain should be analyzed. Open innovation aims to anchor actively external parties into the internal innovation process to include other perspectives into the innovation activities. Therefore, the new open innovation process provides a stage that reflects the internal knowledge and motivates the organization to gather additional or complementary external knowledge based on the existing knowledge base.

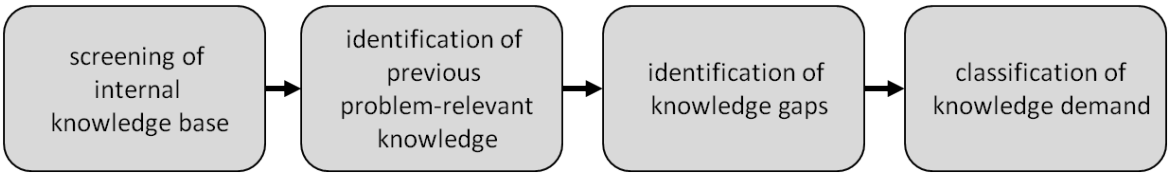

Figure 6.10: Identification of knowledge demand (own illustration)

The identification of the knowledge demand at Unycom considers all steps of the KBIM Framework's *Identification of Knowledge Demand* stage. These steps are again demonstrated in Figure 6.10. Following paragraphs include a detailed description of the steps at Unycom.

Screening of internal knowledge base. In the case of *new functions and modules - innovations*, Unycom already established a platform, where previous product developments as well as already realized change requests and bugs can be tracked. The big advantage of this system is that employees that have been working on a similar project before can be identified easily.

In contrast to the current situation, where the head of the department of product management and design obtains the knowledge about nearly all previous developments concerning the products, the new process should be supported by a knowledge database that contains information about all the existing knowledge and knowledge experts throughout the whole organizations. When the organizations is growing as fast as expected, such a solution is essential in order to ensure that the internal knowledge can be identified

even when the number of employees, and hand-in-hand the firm's knowledge base, is growing.

Identification of previous problem-relevant knowledge. In addition to the already existing project tracking system Jira, where all realized change requests or new functionalities can be tracked, Unycom should think about a knowledge database where knowledge experts and already existing knowledge can be identified. This knowledge database should provide the possibility to identify who the specific knowledge owners are and where and how the relevant knowledge can be accessed. This solution is discussed later in section 6.4 in more detail.

Identification of knowledge gaps. The knowledge gaps are analyzed according to the results of the previous step. The knowledge database not only provides an overview about the internal knowledge, it further detects internal knowledge gaps.

Classification of knowledge demand. Unycom's knowledge demand can be classified into following motivations for co-operations with externals, referring to the framework's motivations for external knowledge sourcing (see section 5.2.1.2):

- *Need for complementary knowledge.* Understanding customer's wishes, their processes, additional information about customer's processes
- *Mitigation of development risks.* Co-operating with externals, especially with customers and suppliers, might mitigate the development risks for Unycom.
- *Cost reduction.* Of course, cost reduction is another driver for external knowledge sourcing for Unycom.
- *Need for fundamental or applied research.* Another reason for gathering external knowledge is the need for fundamental knowledge.
- *Need for scientific knowledge.* Scientific knowledge might also be requested by Unycom during the innovation process.

- *Sharing of risks and costs.* A very significant reason is the sharing of risks and costs.
- *Exploit synergy effects.* Especially in the area of IT, synergy effects could be used more efficiently. Many solutions have already been realized by other IT or software firms that basically act in totally different business areas. This field of knowledge demand is an extremely valuable one that could be improved in any case.
- *Achieving economies of scale.* Even this motivation is a very essential one.

The knowledge demand identified before should be categorized within one of the motivation-categories mentioned above. The further procedure is to be discussed within the next stage of the framework.

Methods and Tools. As already mentioned above, one essential tool at this stage is the *knowledge database*. Even tough the current size of the organization does not necessarily require a knowledge database, the expected growth might necessitate it. This is true for new functions and modules as well as for the business development innovations.

