



*Jukka-Pekka Bergman*

**SUPPORTING KNOWLEDGE CREATION AND  
SHARING IN THE EARLY PHASES OF THE  
STRATEGIC INNOVATION PROCESS**

*Thesis for the degree of Doctor of Science (Technology) to  
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## **ABSTRACT**

Jukka-Pekka Bergman

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The driving forces of technology and globalization continuously transform the business landscape in a way which undermines the existing strategies and innovations of organizations. The challenge for organizations is to establish such conditions where they are able to create new knowledge for innovative business ideas in interaction between other organizations and individuals. Innovation processes continuously need new external stimulations and seek new ideas, new information and knowledge locating more and more outside traditional organizational boundaries. In several studies, the early phases of the innovation process have been considered as the most critical ones. During these phases, the innovation process can emerge or conclude. External knowledge acquirement and utilization are noticed to be important at this stage of the innovation process giving information about the development of future markets and needs for new innovative business ideas. To make it possible, new methods and approaches to manage proactive knowledge creation and sharing activities are needed.

In this study, knowledge creation and sharing in the early phases of the innovation process has been studied, and the understanding of knowledge management in the innovation process in an open and collaborative context advanced. Furthermore, the innovation management methods in this study are combined in a novel way to establish an open innovation process and tested in real-life cases. For these purposes two complementary and sequentially applied group work methods – the heuristic scenario method and the idea generation process – are examined by focusing the research on the support of the open knowledge creation and sharing process. The research objective of this thesis concerns two doctrines: the innovation management including the knowledge management, and the futures research concerning the scenario paradigm. This thesis also applies the group decision support system (GDSS) in the idea generation process to utilize the converged knowledge during the scenario process.

**Keywords:** Innovation process, knowledge creation, scenario, and GDSS

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Lappeenranta, 19 August 2005

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## **Abbreviations**

DSS	Decision support System
ES	Expert System
EIS	Enterprise (executive) Information System
GDSS	Group Decision Support System
ICT	Information and Communication Technology
IDSS	Intelligent Decision Support System and agent
KM	Knowledge Management
KMS	Knowledge Management System
LUT	Lappeenranta University of Technology
R&D	Research and Development
SCM	Supply Chain Management
SECI	Socialization, Externalization, Combination, and Internalization
TBRC	Technology Business Research Center
TEKES	Teknologian Kehittämiskeskus (National Technology Agency of Finland)
VTT	Valtion Teknillinen Tutkimuslaitos (Technical Research Center of Finland)

## **PART II: THE PUBLICATIONS**

**Publication 1.** Bergman J-P., Jantunen A., and Saksa J-M. (2004). Managing knowledge creation and sharing - scenarios and dynamic capabilities in inter-industry knowledge networks. *Journal of Knowledge Management*, Vol. 8, No. 6, pp. 63-76. ISSN: 1367-3270.

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**Publication 5.** Bergman J-P., Jantunen A., and Saksa J-M. (2004). Management of controlled open innovation process. The R&D Management Conference, Sesimbra, Portugal, 7-9 July 2004.

## **PART I: OVERVIEW OF THE DISSERTATION**



## 1 INTRODUCTION

*“Big strategies can grow from little ideas in strange places (Mintzberg, 1994a: 26).”*

### 1.1 Background

The economic growth and innovativeness of organizations have become more dependent on knowledge and abilities to exploit them than before (e.g. Nonaka et al., 1995; Teece, 1998; Miller et al., 1999). The driving forces of technology and globalization continuously transform the business landscape in a way which undermines the existing strategies and innovations of organizations. Innovations are increasingly distributed and based on diverged knowledge sources (e.g. Chesbrough et al., 1996). Due to this, organizations have to be receptive to external changes, have capabilities to make sense of them, and continuously create new innovative ideas to sustain their competitive advantage (Cohen et al., 1990). In such a dynamic environment, collaboration and networking are of increasing importance for acquiring knowledge and the innovativeness of organizations.

The challenge for organizations is to establish such conditions where they are able to create new knowledge for innovative business ideas in interaction between other organizations and individuals (Nonaka and Takeuchi, 1995; Miller and Morris, 1999; Tidd et al., 2001). In other words, organizations should be considered embedded in social, professional and knowledge exchange networks. Innovation processes continuously need new external stimulations (von Hippel, 1988) and seek new ideas, new information and knowledge locating more and more outside traditional organizational boundaries (Chesbrough, 2003). To make it possible, new methods and approaches to manage proactive knowledge creation and sharing activities are needed (Miller and Morris, 1999). However, the purpose of active knowledge creation and sharing in innovation processes is to ensure that the most potential innovation opportunities are recognized and exploited in practice fully and quickly.

Because of these facts, there are a lot of challenges but also opportunities for future strategies and innovations. If the organization wants to succeed, it has to consider strategic management as a proactive process (Ackoff, 1999) that focuses on future-oriented knowledge embedded in organizations and individuals (e.g. Scharmer, 2001), collaboration with other organizations, and methods and practices to support their utilization (Godet et al., 1996). In spite of the wide interest in knowledge management among the academic and practitioner disciplines, there is need for empirical research on the methods and approaches for dynamic knowledge creation and their implications on organizational innovation processes. In literature, the separate elements of the knowledge management and innovation processes have been studied relatively widely and different approaches have been developed to support information acquiring concerning future development (e.g. Porter et al., 1991), i.e. the management of knowledge creation for future innovations (e.g. Nonaka and Takeuchi, 1995; Miller and Morris, 1999; van der Heijden et al., 2002) in the networked business environment (Chesbrough and Teece, 1996). The lack of an integrated method to support knowledge creation and sharing in the proactive and strategic innovation process in collaborative and open context for participants is noticed (e.g. Wiig, 1999; Sawhney et al., 2000; Corso et al., 2001). In their recent study, Grand et al. (2004) argue that the changes in new innovation processes, e.g. the emerging shift from closed to open innovation processes in software industry, and involvement in them in general betoken a new philosophy towards the innovations and innovation processes.

This dissertation suggests a solution to the challenges in the innovation process by developing an integrated procedure for the management of knowledge creation and sharing and its utilization during the early phases of the innovation process in open inter-organizational context considering the divergent and networked business environment. The following section of this thesis presents the research field, the research objectives and the structure of the paper, and clarifies the research methodology.

### *1.1.1 Strategic management of the innovation process*

Innovation has several definitions; according to Webster's Dictionary innovation means something new or different introduced. Considering innovation and the innovation process, van de Ven (1986) defines innovation as "the development and implementation of new ideas by people who over time engage in transactions with others in an institutional context." Innovations are results of iterative processes that embody inventions from industrial arts, engineering, applied science and pure science (Garcia & Calatone, 2001). From the strategic point of view, innovation means a new way of serving new needs of new or existing customer segments to sustain the competitive advantage of the customer and the innovator, e.g. an organization (see e.g. Markides, 1997; Burgelman et al., 1996). In the literature, different types of innovation have been identified. Burgelman et al. (1996) list three types of innovations: *incremental* (continuous) innovations mean an overall refinement and enhancement of existing products and services, or production and delivery systems; *radical* (discontinuous) innovations involve totally new product and service categories, or production and delivery systems; and *architectural* innovations refer to reconfigurations of the system of components that constitutes the product.

Strategy is seen as a unifying theme connecting the operational domains of the organization and its activities with the external business environment, and giving coherence and direction to the decisions of an individual or organization (Grant, 1998). Strategic management should be considered an ongoing process that addresses the attention of the organization to the future giving long-term objectives to reach for (Ackoff, 1999), enables the organization to be sensitive to emergent opportunities (Mintzberg, 1994a,b), and finally, implements the plans to achieve the selected objectives (Steele, 1999). Strategy and innovation are mutually and tightly inter-connected functions which need to be managed (Burgelman et al., 1996). In other words, new innovations direct organizational activities and the strategy gives a framework for the innovation processes. The strategic management of innovation makes it possible to consider the innovation as part of the overall corporate strategy and management processes (Burgelman et al., 1996).

Van de Ven (1986) has presented some central problems in innovation management which are still relevant and also discussed in this thesis:

1. The human problem of managing attention, which means recognition, sharing and creation of valuable knowledge for the innovative ideas. This concerns mainly social interaction during the early phases of the innovation process.
2. The process problem of managing ideas into good currency, which means creating new innovations in a collective process from the initiative knowledge to the final products and services. This concerns mainly individual activity and commitment in the process.

3. The structural problem of managing part-whole relationships, which means creating integrity in the process. This concerns mainly the management of proliferation of transactions in the process.
4. The strategic problem of institutional leadership, which means network building efforts to create such conditions that make it possible to be in creative interaction. It also means that facilitation, commitment, and flexibility issues are considered, as well as cultural issues.

The management of an innovation process involves different organizational levels (e.g. individual, team, business unit, and corporate) and areas (e.g. internal and external resources, market dynamics) which should be taken into account. In recent years, knowledge has been one of the most interesting research areas in management literature. Although, the basic ideas of knowledge-based resources are presented already in the 1950's by Penrose (1959), the importance of knowledge and knowledge-based assets in organizations has been stressed in the 1990's (see e.g. Wernerfelt, 1984; Prahalad et al., 1990; Grant, 1991; Teece et al., 1997; Sanchez et al., 1997). In innovation management, knowledge and knowledge management have been considered main factors since the fourth generation innovation processes (Rothwell, 1994; Miller and Morris, 1999). According to Leonard-Barton (1992), the central theme in organizational knowledge management is to manage the interaction between activities pursued in the course of developing new products, services and organizational capabilities. When Nonaka and Takeuchi (1995) presented their idea of the knowledge-creating company, knowledge and knowledge management methods became a focal point of interest in innovation management literature among the academic as well as the practitioner disciplines. According to the theory of knowledge creation in organizations presented by Nonaka and Takeuchi (1995) and revised by Nonaka and Toyama (2003), the knowledge creation process consists of four main phases, shown in Figure 1: *Socialization* is a process of sharing experiences, i.e. tacit knowledge. It means that knowledge has to be shared, it has to be made conscious and articulated. Nonaka and Takeuchi (1995) also point out that the key to knowledge creation lies in the mobilization and conversion of tacit knowledge. *Externalization* is a process of transforming tacit knowledge into explicit, which has been proved a difficult process (Haldin-Herrgard, 2000). *Combination* is a process of transferring knowledge into a system, and *internalization* processes explicit knowledge into tacit through experiences, where individuals absorb the knowledge e.g. learning by doing.

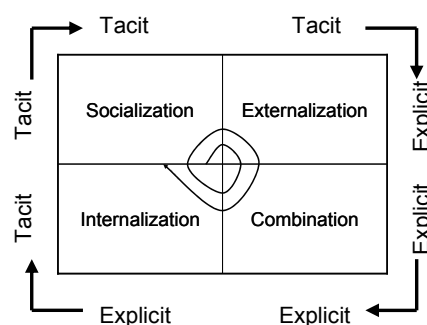


Figure 1. The SECI model and continuous knowledge creation process adapted from Nonaka and Takeuchi (1995: 71) and Nonaka et al. (2003: 5).

The innovation process can be seen as a continuous and also a cyclical knowledge creation process accumulating the organizational knowledge domain and providing potential new innovative ideas (Nonaka and Takeuchi, 1995; Kash et al., 2002, Rothwell, 1994). The role of knowledge management is increasingly important and should be emphasized throughout all the phases of the innovation process (Miller and Morris, 1999; Tidd et al., 2001). In their concept of product innovation management, Tuominen et al. (1999) argue that knowledge about the future opportunities and business environment through which new innovative ideas can be generated is a prerequisite for innovations and their development. According to Miller and Morris (1999), innovation is based on the continuous interaction between the organization and its environment. Choo (1998) states that innovations emerge from the seeds of tacit knowledge through networked relationships and tools to invent new knowledge. Miller and Morris (1999) claim that the innovation starts at the moment of invention which emerges in response to some combination of practical needs, insights, ideas, technologies, processes, problems or possibilities. They continue that the invention is a result of a continuous knowledge creation and accumulation process. Cooper (1997) has presented his general stage-gate model of an innovation process and argues that the early phases of the innovation process are the most critical ones when the focus of the process is on knowledge acquirement and idea generation (Figure 2). He continues that at this point the whole innovation process can be initiated or broken down.

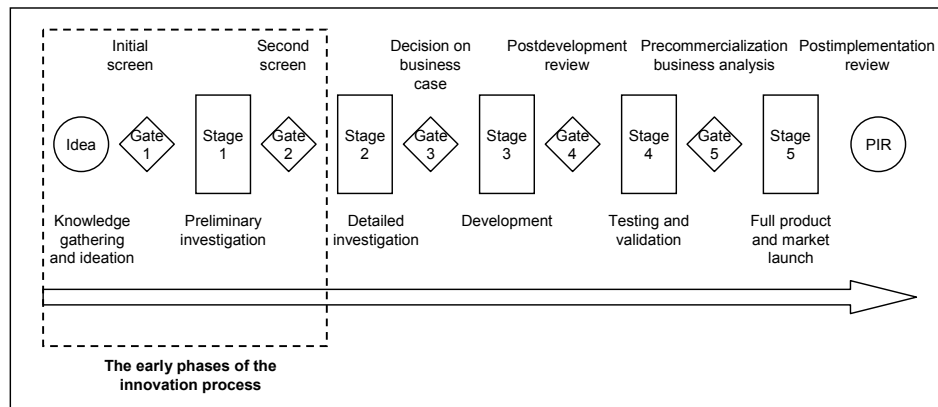


Figure 2. The generic model of innovation process and the early phases of the innovation process: knowledge creation and idea generation (adapted from Cooper, 1997: 108).

The challenge for the strategic management of the innovation is to establish such an interactive process (construct) that the organization is able to receive new and valuable knowledge from diverged external and internal sources and to exploit it providing new innovative ideas for the basis of new innovations. Cohen and Levinthal (1990) claim that the innovative capability of the organization depends on its abilities to assimilate new external knowledge with prior related knowledge. In this complex context, where innovations are distributed and knowledge is diverged, intensive knowledge management methods and practices in innovation processes which allow organizations to act in a collaborative, inter-connected and open context creating future innovation are needed (Amidon, 1998; Miller and Morris, 1999).

### *1.1.2 Knowledge creation and sharing in open and collaborative innovation networks*

It is widely recognized that innovations are increasingly distributed and knowledge intensive when the role of collaboration and knowledge management mechanisms become crucial in innovation processes (see e.g. Chesbrough and Teece, 1996). The importance of collaborative and networked innovation processes in knowledge transfer has been emphasized at length (see e.g. von Hippel, 1988; von Hippel, 1996; Burgelman et al., 1996; Tidd et al., 2001). Organizations rarely innovate alone, and they are increasingly dependent on their customers (e.g. lead users), suppliers, and other external elements as initiators of product improvement and sources of new ideas. This type of collaboration easily becomes biased in the favor of very restricted interests and is often controlled by the most powerful organization.