Social and Cultural Aspects. At this stage especially internal aspects have to be considered. Here, one issue could be that Unycom's employees are not willing to share their knowledge and to make it transparent throughout the whole organization.

6.3.2.3 Identification of Knowledge Owners

Figure 6.11 provides an overview about the essential steps of this stage, according to the *Knowledge-Based Innovation Management Framework*.

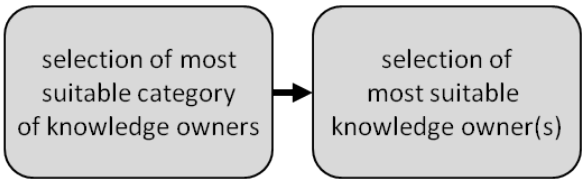

Figure 6.11: Identification of knowledge owners (own illustration)

Selection of most suitable category of knowledge owners. According to the *KBIM-Framework*, first the most suitable knowledge owner category should be identified. This step is supported by the table below, where the different motivations for external knowledge sourcing are mapped with the various knowledge owner groups. In the case of Unycom, there are six types of knowledge owners. Suppliers in software industry are very special, as already mentioned before, since they are often acting in totally different markets. Suppliers are other software firms that already developed well-working solutions for other business areas. This could be either technical solutions (e.g. software security solutions, search algorithms, etc.) or solutions in the field of user interface design and usability. Here, synergy effects are extremely valuable to Unycom. Other motivation-to-knowledge owner group mappings can be found in Table 6.2

Selection of most suitable knowledge owner. After having restricted the potential knowledge owners to a certain category, individual and collaborative attributes have to be considered. The attributes were presented before in the Knowledge-Based Innovation Management Framework. To introducing them into Unycom's innovation management process, a checklist would be an effective tool to analyze the relationship to the external knowledge owner. Only if these parameters are given, a good collaboration can be ensured. The different parameters can be looked up in section 5.2.1.3. Unycom has to

	market	suppliers	science	competitors	consultants	others
complementary knowledge	x	x			x	x
mitigation of development risks	x	x				x
cost reduction	x	x				x
need for fundamental or applied research			x			x
need for scientific knowledge			x			x
sharing of risks and costs				x		x
exploiting synergy effects		x		(x)		x
achieving economies of scale				x		x

Table 6.2: Motivation for external knowledge sourcing to knowledge owner group mapping at Unycom

analyze all the knowledge owners of the selected knowledge owner group according to these attributes and select the most suitable knowledge owner by elimination.

6.3.2.4 Identification and Management of Barriers to Knowledge Transfer

Each co-operation holds a potential of conflicts and therefore, a careful investigation into potential barriers that might come up during the co-operation is essential.

By now, the firm identified few barriers to inter-organizational knowledge transfer. Customers are most often willing to share their knowledge since they are motivated due to the fact that they are influencing the new product development. Further, they might get insights into other customer's IP processes. So, especially customers benefit by several reasons when starting a co-operation as a lead user with Unycom.

What's next, as well technology-driven co-operations do not have to deal with certain barriers to knowledge transfer by now. The firm's development showed, that not all solutions have to be developed internally, and that it sometimes makes sense to outsource several activities and focus on Unycom's core competences instead. The classical NIH syndrome is by now unknown to the organization.

Even though there have not been many barriers to inter-organizational knowledge transfer at Unycom, there are potential barriers that might come up in future, especially when strengthening the open innovation thoughts at Unycom. Therefore, this stage is essential and at least every relationship with new knowledge owners should be analyzed as it is suggested by the framework.

The steps of this stage of the KBIM Framework are again demonstrated in Figure 6.12.

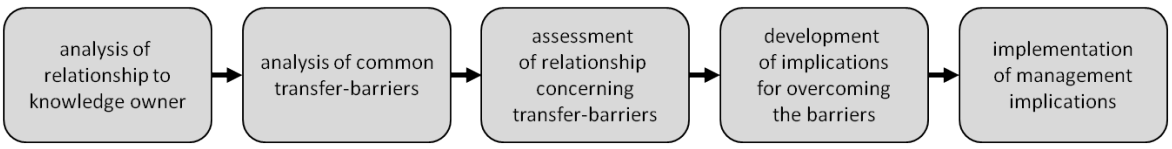

Figure 6.12: Selection of different ways of knowledge transfer (own illustration)

Analysis of relationship to knowledge owner. To analyze the relationship to the selected knowledge owner, Unycom's innovation environment is a very supportive instrument. First, the selected knowledge owner should be located within the innovation environment. If it is a partner of Unycom's *powerful, strategic* or *strong network*, few effort is necessary in order to establish a framework that ensures a good collaboration. More effort to relationship-building might be necessary if it is part of Unycom's weak network. Then the aim is to bring the weak network partner closer to the organizations, e.g. into Unycom's strong network. Further, if the selected knowledge owner is totally unknown to Unycom, relationship-building activities are more time-consuming. Again, the aim is to bring the unknown organization into Unycom's innovation environment.

Analysis of common transfer-barriers. Unycom should be aware about potential barriers to inter-organizational knowledge transfer, even though the firm has not made any bad experiences in past. In order to do so, common barriers to inter-organizational knowledge transfer should be analyzed according to the list provided in section 5.2.1.4.

Assessment of relationship concerning transfer-barriers. Next, the relationship to the selected knowledge owner should be analyzed in order to identify potential barriers that might occur during the co-operation. Therefore, the Knowledge-Based Innovation Environment provides again a list that as well considers the different sources of the barriers. Keeping in mind the potential barriers before starting an intense co-operation is very essential in order to avoid conflicts later in the process.

Development of implications for overcoming the barriers. Having assessed the relationship, and potential barriers have been identified, the responsible people at Unycom have to think about ways how to overcome those barriers that potential conflicts can be avoided from the beginning. There is no predefined way in doing so since relationships are always totally different and the parameters vary a lot between the various relationships. This step aims to create awareness about the necessity of finding solutions for overcoming potential barriers. Here, the different sources of the inter-organizational barriers should be kept in mind (see Figure 5.13.

Implications of management implications. Finally, specific management implications should be developed by Unycom's project team. This might be e.g. common activities, teambuilding events, workshops with members from both parties, etc.

6.3.2.5 Selection of Method for Knowledge Transfer

When having assessed the different barriers that might come up and having found solutions for overcoming those barriers, the next stage of Unycom's new open innovation process includes the selection of the method how the knowledge is to be transferred between the two parties.

In addition to the list provided by the KBIM Framework, Unycom's list considers its specific knowledge owner groups. This list supports the decision about the method for the knowledge transfer.

Market-based co-operations (without competitors). In the case of market-based co-operations, which at Unycom include especially co-operations with current and prospective customers, following methods and tools are relevant at Unycom:

- *Customers as lead users.* One method that is already in use at Unycom is to involve customers (and prospective customers) as lead users into Unycom's innovation process. This requires an intensive co-operation and a relationship characterized by a high level of trust. Further, the external should be willing to take a certain level of risk.
- *Focus groups.* As well the focus groups method is already in use at Unycom, especially to identify the user's requirements at the front-end of innovation. At Unycom, these activities are sometimes outsourced to external consulting agencies that are in frequent contact to Unycom's customers.
- *Co-developing & co-innovating.* Further, co-developing and co-innovating might be relevant to Unycom since different services can be developed together with the customers.

User manufacturing is not relevant to Unycom since its customers are no experts in the field of software development and therefore not producing software solutions. Further, providing equipment that embodies new knowledge is not relevant to co-operations with customers, but to supplier co-operations.

Co-operations with suppliers. There are following methods for inter-organizational knowledge transfer with Unycom's suppliers:

- *Co-developing & co-innovating.* Suppliers may be co-operating co-innovating partners in open innovation projects. By providing their know-how and integrating it into new functionalities or new products for Unycom.
- *Providing equipment that embodies new knowledge.* Another possibility of supplier co-operation in the case of Unycom is that suppliers may provide additional equipment that enables Unycom to generate new knowledge (e.g. access to simulation laboratories etc.).