During the last ten years, the collaborative innovation processes where knowledge creation and sharing gain mutual value between the participants in the process have achieved wider interest among management scholars and practitioners. Communicative knowledge channels, deeper strategic collaboration and knowledge sharing in networked groups have been considered solutions to the creation of new innovations (see e.g. Rothwell, 1994; Amidon Rogers, 1996; Amidon, 1998; Miller and Morris, 1999).

Recent innovation literature has also emphasized the importance of external knowledge sources through open connections within external actors especially when innovations are systemic. There has been a visible shift from closed innovation systems to more open innovation processes and management approaches, e.g. the open source development processes (e.g. Apache, Grid, Linux) within the software industry, in which the dynamic linkages between the organizations' internal and external knowledge sources have a central role (see e.g. Miller and Morris, 1999; Sawhney and Prandelli, 2000; Kogut et al., 2002; Chesbrough, 2003). In such a context, organizations utilize external and internal ideas, use external channels to generate value from their internal ideas and capabilities, and configure their business models to profit from innovations (Chesbrough, 2003). Chesbrough (2003) claims that the knowledge uncovered by an organization cannot be restricted to its own use, and respectively, the internal knowledge processes cannot be restricted by the organizational boundaries. He lists some contrasting principles of closed and open innovation processes (see Table 1). The idea of using external sources is not new. In fact, it has existed decades for example in partnerships and alliances. The key is to enable the creation of an open innovation process from which all the participants will benefit.

Table 1. *Contrasting principles of closed and open innovation (Chesbrough, 2003: 38).*

<b>Closed innovation principles</b>	<b>Open innovation principles</b>
The smart people in our field work for us.	Not all the smart people work for us. We need to work <i>with</i> them inside and outside our company.
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it in the market first.	We do not have to originate research to profit from it.
The company that gets an innovation in the market first will win.	Building a better business model is better than getting in 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 do not profit from it.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business models.

In knowledge management literature, the role of collaboration and networking in innovation processes has been emphasized as an inherent aspect. Especially, when sharing tacit knowledge, interactive working groups (Inkpen, 1996; Leonard et al., 1998), less controlled working communities (von Krogh et al., 2001), and wider collaborative inter-organizational knowledge networks (Debackere et al., 1994; Nonaka and Takeuchi, 1995; Nonaka and Toyama, 2003) provide fruitful grounds for the emergence of new innovation processes. The characteristics of knowledge in a certain domain related to innovation management have an impact on knowledge management mechanisms. The conversion of tacit knowledge into explicit knowledge in the domain of scientific and technological knowledge requires reciprocity and openness in the communication between parties (Sawhney and Prandelli, 2000; Antonelli, 2002).

According to Leonard and Sensiper (1998), the group-based innovation process providing new products, services, processes or organizational forms is a sequentially diverging and converging interactive knowledge creation process (see Figure 3). Providing an open and shared context for the innovation process broad knowledge and information base can be created. The diversity of the participants in the process is essential to the creation of new knowledge. As a result of search, exploration and synthesis of divergent knowledge, a common understanding can be aggregated and created over the innovation process, and finally the process converges into solutions and innovative ideas (Leonard and Sensiper, 1998). A prerequisite for the success in the innovation process is that collective activities during knowledge creation process(es) are structured and that there is a coordinator who keeps the process in line. As Cooper (1997) and Leonard and Sensiper (1998) claim, the well-managed innovation process makes it possible to channel the knowledge into new ideas and products or services. Findings of Kulvik (1977) also show that the management of new product development and the divergent knowledge sources, as connections with the customers and interaction between the development and marketing in organizations, are important factors

underlying the success of new products. Kulvik (1977) have noticed that facilitating the management and guidance activities in an organization, as he calls company potential, during the early phases of new product development processes support the success of new products. Honko et al. (1982) claim that failures in an organizational investment process can emerge in any phase of the investment process, i.e. idea generation, planning, and implementation phases. They divide the failures in three groups: failure in idea, failure in planning, and failure in implementation. They argue that the balance, fitting them together in various phases of the process, is essential. In the early phases of the process, when searching for new ideas for the basis of new investments to avoid failures, divergent information, divergent knowledge, and extensive evaluation of it are required (Honko et al., 1982).

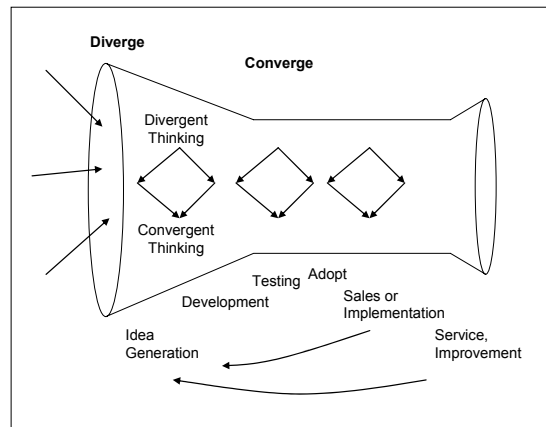


Figure 3. Convergence of divergent knowledge in the innovation funnel (Leonard and Sensiper, 1998: 117).

As a whole, collaboration and openness between the organizations and individuals is required. The complexity of innovations as well as innovation processes is increasing. Management processes require care to overcome the barriers, e.g. managerial, cultural, hierarchical, communicative, in knowledge creation and sharing activities (Nonaka and Takeuchi, 1995; von Krogh, 1998; Fahey et al., 1998; Kulkki et al., 2001). Therefore, new innovative methods are needed in innovation management to facilitate the exploitation of distributed knowledge (Miller and Morris, 1999; Francis et al., 2003). Sanchez (2004) has pointed out that the lack of managerial implications in knowledge management is one of the greatest barriers to succeed in today's challenging environment. He claims that knowledge management should concern the abilities to respond to a dynamic environment, to enhance cognitive capabilities of the organization, to establish an open, knowledge sharing environment in organizations, and to create a holistic understanding of the organization's goals and resources.

### 1.1.3 Creating new innovations

According to Virkkala (1991), in one extreme of the complexity spectrum innovation can widely be seen as a result of the integration of very complex and divergent knowledge into functioning systems, e.g. computer, antibiotic etc., and in the other extreme innovation means creative problem-solving. He claims that the initiation of an innovation is a combination of sense-making, scientific research, and idea development processes (Figure 4).

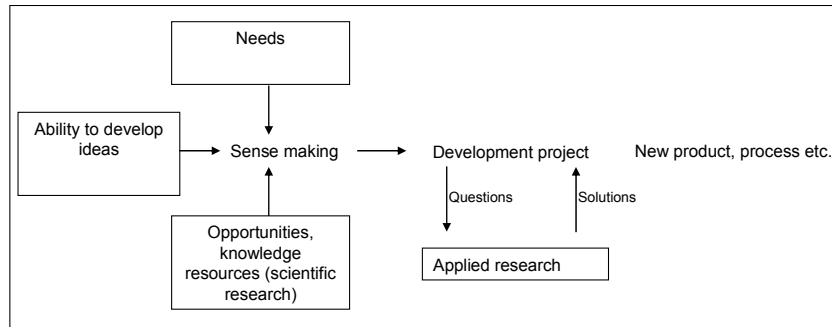


Figure 4. Initiation and progress of an innovation process (Virkkala, 1991: 13).

According to Choo (1998), innovations germinate from the seeds of shared group-based tacit knowledge which creates new knowledge to solve problems for providing new capabilities and products or services. De Bono (1982) argues that innovation needs creative thinking. He (1982) states that thinking is a basic and ultimate resource of humans, and the main problem of thinking is confusion. He argues that to avoid the confusion and to achieve better solutions thinking procedures should be challenged and facilitated. Osborn (1963) argues that problem-solving is creative thinking, and he states that the creative problem-solving process includes three basic procedures:

1. Fact-finding, which calls for problem definition, information and knowledge acquiring, and analysis of the gathered data.
2. Idea-finding, which calls for idea production and development through the analysis and selection process.
3. Solution-finding, which calls for evaluation and adoption. Evaluation calls for testing and verification and adoption means decisions and implementation of the final solution.

Virkkala (1991) has presented a six-phase framework for the creative problem-solving process and argues that the phases can be supported by different methods (Table 2).

Table 2. Creative problem-solving process and some examples of supportive problem-solving methods (Virkkala, 1991: 19).

Problem-finding	<ul style="list-style-type: none"> <li>▪ Knowledge acquiring from different disciplines</li> <li>▪ Meetings, group work</li> <li>▪ Decision trees, fractionation (de Bono, 1982)</li> </ul>
Fact-finding	<ul style="list-style-type: none"> <li>▪ Face-to-face interaction</li> <li>▪ Cause-effect models</li> <li>▪ KJ method (Kawakita Jiro method)</li> </ul>
Idea-finding	<ul style="list-style-type: none"> <li>▪ Brainstorming (Osborn, 1963)</li> <li>▪ Synectics</li> <li>▪ OPERA (in Finnish: tuumatalkoot) (Helin, K., 1990/Innotiimi oy)</li> <li>▪ Reversal Method (de Bono, 1982)</li> <li>▪ Two-headed team work (Osborn, 1963)</li> </ul>
Solution-finding	<ul style="list-style-type: none"> <li>▪ Formal and informal methods based on communication and social interaction</li> </ul>
Acceptance-finding	<ul style="list-style-type: none"> <li>▪ Presentation i.e. "selling" of the solutions</li> <li>▪ Communication</li> </ul>
Implementation and action	<ul style="list-style-type: none"> <li>▪ Simulations</li> <li>▪ Testing</li> <li>▪ Sensitivity analysis</li> </ul>

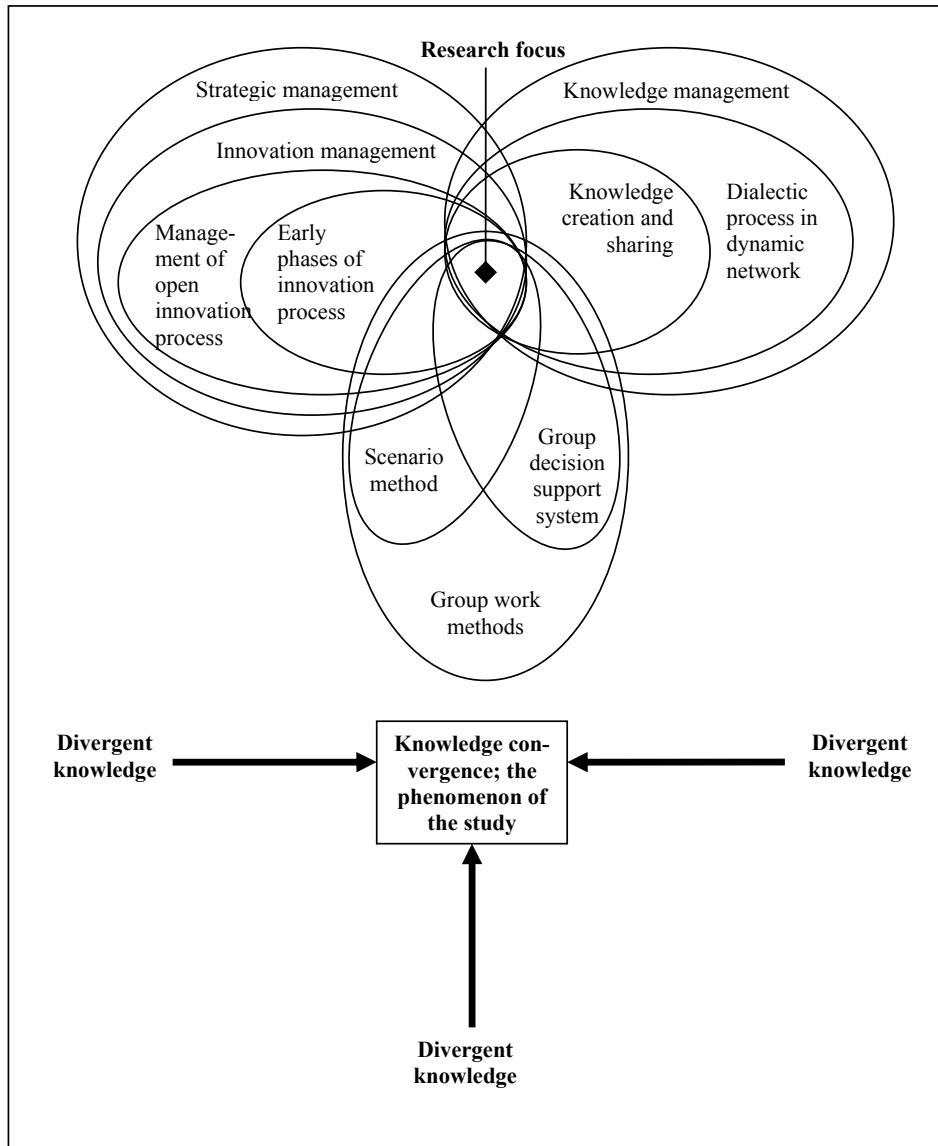
According to Virkkala (1991), innovation is a problem-solving process providing "novel associations that are useful". He states that the problem-solving process begins by understanding an opportunity in the future to act or make something differently and in a better way. Finally, the process provides an accepted idea or a solution which can be realized and put into practice. Virkkala (1991) reminds that the problem solving is not always a linear step-by-step process but a complex and iterative one. It includes the process, supportive problem-solving methods, and capabilities and sensitivity to solve problems.

## 1.2 Purpose and objectives of the study

In this thesis, the strategy formation and innovation processes are seen as continuous and parallel processes supporting each others. Innovation management is part of strategic management processes and concerns operational as well as strategic issues (Burgelman et al., 1996; Tidd et al., 2001). As Mintzberg (1994a) states, the fact that the strategies are emergent leads us to a continuous strategy formation process. As he puts it, strategies can emerge from a piece of information in any place, anytime and by anyone. Miller and Morris (1999) also state that, the innovations are emergent and results of continuous knowledge development processes. Therefore, from the innovation point of view, the process of continuous knowledge creation enables the emergence of new innovations (Nonaka and Takeuchi, 1995). However, Cooper (1997) has noticed that the early phases of the innovation process are the most critical

ones. During these phases, the innovation process can emerge or conclude. External knowledge acquirement and utilization are noticed to be important at this stage of the innovation process giving information about the development of future markets and needs for new innovative business ideas (von Hippel, 1988). Separate methods and approaches have been studied intensively for information acquiring purposes in innovation management literature for a long time (see e.g. Porter et al., 1991). In recent studies, collaborative and open knowledge creation and sharing processes have become one of the main focuses in innovation management research. In aggregate, the research field concerning the management methods which make it possible to support the process of knowledge creation and sharing and the utilization of its outcomes in open inter-organizational innovation processes is emergent and relatively new, and more empirical research in this area is needed.