Science-based co-operations. There are several possibilities for Unycom to strengthen its science-based collaborations. Especially when fundamental, applied or scientific knowledge is required, following methods may be taken into account by Unycom:

- *Publications.* Publishing publications together with members from universities might be a good tool for Unycom to show that the organization is collaborating with academic partners. This might be used as a marketing tool to address new customers. It is of course as well a method of generating new knowledge, but only with limited influence on potential product innovations.
- *Mobility of people.* Interchanging employees with people from public knowledge institutes is another valuable knowledge source for Unycom. Here, e.g. internal employees can be sent to universities for doing their PhD in co-operation with the organization. Unycom may benefit from such a co-operation by getting early and exclusive access to new knowledge.

- *Co-operations in R&D.* This could be a very valuable method for Unycom to get access to fundamental and scientific knowledge, if required. Unycom is already collaborating with an university institute in the field of knowledge management solutions.
- *Co-operation in education.* Further, active co-operation in education might be a good tool, e.g. for gathering new ideas. This can be realized e.g. by idea workshops with students during innovation management classes or case studies students may work out for Unycom. Students may bring in their fresh, independent knowledge and are often highly motivated to working on real business cases.

Other methods and tools, e.g. the sharing of facilities, are not that important in the field of software industry and are therefore ignored here.

Co-operations with competitors. Currently, co-operations with competitors are not under consideration of Unycom. From today's perspective there are only few reasons for starting a co-operation with competitors. Therefore, here no methods and tools in that context are discussed.

Co-operations with consultants. The most significant method here is co-developing and co-innovating as already discussed before.

Other partners. Co-operations with other partners may use some of the previously mentioned methods and tools. Further, another instrument where totally independent partners may be involved is crowdsourcing:

- *Crowdsourcing.* This method in the case of Unycom does not necessarily address its customers or potential customers. Here as well other parties may be involved that do not have to know about Unyom's business. Unycom may use crowdsourcing activities, e.g. to receive new ideas or solutions for specific technical solutions or usability issues.

It really depends on the selected knowledge owner group, which method and tool is the most suitable for the planned open innovation project. This section provides selected methods that can be applied by Unycom.

6.3.2.6 Integration of Knowledge in the Innovation Process

According to the *KBIM Framework*, following mechanisms should be taken into account at this stage:

Rules and directives. To establish an open innovation culture, Unycom needs to anchor the open innovation approach within its innovation process. The process *always* includes steps that require the consideration of the firm's environment. The major aim is to provide a standard innovation process that involves externals whenever it makes sense. In any case it brings the employees to think about a potential co-operation with externals.

Sequencing of tasks. The sequencing of tasks is another essential mechanism, introduced by Grant (1996). In the case of Unycom, this mechanism can be realized by defining time-slots for the different activities of the open innovation process.

Routines. Further, it is important to define certain routines, e.g. influenced by rules and directives that have been introduced before. Open innovation has to be a routine within Unycom's innovation process. Contacting external knowledge owners and thinking about possibilities for integrating externals into the internal innovation process should be a routine for all employees involved into Unycom's innovation activities.

Group problem solving and decision making. Finally, when having chosen a proper knowledge owner for the co-operations, it should be involved into all problem solving and decision making activities throughout the process. Space for personal meetings

should be prepared in advance of the project. This is another way of overcoming potential barriers to inter-organizational knowledge transfer.

6.3.3 Methods & Tools

The *Knowledge-Based Innovation Management Framework* further suggests to not only consider the open innovation process but also introducing methods & tools that support the new process. This section concludes the different methods & tools that are relevant in Unycom's context. Therefore, the different stages of the process are discussed according to the suggested methods & tools:

- *Definition and analysis of innovation problem.* This stage includes methods that support the problem definition and the problem analysis. For Unycom, especially methods like reverse brainstorming might be helpful in order to identify the specific problem that is given. The firm already established several preliminary assessments at the beginning of the innovation process. Here, activities related to the early market assessments could be enriched by trend-scouting activities in other branches of the software industry.

- *Identification of knowledge demand.* This stage demands a knowledge management instrument that provides easy access to existing internal knowledge and the specific knowledge owners. More information about the requested knowledge database is provided later when discussing the management implications for Unycom (see section 6.4). Further, the classification schema of the knowledge demand referring to the motivation of gathering external knowledge is a simple but helpful tool for this stage as well.

- *Identification of knowledge owners.* This stage is supported by the visualization of the innovation environment (details on the visualization can be again looked up in section 6.4). Further, the mapping of the motivation for external knowledge sourcing to the knowledge owner group is essential in order to make decisions about which knowledge owner group is the most relevant for the specific innovation problem. Additionally, this stage is supported by the list of individual and collaborative attributes collaboration partners have to fulfill in order to ensure a successful co-operation.

- *Identification of knowledge transfer barriers.* This stage uses the list of common barriers to inter-organizational knowledge transfer in order to establish a first quick-check about potential conflicts and barriers that might come up during the innovation co-operation. This list is another essential instrument for Unycom.
- *Selection of method for knowledge transfer.* As already demonstrated before in Table 6.1, Unycom currently only uses few methods for inter-organizational knowledge transfer. In future, different other methods should be taken into account, especially when co-operating with other knowledge owners than customers and users.
- *Integration of knowledge in innovation process.* This stage is basically supported by a set of rules that regulate open innovation activities. Further, another tool for ensuring the integration of the external knowledge in the internal innovation process is the process map itself. The whole innovation process should be visible to every involved employee. This process should contain as many milestones and steps as necessary but it should on the other side leave enough space for creativity, failures and experiments.

The methods and tools discussed above are suggested in order to support the open innovation process. For the implementation of the framework at Unycom it should be considered, that not all methods & tools are necessary from the beginning and can be introduced step-by-step. Some of the methods are easy to implement, others may take time and require a certain level of experience in that field (e.g. when introducing new methods for the knowledge transfer).

6.3.4 Social & Cultural Aspects

This section discusses social and cultural aspects the organization has to consider when introducing the *Knowledge-Based Innovation Management Framework*.

The most significant issue in the context of social and cultural aspects is the establishment of an open innovation culture. Unycom's management board has to be convinced of the idea of open innovation and all must be willing to live this new open innovation approach. This is the very first basis for successfully establishing the new framework at Unycom or any other organization.

Further social and cultural aspects related to the specific process steps are discussed below:

- *Definition and analysis of innovation problem.* What is as well significant to Unycom here is that in future especially problems should be collected in contrast to ideas or solutions.
- *Identification of knowledge demand.* Within the second step as well at Unycom potential conflicts may arise when trying to identify already existing internal knowledge. Maybe not all employees are convinced with this new transparency throughout the whole organization.
- *Identification of knowledge owners.* Here again the first and very basic issue in that context is relevant - only when all the involved players are willing to live the open innovation approach, this step is successful. Only then external knowledge owners can be identified.
- *Identification of knowledge transfer barriers.* Potential conflicts and social & cultural aspects referred to this process step are very individual and heavily depend on the relationship to the selected external knowledge owner. Therefore, all potential barriers to inter-organizational knowledge transfer should be taken into account in order to be prepared for upcoming conflict situations. A list of the specific barriers is provided by the *Knowledge-Based Innovation Management Framework*.

- *Selection of method for knowledge transfer.* The social and cultural aspects in this stage are again related to the inter-organizational co-operation between Unycom and the external knowledge owner.
- *Integration of knowledge in innovation process.* When trying to integrate the external knowledge into Unycom's internal innovation activities, the NIH syndrome might occur. Since Unycom's employees have always been open to external co-operations during previous projects, this threat is classified very low.

Unycom has always been a very open and innovative organization, therefore the potential of arising conflicts, neither internally nor externally, is rated very low. Nevertheless, the new open innovation approach might probably holds potential conflicts that might occur. That's why social and cultural aspects are as well relevant to Unycom.