During this study, knowledge creation and sharing in the early phases of the innovation process has been studied, and the understanding of knowledge management in the innovation process in an open and collaborative context advanced. Furthermore, the innovation management methods in this study are combined in a novel way to establish an open innovation process and tested in real-life cases. For these purposes two complementary and sequentially applied group work methods – the heuristic scenario method and the idea generation process – are examined by focusing the research on the support of the open knowledge creation and sharing process. The research objective of this thesis concerns two doctrines: the innovation management including the knowledge management, and the futures research concerning the scenario paradigm. This thesis also applies the group decision support system (GDSS) in the idea generation process to utilize the converged knowledge during the scenario process (see Figure 5).

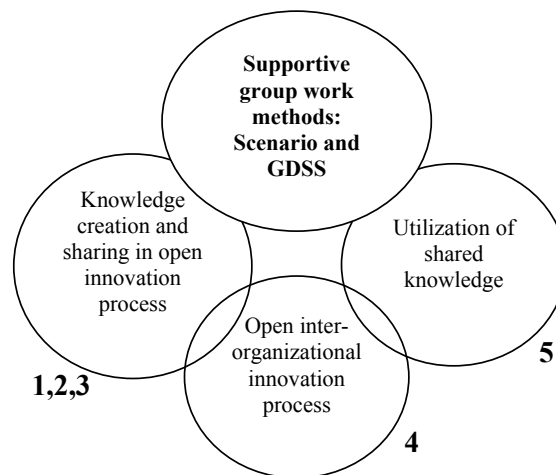


*Figure 5. Research focus of the study: Supporting open knowledge creation and sharing in the early phases of the strategic innovation process using the scenario method and the GDSS and the overall phenomenon of the study.*

Considering the doctrines and the research focus, on the basis of extensive literature analysis and relatively long working experience in managerial issues, the following research questions were set to serve the purpose of this thesis and read as follows:

1. How can the process of knowledge creation and sharing during the early phases of the strategic innovation process be supported?
  - a. What are the central challenges in supporting the process of future-oriented knowledge creation and sharing?
  - b. What are the potential benefits of knowledge convergence in the early phases of the innovation process?
2. How can the utilization of the new knowledge created during the early phases of the strategic innovation process in the organizations be promoted?
  - a. How can future-oriented knowledge converge effectively into concrete innovation ideas?
3. Which supporting knowledge management methods are potentially appropriate in the collaborative and open innovation process considering a networked business environment?

Through these research questions and objectives examined in separate publications (Figure 6) new theoretical and empirical insights for the innovation and knowledge management disciplines and the development of the scenario method are provided on the basis of findings in real-life cases and extensive literature analysis.



*Figure 6. Relations of the used group work methods to the other objectives and the publications.*

Due to the multidisciplinary character of this thesis and the relatively long research period, the group work methods were used differently and from different points of views. In the publications, the research focus is examined sequentially from different perspectives, as shown above in figure 6, to ensure the holistic understanding of the phenomenon and its implications.

### 1.3 The research facilities of this study

This section introduces three research projects, *Wireless eBusiness* and *Developments of electricity distribution business*, which acted as case studies for this thesis to develop and test the created new construct (Figure 7). The third research project, *Future scenarios and business models of distributed energy systems* was used to test and validate the usability of the new construct. All the projects were conducted at Lappeenranta University of Technology in the Technology Business Research Center (TBRC) and were funded by the National Technology Agency of Finland TEKES and the participating companies.



Figure 7. Case studies and the publications.

**In the first case study**, the scenario process was part of a larger research project ‘*Wireless eBusiness*’ aiming at a better understanding of the management of the corporate strategy process and providing industrial foresight. The multi-disciplinary structure of the research project can be seen in Figure 8. The research process consisted of seven separate phases of which the first four phases provided background knowledge for the following phase “Foresights of wireless technology”. In this phase, the scenario process was conducted to manage the creation of new knowledge on the basis of explicit and tacit knowledge gathered during the preceding phases of the research project and to facilitate interaction among the participants. During the scenario process, new knowledge about the future business opportunities of wireless technology was created, new requirements for future capabilities identified and learning within the collaborative network facilitated. The participants in the research project were two leading global pulp&paper companies StoraEnso and UPM Kymmene, the international telecom company TeliaSonera, the SME software company Modultek, the National Technology Agency of Finland TEKES and the Technology Business Research Center at Lappeenranta University of Technology (TBRC). The project started in April 2001 and continued for three years. The management and facilitation of the research project was conducted by the experts of the TBRC.

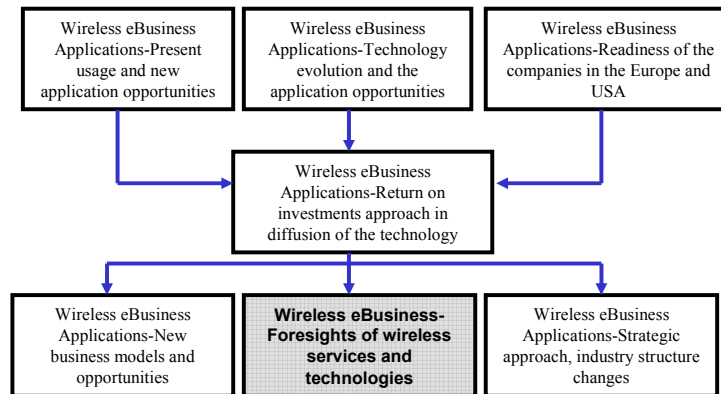


Figure 8. The phases of the research project “Wireless eBusiness” (Laaksonen, 2001a).

**In the second case study** ‘*Developments of electricity distribution business*’, a combination of the heuristic scenario method and the GDSS laboratory located at Lappeenranta University of Technology in the Department of Industrial Engineering and Management was used in the innovation process aiming at providing new innovative business ideas for the electricity distribution business which is changing radically due to deregulation in Finland and the EU. During the research project, the aim of the heuristic scenario process was to create new knowledge about the requirements for the future business environment, to identify future business opportunities and to provide four alternative scenarios resulting in a vision for the development of the industry. The heuristic scenario process worked as a knowledge base for idea generation in the GDSS. Results of the research are presented in the Research report (Partanen et al., 2004). The participants in the research project were the global electrical engineering company ABB, the international energy company Fortum, the international telecom company TeliaSonera, three local electrical distribution companies Koillis-Satakunnan Sähkö, Jyväskylän Sähkönsiirto and Tampereen Sähkölaitos, SME software and electrical engineering companies: Eltel Networks, Empower, Enermet, Head Power, MX Elextrix, Process Vision, Power Q, Telewice and Wimotec, and SVK-Pooli; the National Technology Agency of Finland TEKES, Lappeenranta University of Technology and Tampere University of Technology. The research project started in January 2003 and will continue for three years.

**The third case study**, the research project ‘*Future scenarios and business models of distributed energy systems*’ is part of the DENSY Programme which is a Finnish national technology program for distributed energy systems and will run during 2003-2007. The program will focus on system integration and commercial services of the distributed generation of power, heating and cooling. The main objectives of the program are to assist the Finnish industry, especially SMEs in developing products and services for the global market, make Finnish technology known, build an innovation environment of world-class and produce commercial products for several niche-markets by 2010.

In this case study, the used research methods – the heuristic scenario method and the GDSS – make it possible to create new knowledge in the inter-organizational context and then utilize it by generating new business ideas for the future. From the research point of view, this case study was used to test the created construct during the preceding cases to confirm the

generalization of the research results. The main goals of the research project are to provide a holistic understanding about the development of the distributed energy systems, to create alternative future scenarios and descriptions of the value networks in the year 2019, to evaluate technological development from the business model point of view and reveal future service business opportunities for further development, and to provide recommendations about the strategic alternatives for the R&D work for the Finnish distributed energy industry. The first phase of the research project started in April 2004 and reported in January 2005 (Bergman et al., 2005). The second phase will start in January 2005 and continue for one year. The research partners are the Institute of Power Engineering at Tampere University of Technology, VTT Industrial Systems, Intelligent Products and Services in VTT Technical Research Centre of Finland and TEKES.

#### **1.4 Structure of the study**

This thesis consists of two parts. The purpose of Part I is to give an overview of the study. Part II introduces the five consecutive and complementary research papers concerning the focus of the study. Part I of the study consists of five chapters: Chapter One introduces the research field, purpose and research questions of the study, and finally the structure of the thesis. Chapter Two presents the research focus in detail and introduces the concept created. Chapter Three presents the research strategy and methodologies. Chapter Four introduces and summarizes the research papers. Chapter Five presents the theoretical and managerial contribution of the dissertation clarifying the limitations of the research, and delineates possible future research areas around the focus of the study. Part II includes the research papers relating to the research focus discussed in Part I. The structure of the thesis is specified in Table 3.

*Table 3. The structure of the thesis.*

<b>Part I: Overview</b>
<b>1. Introduction</b> Presentation of the background, research fields, the research questions of the thesis, case studies
<b>2. Innovation process and knowledge creation and sharing</b> Concept of knowledge creation, sharing, and utilization in the innovation process
<b>3. Research methodologies</b> Introduction of the used methodologies: qualitative case study research and the constructive research approach
<b>4. Summaries of the publications</b>
<b>5. Conclusion</b> Presentation of the theoretical and managerial contribution of the papers and the thesis
<b>Part II: Publications</b>
<b>Publication 1</b> Managing knowledge creation and sharing – Scenarios and dynamic capabilities in inter-industrial knowledge networks
<b>Publication 2</b> Creating future capabilities – Scenario process in inter-industrial networks
<b>Publication 3</b> Managing the exploration of new operational and strategic activities using the scenario method – Assessing future capabilities in the field of electricity distribution industry
<b>Publication 4</b> The exploration of future service innovations in the radically changing business environment within the electricity distribution industry
<b>Publication 5</b> Management of controlled open innovation process

## 2 INNOVATION PROCESS AND KNOWLEDGE CREATION AND SHARING

### 2.1 Introduction

Watts and Porter (1997) argue that creating new successful innovations knowledge about the future technological, market and societal development is needed. In organizations, different methods and practices to anticipate the development of technology, markets etc. has been routinely utilized in strategic management processes (see e.g. Porter, 1985; Porter et al., 1991; Martino, 1993; Burgelman et al., 1996). Mostly, the methods are used to provide forecasts of the technological or market development trajectories and to bring additional information, often numeric data, in the decision-making. From the innovation management point of view, the role of different anticipatory methods is to stimulate and guide innovation processes by giving for instance new limits and information to reach for (Jantsch, 1967; Hamel et al., 1994; Leonard and Sensiper, 1998; Miller and Morris, 1999; Ackoff, 1999) which stress the importance of creative tension between the present and future for the innovation creation (Miller and Morris, 1999).

In the innovation process and in general, knowledge itself can be certain and known, uncertain, or unknown. Porter et al. (1991) claim that when evaluating the newness of knowledge and its value, the criteria are conceptions of desirable states of affairs guiding the judgments across specific objects and situations. The legitimacy and perceived value are context-specific and depend on the perspective considered (van der Heijden, 2004). Criteria are compiled on the basis of goals, problems, and choice behavior regulated by rules and routines (Choo, 1998). In other words, newness and value of knowledge are subjective issues driven by human values. Especially, future-oriented knowledge is highly subjective and valued by human perceptions of the development of the issue. From the knowledge management point of view, the ability to sense and presence the emerging opportunities concerns the creation of future-oriented “self-transcending” knowledge (see Table 4) (Scharmer, 2001). According to Polanyi and Prosch (1975), “the knowledge of future is based on heuristic act of insights where the mind is in contact with a still-hidden reality” (cf. Kulkki and Kosonen, 2001: 246). Ingvar (1985) has noticed in his research that the ability to act in the present is based on the abilities of the human mind to create plans of future, as he calls “memories of future”. Aligica (2003) states that the knowledge of future is attached to personal knowledge repositories of background information, which becomes explicit, i.e. prediction, through the social process. According to Kulkki and Kosonen (2001), the future-oriented knowledge means stretching the historical and experience-based tacit knowledge over the discontinuity between the past and the future being an open-ended problem-solving process. Leonard and Sensiper (1998) argue that the intuitive, creative and still non-conscious tacit knowledge is of increasing value to innovative efforts and problem-solving abilities.

Table 4. Epistemological assumptions of knowledge (Scharmer, 2001: 142).

Epistemology	Explicit knowledge	Tacit knowledge	Self-transcending knowledge
Type of knowledge	Knowledge about things	Knowledge about doing things	Knowing about thought-origins for doing things
Data	External reality	Enact reality	Not-yet-enacted reality
Experience type	Observation experience	Action experience	Aesthetic experience
Action-reflection ratio	Reflection without action	Reflection-on-action	Reflection-in-action
Truth	Matching reality	Producing reality	Presencing reality
Truth criterion	Can you observe it?	Can you produce it?	Can you presence it?
Perspective	External: view on object reality	Internal: view on enacted reality.	Both internal and external: view on not-yet-enacted reality
Subject-object relation	Separation	Unity (after action)	Unity (in action)

From both the innovation and knowledge management point of views, the source of an innovation is new knowledge which is created from the historical, experience-based explicit and tacit information through some social knowledge development process. As Nonaka and Takeuchi (1995) state, the innovation process is a continuous process to capture, create, leverage, and retain knowledge. Druker (1993: 173) argues that “the innovation is the application of knowledge to produce new knowledge...which requires systematic efforts and high degree of organization”.

**2.2 Scenario method**

Scenario method is part of the futures research which has been considered as a complementary discipline in the field of scientific research. According to Mannermaa (1999), futures research is still an emerging discipline and he positions it within the field of scientific research and action, shown in Figure 9.

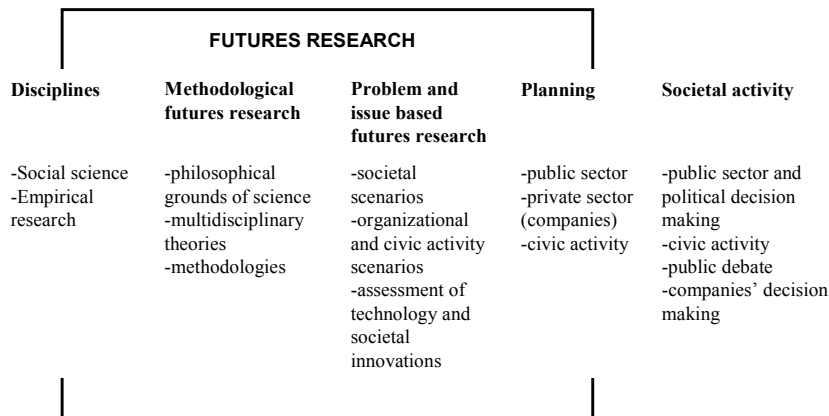


Figure 9. Position of the futures research in the field of scientific research and action (Mannermaa, 1999: 90).