6.4 Management Implications

In relation to the developed ideal situation for Unycom, this section includes general management implications in order to overcome the gap between current and intended situation.

Strengthening open innovation approach. If Unycom wants to establish the new framework, first, the organization should strengthen the open innovation approach. The new approach must be supported and encouraged by the management. Only if the management board is convinced with the idea of open innovation, other organizational members are able to bring it into life. Then, an effective co-operation with external knowledge owners can be ensured.

Visualization of the innovation environment. The innovation environment should be available to every employee. To demonstrate the open innovation orientation, the already existing info screens within the company may be a good platform for making the innovation environment visible to everyone. Further, the intranet should provide access to the visualization of the innovation environment as well. Internal employees should get aware about the firm's environment to take it into consideration for different innovation projects.

The intranet solution should further provide the possibility for the employees to expand the innovation environment by entering own contacts. Of course, this functionality needs to be coordinated by a responsible person from innovation management. Additionally, this person should define the location within the Innovation Environment. Each knowledge owner of the innovation environment contains following additional information:

- *Internal contact person(s).* This is especially important when further information about the knowledge owner is required, or when the organization is willing to co-operate with this external knowledge owner and it is located within the firm's weak network.

- *Knowledge owner's core competences.* One significant information about each knowledge owner is its core competences and in addition to that information about potential connecting points and co-operation fields.
- *Information about previous co-operations/co-operation projects.* Further, information about already established co-operations and projects together with this knowledge owners should be made available.
- *Link to information material and website.* If there is any information material available, it could be made available here.

The innovation environment would then not only be a simple visualization of the different knowledge owners, it would provide a perfect platform for gathering information about the external parties and therefore it further works as a kind of knowledge database or knowledge map with the focus on externals.

Implementation of the knowledge database. Another important topic for Unycom's future is the realization of the knowledge database. This knowledge database should offer following options:

- Quick access to requested knowledge (e.g. by providing a key word search).
- Information about employees that have been working on the topic (or similar topics) in past.
- Link to project tracking system if the topic has already been covered before. Here, additional information may be looked up.

Additionally, the knowledge database may be combined with the innovation environment to not only providing access to internal knowledge owners but as well to externals. This would perfectly fit into the mindset of open innovation.

Strengthening trend-scouting activities. One issue that came up during conducting the interviews was that trend-scouting activities should be strengthened in future. These activities would include an active research about ongoing trends in different business areas (e.g. what is Apple or Microsoft doing in the field of user interface design). Unycom's marketing or innovation management should actively conduct research in that context in future. What is significant in that context is that the results of this research should be involved into Unycom's innovation process.

6.5 Discussion

The case study showed how the *Knowledge-Based Innovation Management Framework* can be brought into life. Further, the practical relevance of the framework has been demonstrated. Unycom realized that external sources are extremely valuable for its innovation activities. An external orientation in innovation management helps Unycom to focus on its core competences while additional knowledge can be gathered from external sources.

Open innovation is of high relevance to firms of all industries. The software industry is a very fast growing and as well fast changing industry and therefore, open innovation is significant to (especially medium-sized) software firms. Therefore, Unycom has been selected as research object for this case study. The case study further showed that the KBIM Framework is relevant to software firms. Since open innovation is, as already mentioned above, as well relevant to other industries, further research should prove the relevance of the KBIM Framework in other industrial sectors.

Furthermore, by using the single case study method this case showed that the developed topic is relevant in that single case. To being able to address the issue more comprehensively, further case studies in other industries, as well as quantitative empirical studies should be conducted in future.

7 Conclusion and Outlook

This final chapter provides a conclusion of this research work by answering the research questions defined in chapter 1.

7.1 Answers to the Research Questions

This section provides an overview about the research questions defined at the beginning of this work and their answers. It concludes previous findings of this work.

Research Question 1: Who are the main (external) knowledge owners in open innovation processes?

The open innovation approach does not limit the potential knowledge owners to a certain group or number - therefore all stakeholders are relevant as potential co-operation partners for open innovation projects. This research question has been answered in section 3.3. The main knowledge owners for innovation issues, according to the open innovation approach, are then: (Freeman 1984, p. 25)

- Customers & Users
- Suppliers
- Competitors
- Research Institutes
- Universities
- Private Laboratories
- Consultants
- Independent Co-Operation Partners

Further, when having identified the different knowledge owners that are relevant for open innovation activities, a classification should be provided. Therefore, following research question should be answered.

How can the knowledge owners be classified?

In order to make a pre-selection of the significant knowledge owner, a classification into several groups is a powerful way. The different knowledge owners are classified into different categories according to Mention's approach: (Mention 2011)

- *Market-based co-operations (without competitors).* This category includes customers, users, and suppliers. Mentioned called this category *market-based co-operations*. The players here are always related to the market.
- *Co-operation with competitors.* One further category includes competitors as potential co-operation partners. Co-opetition
- *Science-based co-operations.* Research institutes, universities, and private laboratories
- *Other co-operations.* Independent co-operation partners (e.g. firms belonging to the same group, consultants, totally independent partners)

The classification of the knowledge owners supports the decision of selecting the most relevant knowledge owner depending on the given innovation problem. The next research question deals with the issue of selecting the right knowledge owner.

Research Question 2: How can the most significant knowledge owners concerning a specific innovation problem be identified?

One essential step in order to identify the right knowledge owner for the innovation problem is to assess the given problem. An adequate problem definition is essential to ensure a successful innovation process. Further it provides the basis for identifying knowledge gaps, that is the next step, according to the *Knowledge-Based Innovation Management Framework*.

Second, when having identified and analyzed the innovation problem, the knowledge demand has to be analyzed. Therefore, internal knowledge is screened and knowledge gaps are identified. Based on those knowledge gaps, the organization might derive the knowledge demand. The *Knowledge-Based Innovation Management Framework* further provides a classification of the knowledge demand. The motivation for the knowledge sourcing is identified and a portfolio presented in this thesis provides the linking of the motivation to the knowledge owner group that fits to the demand.

Then, having identified the right group of knowledge owners, the framework provides further solutions on how to select the right knowledge owner within that group. This decision is supported by individual and collaborative attributes that should be fulfilled by the external knowledge owner. The following attributes are to be considered:

- **Individual attributes**
  - Technology capability
  - Financial health
  - Knowledge and managerial experience
  - Capability to access new market
- **Collaborative attributes**
  - Resource complementarity
  - Overlapping knowledge base
  - Motivation correspondence
  - Goal correspondence
  - Compatible cultures

Taken this attributes into account, and further having done a pre-selection of the specific knowledge owner group based on the motivation for external knowledge sourcing, good basis for the selection of the right knowledge owner is provided.

Research Question 3: How can the external knowledge be integrated and used within the internal innovation process?

How can the external knowledge be transferred into the company?

The framework developed in this thesis suggests different knowledge transfer methods depending on the specific knowledge owner groups. Following methods are suggested by the *Knowledge-Based Innovation Management Framework*:

- **market-based co-operation (without competitors)**
  - co-developing
  - co-innovating
  - lead user
  - user manufacturing
  - crowdsourcing
  - focus groups
  - providing equipment that embodies new knowledge
- **co-operation with competitors**
  - co-developing
  - co-innovating
  - intellectual property rights
- **science-based co-operation**
  - publications
  - participation in conference professional network & boards
  - mobility of people

  - other informal contacts/networks
  - co-operation in R&D
  - sharing of facilities
  - co-operation in education
  - contract research and advisement
  - intellectual property rights
  - spin-offs and entrepreneurship
- **other co-operations**
  - different methods

Having selected the right method for the inter-organizational knowledge transfer, this co-operation might bring up potential conflicts. In order to being aware about these conflicts and further barriers to knowledge transfer, they should be assessed in a very early stage. Therefore, following question is to be answered.

Which barriers to knowledge transfer can be identified?