Mannermaa (1999) argues that the scenario creation can be seen as its own paradigm within the futures research. He divides the future research into three main paradigms shown in Table 5.

*Table 5. The main characteristics of the paradigms in futures research (Mannermaa, 1999: 343).*

	<b>Descriptive futures research</b>	<b>Scenario paradigm</b>	<b>Evolutionary futures research</b>
<b>Scope of approach</b>	Narrow perspective	Broad perspective	Systemic perspective
<b>Goal of research</b>	Forecasting	Identification of alternatives	Forecasting and identifications of bifurcations; future assessment
<b>Methods</b>	Mainly qualitative	Mainly qualitative	Qualitative and quantitative
<b>Attitude towards scientific research</b>	Use of scientific methods	Creativity more important than formal methods	Use of scientific theories and methods
<b>Attitude towards the future</b>	Future is predictable	Alternatives for the future are identifiable	Interplay between almost predictable and unpredictable phases
<b>Idea of societal change</b>	Progress usually growth	Progress, catastrophes, other views	Evolution
<b>Domain of competence</b>	Quantifiable objects in a nonturbulent environment	In principle: "whatever"	Human systems
<b>Time horizon</b>	Rather short	Varied	Varied
<b>Nature of the results</b>	Forecasts	Possible stories about the future	Forecasts and analyses of bifurcations
<b>Relation of empirical data</b>	Discovering the invariance in the past	Varied	Multiversal idea of reality

Schoemaker (1991: 550) lists some preconditions when the use of scenarios is favorable:

1. Uncertainty is high (relative to one's ability to predict or adjust)
2. Too many costly surprises have occurred in the past
3. Insufficient new opportunities are perceived and generated
4. The quality of strategic thinking is low (e.g. because strategic planning has become too routinized)
5. The industry has experienced significant change or is about to
6. A common language and framework is desired, without stifling diversity
7. Strong differences of opinion exist, each of which has its merits
8. Competitors are using scenarios

In this study, the use of the scenario method as a method of futures research is based on the preliminary research concerning the technological forecasting methods (Bergman, 2002) which showed the applicability of the scenario method for the holistic and integrative future-oriented knowledge creation in the extremely complex and radically changing environment. It also showed that the scenario method has been widely and successfully applied in many organizations for this purpose.

Traditionally, scenario method has been used for creating a holistic understanding about the future development of the business environment to provide alternative development paths for the future (see e.g. Schoemaker, 1991; Porter et al., 1991; Mintzberg, 1994a; Schoemaker, 1995; Burgelman et al., 1996; Tidd et al., 2001). In other words, the scenario method is an ongoing communicative learning process that enables periodical revising of corporate strategies in the light of current business environment (Millett et al., 1986; Schwartz, 1996; Masini et al., 2003). But the most important role for the scenario process is to build intentional or unintentional strategic conversations or dialectic processes (Schwartz, 1996). The scenario process enables divergent thinking and makes it possible to converge created new knowledge into explicit presentations, i.e. scenarios. The scenario process has also been considered an appropriate management method enabling individuals to interact in a networked context to create knowledge of the future (Roubelat, 2000; de Jouvenel, 2000; van der Heijden et al., 2002). During the process, the focus is on future-oriented knowledge embedded in expertise, beliefs, the behavior of individuals, social and cultural norms and customs in different societies and organizations (see e.g. Ingvar, 1985; Scharmer, 2001; Kulkki and Kosonen, 2001; Aligica, 2003).

Schoemaker (1993) considers the scenario method as a method to enhance human thinking and communication. He compares it with other thinking methods shown in Table 6, and argues that the other methods are more limited in scope and organizational use.

Table 6. Summarization of the methods to enhance strategic thinking (Schoemaker, 1993: 195).

	Systematic thinking tool	Internal communication device	Identifier of strategic issues	Problem scope	Uncertainty bounding
1. Lateral thinking and brainstorming	No	No	Somewhat	Broad	No
2. Synectics and morphological analysis	Medium	Perhaps	Perhaps	Limited	No
3. Delphi method	High	Yes	No	Narrow	Yes
4. Dialectic reasoning	Perhaps	Perhaps	Yes	Broad	Perhaps
5. Multiple scenarios	Medium	Yes	Yes	Broad	Yes
6. Requisite decision modeling	High	Yes	Perhaps	Narrow	Perhaps
7. Dynamic systems analysis	High	Yes	Perhaps	Medium	Perhaps

According to Masini and Vasquez (2003), there exist several different variations of scenario methods which can be classified in three main categories including a various number of procedural steps (see Appendix 1):

1. Intuitive approaches (e.g. Schwartz, 1996)
2. Heuristic approaches (e.g. Meristö, 1991; Schoemaker, 1991; van der Heijden et al., 2002)
3. Statistic approaches (e.g. Godet, 1993)

The scenario method is an effective group work method which has many advantages but also includes some drawbacks. The main advantages and disadvantages are derived from the extensive literature analysis and presented in Table 7.

Table 7. Some advantages and disadvantages of the scenario method as an interactive group work method.

Advantages	Disadvantages	Source
<ul style="list-style-type: none"> <li>▪ Simplifies complex issues<sup>1,3</sup></li> <li>▪ Enhances organizational communication<sup>1,3</sup></li> <li>▪ Reduces overconfidence<sup>1</sup></li> <li>▪ Overcomes organizational blind spots<sup>1</sup></li> <li>▪ Broadens mental models<sup>1</sup></li> <li>▪ Overcomes cultural barriers in organizations (communication, hierarchical, ignorance, fragmentation, language)<sup>3,6</sup></li> <li>▪ Better commitment to decisions<sup>3,4</sup></li> <li>▪ Enables organizational learning<sup>1,3,5</sup></li> <li>▪ Creates a holistic understanding of the external business environment<sup>1,3,4</sup></li> <li>▪ Helps to frame the problems<sup>3,4</sup></li> <li>▪ Flexible process<sup>3,6</sup></li> <li>▪ Bounds uncertain issues<sup>3,4</sup></li> <li>▪ Enables use of expertise and intuition<sup>2,3,4</sup></li> <li>▪ Stimulates strategic thinking<sup>6</sup></li> <li>▪ Can incorporate other techniques<sup>7</sup></li> <li>▪ User-friendly<sup>7</sup></li> <li>▪ Identifies new opportunities<sup>3,8</sup></li> <li>▪ Enables resource allocation<sup>7</sup></li> <li>▪ Enables evaluation of investments and projects<sup>2,3,7,8</sup></li> <li>▪ Enables problem-solving<sup>9</sup></li> <li>▪ Enables strategic planning<sup>1,2,3,6,7</sup></li> <li>▪ Enables networking<sup>10</sup></li> <li>▪ Enables knowledge convergence<sup>10</sup></li> <li>▪ Improves decision-making<sup>11</sup></li> <li>▪ Improves performance of organizations<sup>11</sup></li> <li>▪ Participative<sup>12</sup></li> <li>▪ Enables system thinking<sup>12</sup></li> <li>▪ Results are (narrative) easy to understand<sup>3</sup></li> <li>▪ Encourages new ideas<sup>3</sup></li> <li>▪ Effective management tool<sup>3</sup></li> </ul>	<ul style="list-style-type: none"> <li>▪ Detailed scenarios lose credibility<sup>1</sup></li> <li>▪ Time consuming process<sup>3</sup></li> <li>▪ Demands management's commitment to whole process<sup>4</sup></li> <li>▪ Results may be unfocused<sup>2</sup></li> <li>▪ Lack of numeric data and results<sup>2,3</sup></li> <li>▪ Relies too much on intuition<sup>3,4</sup></li> <li>▪ Results remain often on the hypothetical level<sup>4</sup></li> <li>▪ Demands experienced facilitator of the process<sup>6,7</sup></li> <li>▪ Cannot be used as truth (prediction)<sup>1,4</sup></li> <li>▪ Lack of objectivity<sup>1,4</sup></li> <li>▪ Too much simplicity<sup>7</sup></li> <li>▪ Little input on the operational level<sup>7</sup></li> <li>▪ Lack of transparency of process<sup>7</sup></li> <li>▪ Lack of involvement during the process<sup>9</sup></li> <li>▪ Lack of time<sup>3</sup></li> <li>▪ Lack of action<sup>9</sup></li> <li>▪ Confusion between the scenarios and strategies<sup>9</sup></li> <li>▪ Long lead-times<sup>9</sup></li> <li>▪ Potentially unwieldy<sup>12</sup></li> <li>▪ Biased by dominant persons, groupthink<sup>12</sup></li> <li>▪ Lack of consensus<sup>12</sup></li> <li>▪ Lack of concreteness<sup>9,12</sup></li> <li>▪ Hindsight bias (information you want to hear to confirm your decisions)<sup>3</sup></li> <li>▪ Decision avoidance<sup>3</sup></li> <li>▪ Scenario as a forecast<sup>1,3,6</sup></li> </ul>	<ul style="list-style-type: none"> <li><sup>1</sup> (Schoemaker, 1993)</li> <li><sup>2</sup> (Wilson, 2000)</li> <li><sup>3</sup> (van der Heijden et al., 2002)</li> <li><sup>4</sup> (Schoemaker, 1991)</li> <li><sup>5</sup> (Bood et al., 1997)</li> <li><sup>6</sup> (Schwartz, 1996)</li> <li><sup>7</sup> (Linneman et al., 1985)</li> <li><sup>8</sup> (Schoemaker, 1992)</li> <li><sup>9</sup> (Godet and Roubelat, 1996)</li> <li><sup>10</sup> (Roubelat, 2000)</li> <li><sup>11</sup> (Phelps et al., 2001)</li> <li><sup>12</sup> (Miller et al., 2003)</li> </ul>

### 2.2.1 Convergence of knowledge embedded in scenarios

According to intensive scenario literature analysis, the main purpose and advantage in scenario making is the process itself. For example, Wack (1985a), Schoemaker (1991), van der Heijden (2002), and Masini and Vasques (2003) stress the communicative and learning effects during the scenario process which lead to better decisions. Godet (2000), Roubelat (2000), de Jouvenel (2000), and Meristö (1991) stress the action-oriented scenario process, which means that on the basis of the scenarios, concrete decisions and actions are made. Schoemaker (1992; 1995) and Ringland (2002) have developed the scenario process further to make the knowledge embedded in scenarios more explicit and focused. According to Schoemaker (1992), scenarios make it possible to determine the market segments and recognize and link the company's competencies into future opportunities which results in visions for the company. Ringland (2002) connects the scenarios with the market attractiveness and organizational capabilities which makes it possible to analyze the competitiveness of company's business portfolios. Miller and Waller (2003) have combined scenarios and real option methods to assess future opportunities revealed during the scenario process in the form of strategic investments. Summary of the knowledge convergence in the scenarios is shown in Table 8.

Table 8. Summary of the knowledge convergence in different approaches creating scenarios.

	<b>Analysis and convergence approaches of knowledge in scenarios</b>	<b>Results</b>
Wack (1985a,b)	<ul style="list-style-type: none"> <li>▪ Communication in organization</li> <li>▪ Option planning</li> <li>▪ Visioning</li> </ul>	<ul style="list-style-type: none"> <li>▪ Learning, recognition of uncertainties of the environment</li> <li>▪ Faster adaptation of the operations</li> </ul>
Schoemaker (1991; 1992; 1995)	<ul style="list-style-type: none"> <li>▪ Communication in organization</li> <li>▪ A key-success-factor analysis</li> <li>▪ Market segmentation and competence analysis</li> <li>▪ Visioning</li> </ul>	<ul style="list-style-type: none"> <li>▪ Learning, recognition of uncertainties of the environment</li> <li>▪ Faster adaptation of operations</li> <li>▪ Recognition of competencies, and market segments</li> </ul>
van der Heijden (2002)	<ul style="list-style-type: none"> <li>▪ Communication in organization</li> <li>▪ Stakeholder analysis</li> <li>▪ System thinking</li> </ul>	<ul style="list-style-type: none"> <li>▪ Learning, recognition of uncertainties of the environment</li> <li>▪ Problem-solving</li> <li>▪ Recognition of business opportunities</li> <li>▪ Improvement of organizational anticipation</li> <li>▪ Management of planning</li> </ul>
Masini and Vasques (2003)	<ul style="list-style-type: none"> <li>▪ Communication in organization</li> <li>▪ Determination of key factors and actors of the environment</li> <li>▪ Questioning of three modes of scenarios (utopian, catastrophic, and desired)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Education and clarification</li> <li>▪ Identification of problems and opportunities and their variables</li> </ul>

Ringland (2002)	<ul style="list-style-type: none"> <li>▪ Communication</li> <li>▪ Market attractiveness analysis</li> <li>▪ Business portfolio analysis</li> </ul>	<ul style="list-style-type: none"> <li>▪ Learning, recognition of uncertainties of the environment</li> <li>▪ Faster adaptation of operations</li> <li>▪ Evaluation of investments and market entry</li> </ul>
Schwartz (1996)	<ul style="list-style-type: none"> <li>▪ Communication and strategic conversation in organization</li> <li>▪ Leading indicators</li> </ul>	<ul style="list-style-type: none"> <li>▪ Learning, recognition of uncertainties of the environment</li> <li>▪ Faster adaptation of operations</li> </ul>
Godet (2000)	<ul style="list-style-type: none"> <li>▪ Communication in organization</li> <li>▪ Morphological analysis</li> <li>▪ MICMAC analysis</li> </ul>	<ul style="list-style-type: none"> <li>▪ Learning, recognition of uncertainties of the environment</li> <li>▪ More relevant decisions</li> <li>▪ Pooling and ranking of uncertainties and drivers</li> </ul>

As a whole, the knowledge embedded in scenarios remains in relatively divergent level after the scenario process, although the process is designed to simplify a very complicated phenomenon and integrate knowledge and information sources (see e.g. Roubelat, 2000). According to Phelps *et al.* (2001), further development and analysis of the scenarios is time consuming due to the fact that the only way is to re-perform the process. In other words, it means learning through experimentation and feedback (van der Heijden *et al.*, 2002).

### 2.2.2 Scenario method as a knowledge management tool

From the knowledge management point of view, the scenario process is a facilitated and managed process for interactive knowledge creation and sharing (van der Heijden *et al.*, 2002). From the innovation management point of view, it can enable collaborative knowledge acquiring in a networked environment to reveal new potential innovative product and service ideas (Porter *et al.*, 1991). The scenario process helps to make sense of a wide variety of unstructured, complex and contradictory knowledge which has both tacit and explicit dimensions. Scenarios that are drawn through different personal experiences and perspectives have a multidisciplinary and multidimensional character and help organizations and individuals to develop and broaden mental maps of possible future realities and understand the fundamental drivers of business, market and technological trends and changes (Wack, 1985b; Schoemaker, 1991; 1992; 1993; Teece, 1998; Masini and Vasquez, 2003). According to Grant (2003) and Chermak (2003), the primary contribution of scenario planning is to promote a process of strategic thinking and organizational knowledge creation through learning. Grant continues that organizations need to have channels and forums for communication and knowledge sharing and they should be capable of promoting a dialogue between the different levels of organization. Nonaka and Takeuchi (1995), Nonaka and Toyama (2003), and Nonaka *et al.* (2000) state that to create new meanings through interaction the participants in the process need to have a shared, physical context, i.e. *ba*. The scenario process involves organizational leaders and managers, R&D centers, associations, different groups of experts and many other stakeholders in the form of a structured and

managed network to share knowledge and to create alternative presentations of the future on the basis of this shared knowledge (Roubelat, 2000).

These networks vary from intra-organizational working groups to inter-organizational virtual networks. The common task of the networks is to produce new knowledge and enhance the performance of the participating organizations. When managing knowledge, organizations must specialize and fragment knowledge and expertise but at the same time integrate them into a certain task (Collinson, 2001). This leads organizations to form collaborative, inter-organizational learning knowledge networks around a common goal which offers a place or some degree of coordinated structure. This fosters participants to share their knowledge and create new knowledge through interaction between individuals throughout the organization (Debackere et al., 1994; Amidon Rogers, 1996; Bennett III, 1998; Leonard and Sensiper, 1998; Roubelat, 2000; Lubit, 2001; Mudambi, 2002; Nonaka and Toyama, 2003). The creation of new knowledge in these networks requires a managed process to facilitate dialectic social communication in a physical context and to ensure learning and knowledge accumulation in organizations (Blumentritt et al., 1999; Mentzas et al., 2001; Weisenfeld et al., 2001; Buckley et al., 2002; Kash and Rycroft, 2002; Nonaka and Toyama, 2003). According to Chesbrough and Teece (1996), Collinson (2001), de Meyer (1999) and Weisenfeld *et al.* (2001), networks need to be managed and coordinated from someone's point of view in order to succeed. Scenario creation is always an intentional and structured process for a certain task and point of view.

Van der Heijden *et al.* (2002) and Wilson (2000) state that the scenario process is considered a successful management tool in a communicative social context. The scenario process has been developed to help manage knowledge creation and sharing through interaction between individuals and organizations. The scenario process is a method for steering complex and creative group innovation and decision processes (Millett and Randles, 1986; Schoemaker, 1991; 1993). In other words, it works as a facilitated and loosely structured context enabling a group of individuals to be intermediaries (or interface) in interaction between the internal and external environment connecting the participants into a community which involves a number of individuals from different organizations working on the same task under a shared vision. In such a community, individuals have access to a wider organizational knowledge base, the connections become more interactive, and more holistic interpretations are formed (Daft et al., 1984). It provides a framework for rational discussion about alternative views emerging inside and outside the organization (Schoemaker, 1993). Scenarios reflect beliefs, expertise and intuition of individuals and organizations concerning the future, i.e. future-oriented knowledge (Bood and Postma, 1997; Johannessen et al., 1999; Scharmer, 2001). Scenarios are shared collective representations of the possible future of an organization and its environment (Wack, 1985a; Roubelat, 2000). These representations reveal a potential variety of emerging opportunities to be turned into new innovations.

The challenge for the management of such processes is to empower and harness the skills, knowledge and experience learned inside and outside the networks of the organization (Schwartz, 1996; van der Heijden et al., 2002). Learning from the business environment is an organizational ability to experiment, continually to explore new opportunities for creating new sources of success, and to change behavior (van der Heijden et al., 2002; Chermak et al., 2003; Leppimäki et al., 2004). According to Grant (2003), in corporate strategies the scenario process enhances sensitivity to emerging discontinuities in a corporation's evolution and ensures short-term flexibility and stable long-term development of business. In other words,

scenarios provide a method for discovering and comparing firm-specific capabilities with future requirements, and making it possible to face the situations of complex rapid change (Schoemaker, 1992).

### 2.2.3 Scenario process and knowledge creation

According to Masini and Vasquez (2003), creating scenarios means carrying out an ongoing cumulative process, establishing a project periodically or when needed. The scenario process helps create an interactive and structured social environment for an organizational communication process, enabling exploration and discussions of the emerging future. The scenario process has a certain and common structure involving a varying number of steps (e.g. (Schoemaker, 1993; Schwartz, 1996; Godet, 2000; van der Heijden et al., 2002; Masini and Vasquez, 2003). Phelps et al. (2001) argue that the scenario process can be conceptualized into four stages: (1) the delimitation of the focus to (2) interactive knowledge sharing and creation, forming the scenario context, and (3) from resulting combinations of new knowledge in the form of scenarios to organizational development through (4) the implementation of the scenarios (Figure 10).

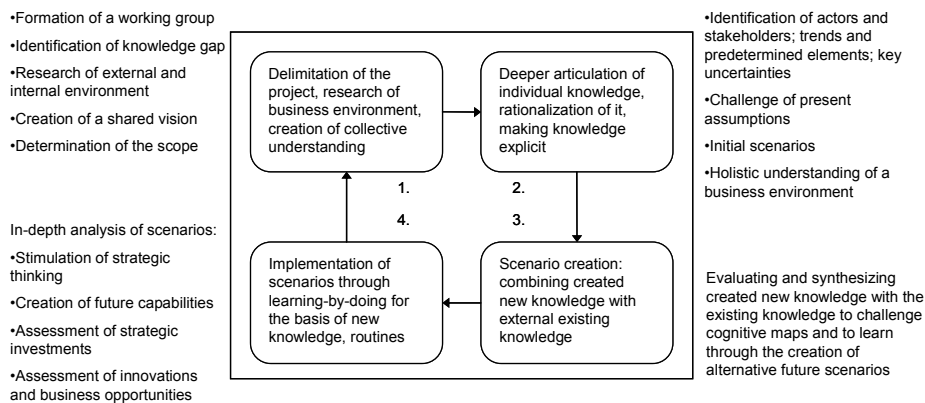


Figure 10. Ongoing scenario process and knowledge creation (Bergman et al., 2004b: 69).

**1. Preparation of the scenario process: background analysis and delimitation of the focus.** The scenario process starts by organizing a working group from the participating organizations by connecting the organizations in a knowledge sharing network (Roubelat, 2000). The working group identifies the knowledge gap between the network and the environment, and between the individuals of the working group. This phase may require a long research period and several meetings depending on the goals of the scenario process. The analysis of the industry explains the dynamics of the external business environment. In this phase, the shared collective knowledge base, a common language and practicalities for the basis of the scenario process and knowledge creation are provided. During this phase, the scope and the goals around a shared loose vision are created (Godet, 2000; von Krogh et al., 2001).

**2. Knowledge base construction.** The articulation of shared knowledge is continued by having intensive sessions within the working group and face-to-face meetings to rationalize the knowledge created in the preceding phase. The working group can be enlarged by inviting

temporary partners to bring new knowledge and insight into the process, e.g. economists, social and cultural specialists, technological experts etc. Surveys or Delphi panels can also be conducted to examine wider opinions about the development of the issue (von Krogh et al., 2001; van der Heijden et al., 2002). When the backgrounds have been examined, the stakeholders, driving forces, and the required capabilities of future business are recognized, and the working group explores their significance and logical implications (Schwartz, 1996; van der Heijden et al., 2002). In the end of this phase, the disseminated and articulated tacit knowledge within the working group is transformed into explicit knowledge and is represented in the form of initial scenarios.

*3. Scenario creation.* The scenario process is continued by integrating the existing explicit organizational and collected external knowledge into created new knowledge (Schoemaker, 1992; Godet and Roubelat, 1996; Nonaka and Toyama, 2003). The final alternative scenarios are created through the evaluation and combination of knowledge gathered during the preceding phases on an intuitive, *heuristic* or statistic basis (Schoemaker, 1997; Masini and Vasquez, 2003). The goal is to identify the logics of the business environment that are important and relevant to the issue, and then organize the possible outcomes of the scenarios around these logics (Schoemaker, 1993; van der Heijden et al., 2002). This phase provides alternative scenarios of the future related to the issue considered. The scenario creation process enhances organizational learning, reveals blind spots in the decision-making challenging the present assumptions, and simplifies the complex reality.

*4. Implementation of scenarios.* The scenarios make it possible to evaluate organizational capabilities against future requirements, and develop new capabilities and renew existing ones to meet them (Schoemaker, 1992; Mason, 2003). The scenarios also serve as a platform for the evaluation of new innovations and business ideas to assess their possibilities and market potentials, e.g. making “what if questions”. The scenario process stimulates strategic thinking and challenges present routines and mental models, and leads to a continuous and cumulative knowledge creation and learning process (Wack, 1985b; Bennett III, 1998; van der Heijden et al., 2002; Masini and Vasquez, 2003). Finally, the scenarios are used as a communication tool to diffuse explicit future-oriented knowledge throughout the organization and accelerate the process of organizational learning (Bood and Postma, 1997).

## **2.3 Utilization of knowledge in the innovation process using the GDSS**

### *2.3.1 Introduction*

Utilization of knowledge in innovation processes confronts many barriers, e.g. cultural, economic, mental and hierarchical which should be taken into account (see e.g. Bood and Postma, 1997; von Krogh, 1998; Fahey and Prusak, 1998; van der Heijden et al., 2002). Especially, when considering knowledge in collaborative and open innovation processes where governance and appropriability issues are not as clear as in closed innovation processes the utilization methods and practices of created knowledge become an important aspect (Chesbrough and Teece, 1996; Sawhney and Prandelli, 2000; Chesbrough, 2003; Teece, 2004).

Often knowledge creation and utilization are sequential activities in the early phases of the innovation process (Nonaka and Takeuchi, 1995; Cooper, 1997; Miller and Morris, 1999). To make new knowledge productive, the most important knowledge from external sources needs

to be selected and implemented for further internal development which often leads to new innovative business ideas (Gallupe et al., 1993; Miller and Morris, 1999; Turban et al., 2001). Creating new ideas and innovations means a creative and forward (building up something new) group-thinking and decision-making process (Osborn, 1963; de Bono, 1982). Transferring knowledge into the organizations and utilizing it in their internal innovation processes, a number of individuals from different departments, e.g. marketing, R&D and HRM, are involved. In this context, supportive group-working management and decision systems are essential (Eden, 1990; Turban and Aronson, 2001).

### *2.3.2 Group decision support system*

Dhar and Olson (1989) state that computer-based systems can be categorized into two general groups: the communication-oriented and problem-solving systems. Keen and Norton (1978) claim that “decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions.” It is a computer-based support system for management decision makers who deal with semistructured problems (cf. Turban and Aronson, 2001: 13). In other words, decision support systems (DSS) have been developed to enhance the use of organizational and individual knowledge in creative problem-solving and decision-making processes (Turban and Aronson, 2001). Finley and Marpels (1992) argue that the Group DSS makes it possible to support directly the group decision processes enabling participants to work together in a facilitated context. They (1992) state that the group decision support system (GDSS) is a subgroup of the decision support systems.

To improve the performance in group work, and especially, knowledge utilization in innovation processes, different decision support systems have been developed, shown in Table 9 (see e.g. Gallupe and Cooper, 1993; Turban and Aronson, 2001).

Table 9. Decision support framework (Turban and Aronson, 2001: 12).

Type	Operational control	Managerial control	Strategic planning	Technology support needed
Structured decisions	Accounts receivable order entry	Budget analysis, short-term forecasting, personal reports	Financial management (investment), warehouse location, distribution systems	Management information systems, operations research models, transaction processing
Semistructured decisions	Production scheduling, inventory control	Credit evaluation, budget preparation, plant layout	Building new plant, mergers and acquisitions, new product planning, quality assurance planning	DSS, KMS
Unstructured decisions	Selecting a cover for magazine, buying software	Negotiating, recruiting an executive, lobbying	R&D planning, new technology development, social responsibility, planning	IDSS <sup>1</sup> , ES, neural networks
Technology support needed	Management information system, System management science	Management science, DSS <sup>2</sup> , ES <sup>3</sup> , EIS <sup>4</sup> , SCM <sup>5</sup>	EIS, ES, neural networks, KMS <sup>6</sup>	

Due to the group-working nature of the innovation process, the GDSS improves interactive group work in the utilization of knowledge and expertise of a wide variety of actors, and helps to build a creative and open-minded environment (Finlay et al., 1992; Gallupe and Cooper, 1993; Turban and Aronson, 2001; Elfvengren et al., 2004). The GDSS reduces the process losses in conventional decision-making, disorganized and unfocused activity, the dominance of any participants and the social pressure to conform, and enables a productive utilization of prior and new knowledge (Torkkeli et al., 2002; Elfvengren et al., 2004). According to Turban and Aronson (2001), using the right approach in idea generation during the innovation process, knowledge can be utilized more effectively and more creative ideas can be generated. Despite the many advantages of the Group DSS, scholars have identified disadvantages which should be noticed as well, shown in Table 10.

<sup>1</sup> IDSS, Intelligent Decision Support Systems and agents

<sup>2</sup> DSS, Decision Support Systems

<sup>3</sup> ES, Expert Systems

<sup>4</sup> EIS, Enterprise (executive) Information Systems

<sup>5</sup> SCM, Supply Chain Management

<sup>6</sup> KMS, Knowledge Management Systems

Table 10. Benefits and dysfunctions of Group DSS (Turban and Aronson, 2001: 273).

Benefits	Dysfunctions
<ul style="list-style-type: none"> <li>▪ Groups are better than individuals at understanding problems</li> <li>▪ People are held accountable for decisions in which they participate</li> <li>▪ Groups are better than individuals as catching errors</li> <li>▪ A group has more information than any one member. Groups can combine this knowledge to create new knowledge</li> <li>▪ It may produce synergy during problem-solving</li> <li>▪ Working in a group may stimulate creativity of the participants and the process</li> <li>▪ A group may have better and more precise communication working together</li> <li>▪ Group members have their egos embedded in the decisions, and so they will be committed to the solutions</li> <li>▪ Risk propensity is balanced. Groups moderate high-risk takers and encourages conservatives</li> </ul>	<ul style="list-style-type: none"> <li>▪ Social pressures of conformity may result in group-think</li> <li>▪ It is a time-consuming, slow process</li> <li>▪ Lack of coordination of the meeting work and poor meeting planning</li> <li>▪ Inappropriate influences</li> <li>▪ Tendency of group members to rely on others to do most of the work</li> <li>▪ Tendency toward producing compromised solutions of poor quality</li> <li>▪ Nonproductive time</li> <li>▪ Tendency to repeat what was already said</li> <li>▪ High cost of meeting</li> <li>▪ Tendency of groups make riskier decisions than they should</li> <li>▪ Too much information cues</li> <li>▪ Incomplete or incorrect task analysis</li> <li>▪ Inappropriate or incomplete representations in the group</li> <li>▪ Attention blocking</li> <li>▪ Attenuation blocking</li> <li>▪ Concentration blocking</li> <li>▪ Slow feedback</li> </ul>

Finlay and Marples (1992: 99) state that the Group DSS can support a group of people in decision-making processes by offering:

1. communication facilities between the participants,
2. enhanced modeling and interface facilities to permit voting and ranking for developing consensus,
3. both qualitative and quantitative decision aids as appropriate,
4. decision aids with which the participants are comfortable,
5. decision aids that are transparent in operation, so that the participants will understand and so use the results, and
6. decision aids that are flexible, so that they do not constrain problem formulation.