As already mentioned above, inter-organizational co-operations always have to deal with certain barriers that might come up. These barriers have been identified within this research work and are discussed in section 5.2.1.4. Figure 5.13 provides an overview about inter-organizational barriers and further demonstrate the sources of these barriers. In order to omit potential conflicts that might come up, the relationship to the selected knowledge owner should be assessed very early before starting the co-operation. Common barriers to knowledge transfer should be reflected regarding their potential within the planned co-operation.

Which knowledge management tools and methods can be used to support the successful transfer of knowledge from outside to inside?

The different methods and tools that support the whole process from selecting the right knowledge owner to integrating the gathered knowledge into the internal innovation

process are demonstrated in section 5.2.2. Table 7.1 provides again an overview about the methods and tools that provide the different steps of the *KBIM Framework*.

7.2 Implications for Further Research

This section discusses research gaps of this thesis and gives hints on further research on this issue.

Open innovation process. The requested overall process is still an open issue for the research on open innovation. Focus of this thesis was to establish a structured process for the front-end of innovation which did not consider the development phase and issues related to intellectual property rights in terms of inventions. As well the market introduction needs further research.

Applicability to other industrial sections. The case study of this research work showed, that the *Knowledge-Based Innovation Management* approach is significant to an organization of the software industry. Additional research on this topic should consider such case studies for other industrial sections first, and then quantitative research on a broader basis.

Research on the motivation of sharing own knowledge with externals. Another perspective that has not been considered within this work is the research on the motivation of the knowledge owners to share their knowledge with the organization.

Outlook on inter-organizational co-operation. This work especially considered strong and weak ties as potential co-operation partners for open innovation projects. Further research could investigate how relationships that root in contacts via social media platforms do have an influence on open innovation projects. *Are social medial platforms potential sources to look for external knowledge sources?*

Stage	Methods & Tools	intra-organizational	inter-organizational
Definition and analysis of innovation problem	Reverse brainstorming/Problem-based concept generation	x	
	Preliminary market assessment		x
	Preliminary technical assessment	x	x
	Preliminary business and financial assessment	x	x
Identification of knowledge demand	Yellow pages	x	
	Knowledge map	x	
	Expert registers	x	
	Knowledge matrix	x	
	Classification schema of knowledge demand	x	
Identification of knowledge owners	Mapping of motivation for external knowledge sourcing to knowledge owner group	x	
	List of individual and collaborative attributes	x	x
	Visualization of innovation environment	x	x
Identification of knowledge transfer barriers	List of common barriers on inter-organizational knowledge transfer		x
Selection of Method for Knowledge Transfer	Co-developing, Co-innovating		x
	Lead user		x
	Focus groups		x
	User manufacturing		x
	Crowdsourcing		x
	Providing equipment that embodies new knowledge		x
	Publications		x
	Participation in conference professional network & boards		x
	Mobility of people		x
	Other informal contacts/networks		x
	Co-operation in R&D		x
	Sharing of facilities		x
	Co-operation in education		x
	Contract research and advisement		x
	Intellectual property rights		x
	Spin-offs and entrepreneurship		x
Integration of knowledge in innovation process	Rules & directives	x	x
	Sequencing of tasks	x	x
	Routines	x	x
	Group problem solving and decision making	x	x

Table 7.1: Overview about methods and tools as mentioned in the KBIM Framework

Outlook on balancing incentives & controls. This research did not consider the issue of balancing incentives between the two (or more) co-operation partners, which is still one of the major barriers to inter-organizational collaboration. This issue has not been covered within this research work but is of high significance to industrial units as well as researchers.

Concluding Summary

This research work contributes to the open innovation approach which is currently of high relevance in industry and research. Many publication asked for a structured framework for open innovation. By introducing the Knowledge-Based Innovation Management Framework, this thesis provided a solution for the front-end of innovation by considering not only the process perspective but solutions for supporting the process by several methods and tools. Further, social and cultural aspects that have to bee covered in that context are part of the framework. This solution provides a unique contribution to the open innovation research and hopefully opens new perspectives to further research on the issue.

List of Figures

List of Tables

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