The aim of the Group DSS is to reduce the process losses compared with traditional group decision-making. It has been developed to support and respond real-time problem-solving processes at any level of organization (Finlay and Marpels, 1992).

### 2.3.3 Idea generation in the GDSS

As Leonard and Sensiper (1998) state, the divergent knowledge needs to be converged to be workable and productive. Virkkala (1991) suggests interactive group-working methods for knowledge convergence and idea creation. He claims that computer-based approaches for the idea generation and their further development can be used to support group work, e.g. brainstorming sessions.

Osborn (1963: 39) argues that “human mind acts in forms: a judicial mind analyzes, compares, and chooses; a creative mind visualizes, foresees, and generates ideas”. To support idea generation, Osborne (1963) has presented the idea of group *Brainstorming* session. The process is based on facilitated problem definition and idea generation activities in an interactive group-working session. Gallupe and Cooper (1993) claim that traditional brainstorming has two major problems:

1. Production blocking, which means lack of parallel idea generation and commentary of them and that dominant persons are able to prevent others’ ideas
2. Evaluation apprehension, which means anxiety about what others will think of us if we say what we think.

Gallupe and Cooper (1993) also argue that traditional brainstorming produces less ideas than electronic brainstorming. Turban and Aronson (2001) state that the success of electronic brainstorming is mostly based on its effectiveness and its abilities to integrate complementary tools into the process. The disadvantages and advantages are presented in Table 11.

*Table 11. Advantages and disadvantages of electronic brainstorming (Gallupe and Cooper, 1993: 34-35).*

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>▪ Parallel entry of ideas</li> <li>▪ Anonymity</li> <li>▪ More ideas are generated</li> <li>▪ Higher satisfaction with process</li> <li>▪ Large groups can be effective</li> <li>▪ Can be used both face-to-face and in dispersed groups</li> <li>▪ Record of ideas generated for future sessions</li> <li>▪ Lends itself well to subsequent editing, evaluation and action planning</li> </ul>	<ul style="list-style-type: none"> <li>▪ May be over sold as cure-all</li> <li>▪ Requires some keyboarding skill</li> <li>▪ Loss of power for some senior people</li> <li>▪ Loss of social interaction</li> <li>▪ Overload during idea editing</li> <li>▪ Cost of facilities and software</li> <li>▪ Not all topics are suitable</li> <li>▪ Inflexible process</li> </ul>

Turban and Aronson (2001) state that computer aided idea generation processes can be both decision-making and exploratory in nature. The latter is more focused on generating ideas. The process can be generalized into several basic steps, shown in Figure 11.

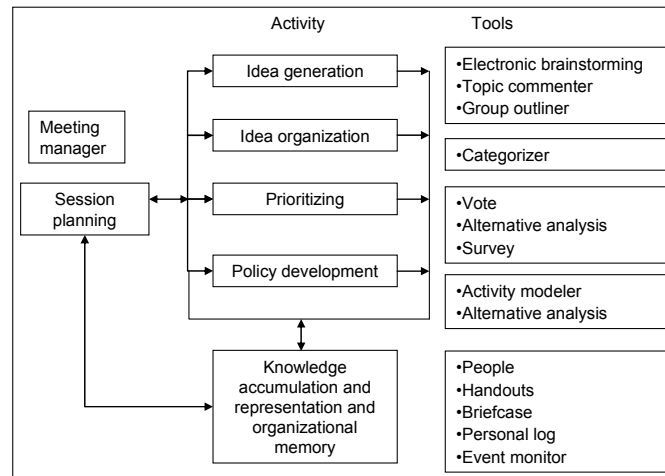


Figure 11. The general structure of the idea generation process for the GDSS (Turban and Aronson, 2001: 277).

Virkkala (1991) argues that with the help of appropriate computer-aided group working tools, effectiveness of the decision making procedures and idea creation processes can be increased, and they can become more structured compared to traditional methods and tools, e.g. whiteboard-based methods. The GDSS laboratory at Lappeenranta University of Technology (LUT), also used in this study, has been applied for teaching, research and business objectives to support the decision-making and idea generation of different interest groups. Recent studies, concerning R&D performance analysis (Ojanen, 2003), technology selection (Torkkeli and Tuominen, 2002), and customer need assessment (Kärkkäinen, 2002; Elfvingren et al., 2004) have shown the usability of the GDSS for the evaluation and decision-making in complex problem-solving processes. When studying the innovation process, the GDSS laboratory at LUT has been used to support the early phases of innovation processes. The GDSS at LUT enables the creation of new innovative ideas on the basis of prior and new knowledge to initiate the whole innovation process. Piippo, Torkkeli, and Tuominen (1999) have developed an idea generation process for the GDSS (shown in Figure 12) which allows individuals and organizations to disseminate and analyze the knowledge gathered during the early phases of the innovation process in a structured way and to select appropriate targets for further innovation development in the companies. In other words, organizations are able to benefit from the knowledge of the collaborative innovation process and to construct prospective innovations.

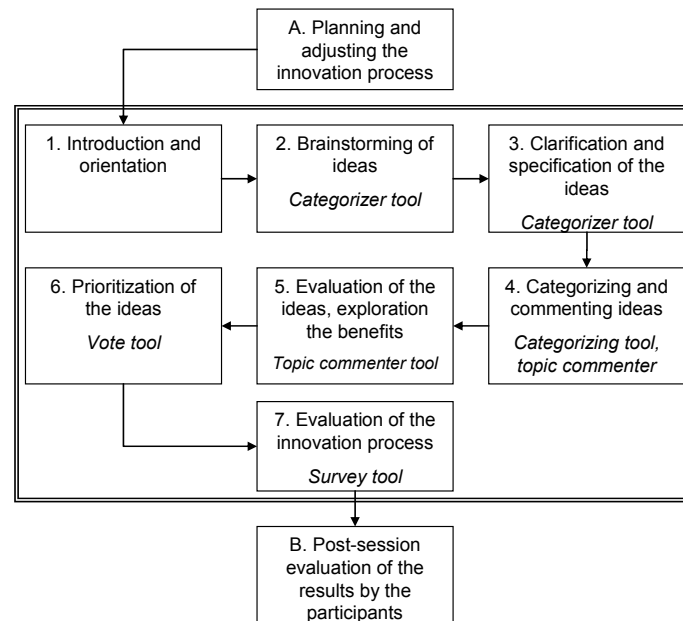


Figure 12. The developed idea generation process for the GDSS (Piippo, Torkkeli and Tuominen, 1999; Laaksonen et al., 2001b).

The developed idea generation process at Lappeenranta University of Technology consists of seven sequential phases and begins with a planning meeting and an introduction of the process when the goal and the agenda of the session are defined. The orientation and introduction phase activates the participants into the process. The main part of the process is the idea generation including several separate phases. During idea brainstorming, participants simultaneously generate new innovative ideas around an issue after which the ideas are clarified and specified. Then the generated ideas (approx. 50–70 per one session) are clustered under main categories, and additional information is given on them. When the generated ideas are categorized, they are evaluated and prioritized according to the importance of the future needs in the participating organizations. Prioritization of the ideas is done by the participants in the process i.e. the lead users on the basis of background research and their own expertise. The idea generation session ends with the assessment of the process providing valuable information for the development of the idea generation process and the GDSS. Finally, the most important and promising new innovative ideas for the participants are evaluated and implemented in their business processes. After the idea generation process, a short feedback questionnaire (see Appendix 3) of the session is completed.

## **2.4 The procedure of supporting knowledge creation and sharing in the early phases of the strategic innovation process**

This section introduces the construct of the heuristic scenario method and the idea generation process in supporting knowledge creation and sharing in the early phases of the strategic innovation process. The development of a novel construct (procedure) for the early phases of the strategic innovation process to solve a primary managerial problem in the field of searching and developing new innovative ideas is based on the data gathered during two separate research projects in the forest, ICT, and electricity distribution industries (presented in Chapter 1.3).

Considering the research doctrines of this thesis, innovation management, and futures research, the study revealed the need for support for the knowledge creation and sharing process in the early phases of innovation processes. In the preliminary research, the Master's thesis (Bergman, 2002), separate technological forecasting methods were evaluated. On the basis of this, the extended literature analysis and the experience gained in the first research project (Case 1), the heuristic scenario process (presented in Chapter 2.2) was applied in order to establish an open knowledge sharing context for the participating companies. The objective was to create new knowledge from divergent sources to reveal the requirements for the future business environment, i.e. to identify innovative business opportunities. The examined heuristic scenario method made it possible to support the knowledge creation and sharing process. However, the results of the process remained in an all too divergent form to serve innovation development adequately. Due to that, the knowledge creation and sharing process was developed further during the next research project (Case 2). The heuristic scenario process was applied to create a common knowledge base, and the results were then utilized in the idea generation process. The idea generation process in the GDSS laboratory, presented in Chapter 2.3.3, continued the knowledge convergence and made it possible to generate concrete innovative ideas for further development of innovations, e.g. R&D projects and marketing operations, and strategy planning. In other words, the idea generation process makes it possible to utilize the knowledge created during the scenario process in the organization. The detailed steps of the novel construct (procedure) to support knowledge creation and sharing in the early phases of the strategic innovation process, the combination of the heuristic scenario process, and the idea generation in the GDSS laboratory are presented below in Figure 13.

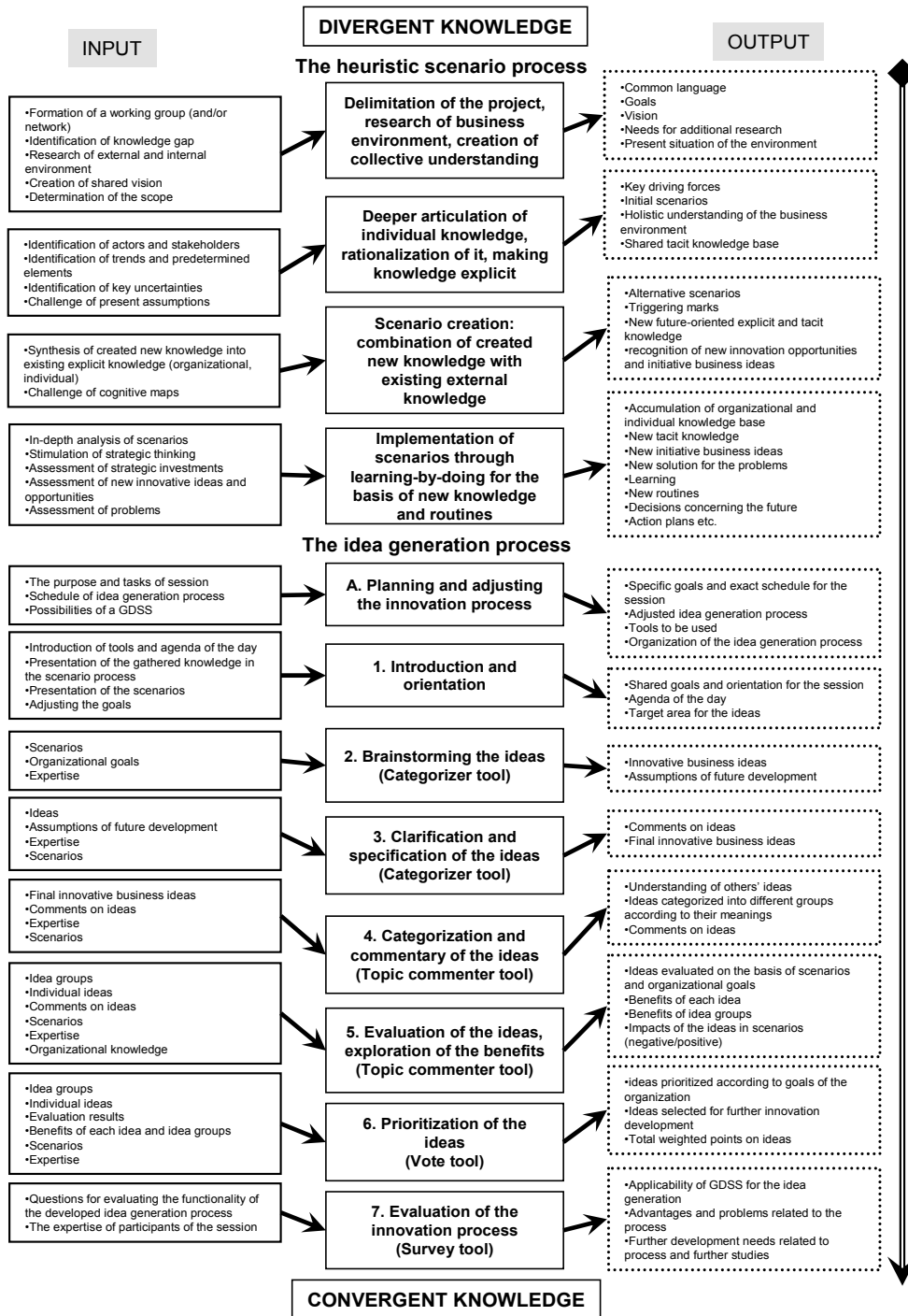


Figure 13. Supporting knowledge creation and sharing in the early phases of the strategic innovation process.

The early phases of the innovation process are fragile and need to be supported. According to Cooper (1998), Leonard and Sensiper (1998), and Miller & Morris (1999), these phases include knowledge creation and its utilization around the issue considered. Virkkala (1991) states that the innovation process can be seen as a creative problem-solving process. He suggests that to solve a problem, divergent knowledge and its analysis are needed, and to generate innovative solutions (ideas) to them, systematic group work methods are essential. Virkkala (1991) further notes that the bottleneck of new innovations is often the ability to combine (create) and utilize knowledge for new ideas and solutions.

The group work methods, the heuristic scenario method and the idea generation process are complementary, and can be used to support knowledge creation and utilization in the early phases of the innovation process. They can be applied in a way that Virkkala (1991) has noticed to be useful in creative problem-solving processes, as in the innovation process. The heuristic scenario method can enable knowledge creation and its analysis from divergent sources. It makes it possible to build an interactive, open inter-organizational knowledge sharing process providing a semi-structured heuristic process for knowledge creation, analysis and problem-solving phases. The process is flexible, and it can be adjusted to new issues and goals arising during the process. The heuristic scenario process also has several disadvantages which inhibit forming accurate and unambiguous solutions and ideas. The process is often biased by dominant persons and groupthink; it may lose its objectivity and need more consensus and concreteness. The process is also time-consuming.

In this study, the idea generation process in the GDSS laboratory has been used to complement the heuristic scenario process. The idea generation process in the GDSS laboratory makes it possible to analyze and share knowledge in a very structured way. The idea generation process has its advantages in the computer-based process developed for creative problem-solving and idea creation. The GDSS aided idea generation process makes it possible to act simultaneously during the group work. It also enables a rapid response to others' ideas and guarantees anonymity. However, the idea generation process also has its disadvantages: During it, social interaction between the participants can be lost. The process is also inflexible if unexpected issues arise during the process, and narrows creative thinking.

According to these findings and the extensive literature analysis, the combination of the heuristic scenario method and the idea generation process can be seen to support knowledge creation and sharing in the early phases of the innovation process. In this combination, the used methods are complementary and support each other in this specific application area. The theoretical as well managerial contribution and validity of the new construct are assessed, when concluding the thesis in Chapter 5.

### 3 RESEARCH METHODOLOGIES

This chapter presents the research strategy and the methodologies of this study. Burrell and Morgan (1979) state that all organizational theories are based on a philosophy of science and a theory of society. They argue that social science can be conceptualized in terms of four sets of assumptions: (1) assumptions of *an ontological nature* which concern the phenomenon studied, (2) assumptions of *an epistemological nature* which concern the grounds of knowledge, (3) assumptions concerning *human nature* and, especially, the relationship between human beings and their environment, and (4) assumptions of *a methodological nature*. These four assumptions determine the way of examining the nature of social world. They suggest that these assumptions should be analyzed from *subjective or objective approaches*.

Next, Burrell and Morgan (1979) argue that when studying the nature of society the ‘order-conflict’ distinction is in many sense the most problematic. They suggest that it should be replaced in terms of ‘regulation’ and ‘radical change’ which define another dimension for analyzing social theories. Combining the *subjective-objective* and *regulation-radical change* dimensions, the social theory can be identified and analyzed. According to Burrell and Morgan (1979), these two dimensions determine four distinct paradigms: radical humanist, radical structuralist, interpretative, and functionalist. Each of these four paradigms has its own way to view the world and offers a convenient framework for the researcher(s) to negotiate the subject area.

The functionalist paradigm has become a dominant framework in social theory. Its roots are in the tradition of sociological positivism. The functionalist paradigm seeks to provide mainly rational explanations of social affairs, and is very pragmatically oriented, also often problem-oriented providing practical solutions to practical problems (Burrell et al., 1979).

In this sense, this study would belong to the functionalist paradigm which makes it possible to investigate the phenomenon of knowledge convergence in the innovation process by approaching the issue from the objective point of view.

A paradigm offering a linked context of ontological, epistemological, and methodological premises for the researcher, makes it possible to find out the relevant and interesting research questions and the appropriate methodological approaches to investigate and negotiate them. Research methodologies can be classified into qualitative and quantitative research approaches having their origins in different scientific paradigms. Quantitative research has its roots in positivism, which means that data is collected through descriptive and comparative studies and analyzed statistically. The positivistic approach assumes that only knowledge gained through measurements and objective identification can be seen as truth (Gummesson, 1991). The qualitative approach has its origins in the hermeneutic paradigm which concentrates on understanding the phenomenon through a personal interpretation process (Gummesson, 1991). The positivistic and hermeneutic paradigms can be seen as two opposite perspectives. In this context, this study can also be seen belonging to the hermeneutic paradigm aiming at creating a holistic understanding of the phenomenon using qualitative data from case studies.

Kasanen et al. (1991) make a distinction between the research methodologies in terms of qualitative vs. quantitative research, positivist vs. interpretative and critical research, and finally, extensive vs. small case data research. According to them, the distinctions in research methodologies, presented above, have the same origins: in the collision of traditional positivistic research approaches and the optional ones. Moreover, Denzin and Lincoln (2001) argue that the methodological frameworks can be seen flexible today when using different research methodologies.

The typology of research approaches which classifies the research methodologies presented by Neilimo and Näsi (1980) has been widely used in the field of Finnish science of industrial engineering management and industrial economics. The typology is based on four distinctive approaches: *concept-analytical*, *nomothetical*, *decision-methodological*, and *action-analytical*. Kasanen et al. (1991) positioned their constructive approach between the normative and empirical approaches in this categorization, shown in Figure 14.

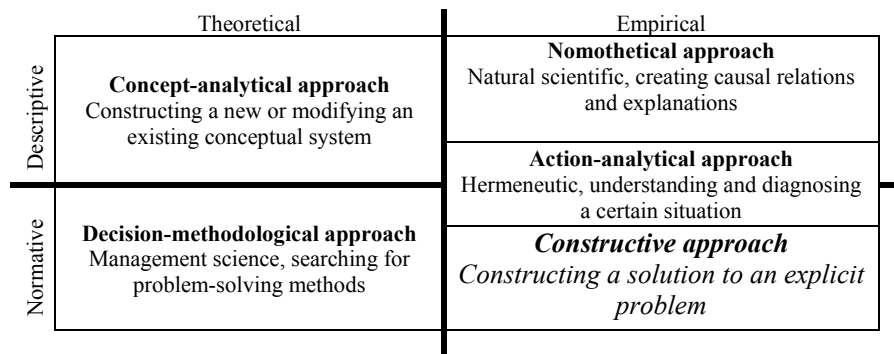


Figure 14. The relation of the constructive approach to other approaches in industrial economics (Kasanen et al., 1991).

### 3.1 Constructive research approach

The constructive research approach has emerged in the literature of management research methodology in the 1990's (Lukka, 2000). The main purpose of constructive research is to solve real managerial problems and to test the functionality of the solutions (construct) during the research process in real-life cases. The constructive research process, having explicit and strong empirical intervention, needs close interaction between researchers and the target organization to solve the problems. Constructive research is a problem-solving and normative approach solving real-world managerial problems by implementing a new construct with practical and theoretical contributions (Lukka, 2000). The basic elements of the constructive research are shown in Figure 15.

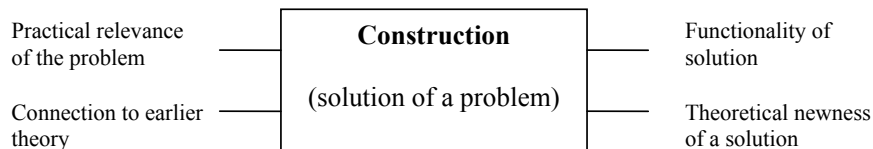


Figure 15. The basic elements of the constructive research approach (Kasanen et al., 1991).

The constructive research process is creative and heuristic by nature. Furthermore, it strongly emphasizes the role of communicative interaction during the research process. The process in the constructive research approach has seven main phases (Kasanen et al., 1991: 307; Lukka, 2000: 116-119):

1. Find a practical and relevant problem, which also has potential for theoretical contribution.
2. Examine the potential for long-term research co-operation with the target organizations.
3. Obtain deep pre-understanding of the topic area both practically and theoretically.
4. Innovate a solution idea and develop a problem-solving construction, which also has potential for theoretical contribution.
5. Implement the solution and test how it works.
6. Ponder the scope of applicability of the solution.
7. Reflect the findings in prior literature.

Evaluating the constructive research has the same criteria as any science and applied science. The created construct has its specific evaluation criteria. The applicability of a new construct should be evaluated by the relevance, simplicity, and ease of use. From the scientific point of view, the applicability of the created construct needs to be linked to current theories. Due to the small number of cases, Kasanen et al. (1991) propose that the generalization of the research results can be verified through the market test based on the diffusion of a new innovation. The diffusion of a construct can be anticipated, but the final results of the verification can be seen after several years (Kasanen et al., 1991). The market based test includes two stages:

- *Weak market test*: Is there any manager responsible for business in the target organization willing to use the created construct in her/his decision-making process?
- *Strong market test*: Has the economic performance of the business units of the target organization increased since the implementation of the created constructs? Are the results better in organizations using the construct than those not using it?

Lukka (2000) has also listed several evaluation criteria for constructive research:

- the research topic is relevant, having potential practical and theoretical contribution,
- the researcher is familiar with the (potential) ex ante theory of the topic area,
- the research design is clear and fruitful in its creative and heuristic way,
- the study is credible, the validity and reliability are dealt with in a satisfactory manner through solid and careful empirical work,
- relevant new theoretical contribution is achieved, and
- the study is clearly and economically reported.

Due to the nature of the constructive approach of this study, the quality of this research can be assessed through these criteria, and the impact of the created novel construct in theory and practice can be evaluated.

### 3.2 Case study approach

The case study is a way of investigating an empirical issue following a well developed procedure. Case studies can be based on both quantitative and qualitative data. According to Yin (2003), case study research is used in several situations to contribute to our knowledge of individual, group, organizational, social, political and related phenomena. The case study method allows the researcher to create holistic and meaningful characteristics of real-life events (Yin, 1981). According to Eisenhardt (1989), the case study focuses on understanding the dynamics present within a single setting and can be employed in embedded designs, that is, multiple levels of analysis within a single study. Yin (2003) claims that the strength of the case study is its ability to deal with a wide variety of data sources: interviews, documents, observations, participant-observation, and even informal manipulation.

When selecting a research strategy the following conditions should be considered important: (a) the type of research question posed (b) the extent of control an investigator has over actual behavioral events, and (c) the degree of focus on contemporary as opposed to historical events. The first condition most often defines the used research strategy. Choosing a research strategy, the questions “How” and “Why” are most suitable for the use of case studies (Yin, 2003). The research question may vary during the research which makes the case study flexible as a research strategy (Eisenhardt, 1989).

The case study has been considered an approach to examine contemporary events without the possibility of manipulating the relevant behaviors. Yin (2003) distinguishes three types of uses of case study: exploratory, descriptive, and explanatory. *Exploratory* case study is carried out to collect evidence for the research questions and hypotheses. *Descriptive* case study describes consequences of events mainly on the basis of observations and reporting (Gummesson, 1991). *Explanatory* case study explains the causal links in complex real-life situations. In his work, Stake (2001) has identified three types of case study: *intrinsic case study*, *instrumental case study*, and *collective case study*. The first one concentrates on understanding the particular phenomenon, the second one provides insights into the issue or helps to redraw a generalization, and the last one supports the generalization and theorization.

According to Stake (2001), selecting the cases is the most important phase when studying the phenomena. He continues that the number of cases is not limited but each case study is a concentrated inquiry into a single case. A well designed case study makes it possible to examine the phenomena, offers an opportunity to learn, and supports the validity and reliability of the research. Yin (2003) specifies four types of case study designs: (1) single-case (holistic) design, (2) single-case (embedded) design, (3) multiple-case (holistic) design, and (4) multiple-case (embedded) design. According to Yin (2003: 21), each case study should include five components of research designs:

1. the questions of the study;
2. its propositions, if any;
3. its unit(s) of analysis;
4. the logic linking of the data to the propositions; and
5. the criteria for interpreting the findings.

Eisenhardt (1989) has presented a synthesized framework for qualitative and case study research providing a complete roadmap for the implementation of case study research (see Table 12).

Table 12. *The process of building a theory from case study research (Eisenhardt, 1989: 533).*

STEP	ACTIVITY
<b>Getting started</b>	Definition of research questions Possible prior construct
<b>Selecting cases</b>	Neither theory nor hypothesis Specified population Theoretical, not random, sampling
<b>Crafting instruments and protocols</b>	Multiple data collection methods Qualitative and quantitative data combined Multiple investigators
<b>Entering the field</b>	Overlap data collection and analysis, including field notes Flexible and opportunistic data collection methods
<b>Analyzing the data</b>	Within-case analysis Cross-case pattern search using divergent techniques
<b>Shaping the hypotheses</b>	Iterative tabulation of evidence for each construct Replication, not sampling, logic across cases Search evidence for “why” behind relationships
<b>Enfolding the literature</b>	Comparison with conflicting literature Comparison with similar literature
<b>Reaching closure</b>	Theoretical saturation when possible

When evaluating research, the criteria should be addressed correctly according to the type of research. The case study research can be evaluated by several criteria and tactics testing them. Yin (2003: 34) has listed four tests for case studies which are common to all social science methods:

- *Construct validity*: establishing correct operational measures for the concepts being studied.
- *Internal validity*: establishing a causal relationship. Whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships.
- *External validity*: establishing the domain to which a study’s findings can be generalized.
- *Reliability*: demonstrating that the operations of a study – such as the data collection procedures – can be repeated, with the same results.

Gummesson (1991) gives some criteria for the case study research when using mainly qualitative data and methods:

- Design and conduction of the research project
- Presentation of the paradigm
- Credibility of the research
- Adequate access to the research processes

- Validity of the findings of the research
- Relevancy of a contribution
- Dynamics of the research process
- Commitment and integrity of the researcher

Case study research should not confuse qualitative research. According to Yin (2003) and Eisenhardt (1989), case study research can involve both data types: qualitative and quantitative. Qualitative research consists of two conditions: the use of close-up, detailed observation of natural world by the researcher, and the attempt to avoid prior commitment to any theoretical model. In this study, qualitative data concerns observations of group working activities in the field and laboratory environment, and also includes documents and informal interviews. Miles and Huberman (1994) distinguish some groups of standards through which the quality of qualitative research can be discussed and evaluated. They propose that by forming questions about the following overlapping issues, the quality and goodness of the research can be evaluated and discussed:

- Objectivity/conformability, which concern the bias of the researcher
- Reliability/dependability/auditability, which concern the consistency of the process
- Internal validity/credibility/authenticity, which concern the truth value of the research
- External validity/transferability/fittingness, which concern the generalization and significance of the research
- Utilization/application/action orientation, which concern the pragmatic validity and benefits of the research

As a whole, the quality of this research can also be assessed in terms of the criteria of case study research based on qualitative data. Because of the flexibility of case study research and the used qualitative data in this study, multiple sources of evidence can be used to increase validity. Yin (2003) suggests the process of triangulation of data, investigator, theory, or methodology for using different sources of evidence. Silverman (2000) argues that assessing qualitative research triangulation is often a very complicated response to validity and might be a flawed method and calls for different ways of thinking critically about qualitative data analysis in order to aim at valid findings. The reliability of the case study when using qualitative data is obviously a difficult issue. Cases are unique, and they are almost impossible to repeat. Due to that, reliability can be provided by following the case study protocol (Yin, 2003).

The quality of this study is discussed in detail in Chapter 5.3 when evaluating the limitations of the study by using the criteria of the constructive research approach and the qualitative case study research. The summary of the used methodologies are presented in Table 13.

### **3.3 Summary of the used methodologies and results of the publications**

As discussed before, this study examines the phenomenon of knowledge convergence during the innovation process, which is very difficult to quantify in terms of positivistic research and research methods. It requires close interaction between the research objects and the researcher(s), and the creation of deep understanding of the phenomenon. The research of innovation management is also considered to be multifunctional research. Innovation and innovation management are closely linked with different functions, in this study with the strategic and knowledge management functions, which can be examined from different points of views. The hermeneutic research approach is often used when the research object or discipline is new, the number of cases is limited, and the phenomenon needs to be understood holistically. The hermeneutic research approach is seen as an appropriate research strategy in this study, when examining the issues concerning the emerging scientific discipline, knowledge management. As consequence of that, the empirical evidence and data are often very limited and based on hermeneutic analysis and collection methods, i.e. qualitative data and methods. Due to that, this study also applies the case study research methodology. This provides the possibility to access the needed data and to use appropriate qualitative methods for the research of the phenomenon. On the other hand, this study also provides a solution to the actual managerial problem. Therefore, it is advantageous to this study to apply the constructive research approach which follows the positivistic procedure of generating hypothesis concerning the creation of the construct and its testing (Olkkonen, 1993: 80). Constructive research is problem-oriented, provides a solution for the existing problem and stresses innovative, creative and heuristic tactics to the solution and used research methods. The used methodologies, basis of data analysis, and the primary results are summarized below in Table 13.

Table 13. Used methodologies, data sources, and the main results of the publications.

	Publication 1	Publication 2	Publication 3	Publication 4	Publication 5
<b>Title of the publication</b>	Managing knowledge creation and sharing – Scenarios and dynamic capabilities in inter-industrial knowledge networks	Creating future capabilities - Scenario process in inter-industrial knowledge networks	Managing the exploration of new operational and strategic activities using the scenario method- Assessing future business opportunities in the field of electricity distribution industry	Exploration of future service innovations in the radically changing business environment within the electricity distribution industry	Management of controlled open innovation process
<b>Objective</b>	To study the methods for dynamic knowledge creation and capability development in open inter-organizational network	To examine the difficulties in inter-organizational open knowledge creation and sharing and the group work method to overcome them	To study the effects of the scenario method on the open knowledge creation and sharing in a real-life case	To study the implementation of common knowledge to the participants of the innovation process applying the GDSS by integrating it with the scenario method	To study open knowledge creation and sharing in an open innovation process, and to offer a new construct to solve managerial problems in the process
<b>Data collection</b>	-literature review -brainstorming within different organizations -informal interviews (periodical meetings)	-literature review -brainstorming within different organizations -Informal interviews (periodical meetings)	-literature review -brainstorming within different organizations -informal interviews (periodical meetings)	-literature review -brainstorming within different organizations -informal interviews -GDSS sessions within four organizations	-literature review -discussion with different organizations -brainstorming -GDSS sessions within four organizations
<b>Methodology and analysis</b>	-constructive approach -case study -participant observations -data triangulation	-constructive approach -case study -observations -data triangulation	-constructive approach -case study -replication logic -observations -data triangulation	-constructive approach -case study -replication logic -observations -data triangulation	-constructive model creation -conceptual discussion -investigator triangulation
<b>Main contribution</b>	Links knowledge creation and the scenario method. Clarifies the benefits of the scenario method in the open knowledge management (KM) process	Provides understanding of KM pitfalls in inter-organizational context and develops the scenario method in KM to overcome them	Offers new insights into the present KM literature by testing the “semi-structured” group work method in the open inter-organizational innovation process	Launches the new structure combining the scenario method and the GDSS to support open knowledge creation, sharing, and utilization in the collaborative innovation process	Introduces the integrated novel construct to support open knowledge creation, sharing and utilizing in the collaborative open inter-organizational network

In this study, the nature of the research phenomenon and the research methods are in close relation to each other, as the previous table 13 shows. The applied constructive research approach also stresses the applicability of the research methods to problem solving and construct creation. The research methods used in this study provide a possibility to create a deep and holistic understanding of the phenomenon and an opportunity to be in close interaction with the data sources. The heuristic scenario method and the GDSS method are appropriate methods to examine the cases which are based on the communication, observation, interviews, and participation, i.e. human driven knowledge creation and sharing activities when converging knowledge for certain purposes, innovations. They are mainly designed for the collection and analysis of qualitative data. To sum up, this study can be seen as a coherent and logical research process which is based on the case studies and the constructive research approach and follows the research traditions accepted and widely applied in the industrial engineering and management discipline during the recent years.

#### **4 SUMMARIES OF THE PUBLICATIONS**

##### **4.1 Managing knowledge creation and sharing – Scenarios and dynamic capabilities in inter-industrial knowledge networks**

The first publication studies the dynamics of knowledge creation and sharing in inter-industrial networks. In this case study, the collaborative and inter-industrial innovation process between the forest and ICT industry companies focusing on the wireless technology and business opportunities is examined. Furthermore, the aim is also to examine the heuristic approach of the scenario method as a knowledge management method and the renewal of organizational capabilities. In this paper, to fill the research gap noticed in the management of knowledge among the academic and practitioner disciplines, some new contribution is provided. In the paper, the fundamental idea of the scenario method and the dynamic capability view are described on the basis of literature analysis. The study demonstrates that in the multi-organizational context the effective group-working method makes it possible to benefit from external as well as internal knowledge sources. From the dynamic capability point of view, knowledge is in an essential position creating new capabilities and requires effective interpreting and sense-making procedures. Here the heuristic scenario method is used to establish an inter-organizational knowledge network among the case organizations and to manage the open knowledge creation and sharing process in order to develop organizational capabilities. During the study, the scenario method revealed its potentials in the interactive knowledge creation process enabling dynamic communication across the organizational boundaries and helped to focus the process on the target issues of the case: wireless eBusiness and technology. This study shows that the scenario method enables the effective knowledge management in a networked environment supporting the creative collaboration modes and is an appropriate way to develop future capabilities. In general, the paper presents a process which can be used to support organizational knowledge management activities and future business development.

## **4.2 Creating future capabilities – Scenario process in inter-industrial networks**

The second paper continues the examination of open knowledge creation and sharing process in multidimensional context. It examines communication barriers and the role of mental models in the process and explains the basis of future-oriented knowledge which is important to the proactive development of organizations. The purpose of this study is to clarify the advantages of the heuristic scenario method overcoming the difficulties in knowledge management, especially, when sharing tacit and often very personal knowledge in the inter-organizational environment. Recognizing the difficulties in communication processes between individuals and between the organizations and understanding the limitations of personal mental models make it easier to collaborate within the open knowledge network. The case study showed that the scenario method as a knowledge management method improves the sharing of tacit knowledge in the network and makes it possible to create new knowledge for the participants of the process. In this paper, the use of traditional strategic planning method, the scenario method, for the new purpose in the field of knowledge management is developed further. The case study proved that the ongoing nature and the basic idea to concentrate on individual knowledge make the scenario process applicable and adaptable for the management of open knowledge creation and sharing process. The scenario process also makes it possible to find solutions to real-life problems on a strategic level when they concern very complex and intangible issues based on assumptions of individuals of the past, present, and future.

## **4.3 Managing the exploration of new operational and strategic activities using scenario method – Assessing future business opportunities in the field of electricity distribution industry**

In the third paper, the scenario process is applied to develop and create the most important knowledge mainly in tacit form for the strategic innovation process and to manage the inter-organizational knowledge sharing process. The purpose of this study is to clarify the complex nature of the business environment forcing organizations to direct their actions into the future and to demonstrate the usability of the scenario method in knowledge management when the knowledge is in a highly intangible and tacit form, i.e. in a not-yet-embodied form. The scenario method which was examined and developed in the previous papers during the first case study “Wireless e-business” for the knowledge management purposes, is tested in a different business environment and within different organizations in the electrical distribution industry. In this case study, the heuristic scenario process carried out in the network of experts to manage the exploration of new operational and strategic opportunities for future business innovations showed to be a very suitable method for analyzing and converging complex, intangible knowledge into explicit scenarios and capability needs. The aim of this study was also to integrate the scenario method with the dynamic capability view in a real-life case. This explains the complexities of capabilities and demonstrates their dependence on knowledge and sense making abilities. With the help of these results organizations are able to manage better their knowledge creation processes and to develop potential innovation opportunities further to succeed in their future business. Through this case study, new insights and contribution were provided for knowledge management (KM) and innovation management literature and also for real-life situations by testing and verifying the results of previous papers.

#### **4.4 Exploration of future service innovations in the radically changing business environment within the electricity distribution industry**

This paper integrates the knowledge creation and utilization processes combining two group working approaches: the scenario method and the group decision support system (GDSS). In this paper, the basic idea of the GDSS is discussed and the process of utilization of the created new knowledge during the scenario process within the case companies using the GDSS laboratory to develop the created knowledge into new strategic innovation ideas, i.e. on a concrete and exploitable level, is presented. When creating new knowledge in collaborative and open inter-organizational context, the knowledge does not often reach a sufficiently concrete level. In this study, the GDSS laboratory is applied within the individual organizations to ensure the exploitation of knowledge common to all the participants of the network. The GDSS laboratory offers an explicit process to analyze and evaluate knowledge and generate new innovation ideas based on new and prior knowledge. This study provides a process for supporting new strategic innovation processes in individual organizations. Altogether, the developed innovation generation process in the GDSS environment and the scenario method enable an appropriate way to transform the highly intangible and distributed knowledge into new concrete innovative ideas. They also make it possible to manage open knowledge creation and sharing.

#### **4.5 Management of controlled open innovation process**

The purpose of this paper is to synthesize the research describing the management process of knowledge creation and sharing and implementation in the early phases of the innovation process in order to initiate the strategic innovation process in a inter-organizational and collaborative context. In this paper, the fundamental idea of the open innovation process is discussed in detail and the functionality of the management process, presented in the earlier papers, in this context is studied on a conceptual level. The study shows that the open and collaborative inter-organizational innovation process can be established and managed using appropriate group work methods. By managing open knowledge creation, sharing and utilization in the inter-organizational innovation process the focus, targets, and coherence of it can be maintained and organizations are able to benefit more from the knowledge of the network, and the generated innovation ideas can be transferred into the organizations. The overall result of this study is an integrated process (construct) for the management of the early phases of the strategic innovation process. The process provides help for the organizations to manage better their connections between other organizations and individuals and open knowledge creation and sharing to sustain organizations' future development.

## 5 CONCLUSION

The main focus of this dissertation was to create a new construct to support the early phases of the strategic innovation process and to increase knowledge and understanding of the knowledge management process within the present knowledge management as well as the innovation management literature and in scenario paradigm. The following research questions of this dissertation were studied from the academic and pragmatic point of views to provide new knowledge and a new solution.

1. How can the process of knowledge creation and sharing during the early phases of the strategic innovation process be supported?
  - a. What are the central challenges in supporting the process of future-oriented knowledge creation and sharing?
  - b. What are the potential benefits of knowledge convergence in the early phases of the innovation process?
2. How can utilization of the knowledge created during the early phases of the strategic innovation process in the organizations be promoted?
  - a. How can future-oriented knowledge converge effectively into concrete innovation ideas?
3. Which supporting knowledge management methods are potentially appropriate in the open inter-organizational innovation process considering a networked business environment?

### 5.1 Theoretical contribution

This doctoral dissertation consists of five original consecutive and complementary publications. In these publications, the role of the author of this dissertation has been central with him acting as the main author in the publications by providing the main contribution in the form of the idea of the issues studied and the concrete literary work also providing the research data and having the main role in the analysis of it. The other authors made a strong contribution by evaluating and validating results and providing links to the other issues in the publications, such as the theory of capability development and the theory of organizations in a networked business environment. This dissertation contributes to the existing management research by focusing on the role of two group work methods – the heuristic scenario and the GDSS – for knowledge creation and sharing in the open inter-organizational context. The *main theoretical contribution* of this thesis to the existing literature is provided by creating a novel workable construct (procedure) and a new solution to the actual problematic situation, knowledge management in the early phases of the strategic innovation processes (see Chapter 1.2). Each of the publications of the thesis also offers new insights and knowledge to the present literature and theoretical discussion by examining separately a specific area of the created construct and the solution. The characteristics of the research questions are multi-disciplinary. The questions are answered in this Chapter from the (1) Innovation management, (2) Knowledge management, and (3) Scenario methodology point of views. Their validity and generalizability are assessed in the following Chapter 5.3.

Answering the question 1: *How can the process of knowledge creation and sharing during the early phases of the strategic innovation process be supported?*

*From the innovation management point of view*, as discussed in Chapter 1, the dilemma in the early phases of the innovation process is that new knowledge should continuously be created and be as divergent as possible, but it also should be converged into new innovations. Moreover, the knowledge creation in the innovation process linked with the future, due to the fact that innovation means building up something new by providing a new solution (de Bono, 1982).

In this thesis, the heuristic scenario method has been used for the knowledge creation and sharing in open context. As discussed before in this thesis and the Publications, the innovation process begins with the creation of new knowledge and recognition of new opportunities to develop the prior and new knowledge further into new solutions and innovation ideas (see e.g. Figures 2 and 3). When comparing the needs of the early phases of the innovation (presented in Chapter 1.1) and the advantages of the heuristic scenario method (presented in Chapter 2.1) it can be seen that the heuristic scenario method supports the process in several ways:

*Firstly*, during the heuristic scenario process, knowledge creation is future-oriented as in the innovation process is required.

In the first and second case studies (presented in Chapter 1.3), during the scenario process the aim was to recognize future business opportunities. The explicit knowledge which was acquired and created concerned the issues which will affect the future development. The tacit knowledge which was shared and converged into explicit form within the participants made it possible to challenge the assumptions of the future and to make sense of the business environment on the basis of expertise and existing knowledge. This process converged into the alternative scenarios, value network descriptions, and driving forces, and the analysis of them revealed new opportunities for the participants of the project.

*Secondly*, the heuristic scenario process uses divergent knowledge sources as in the open innovation process is required.

During the first and second case studies, the process made it possible to connect different organizations and individuals in the form of network. The participants shared their knowledge and information within the networked group aiming at creating a holistic understanding of the business environment. The divergent knowledge was gathered by using different methods, e.g. seminars, face-to-face meetings, interviews, surveys, brainstorming, and literature analysis.

*Thirdly*, the heuristic scenario method makes it possible to converge knowledge as in the innovation process is required.

The results of the first case study show that the very broad knowledge base can be converged into a relatively understandable and usable form, i.e. into alternative scenarios, value network descriptions, driving forces, reports, and initiative innovation ideas. In other words, the gathered and created knowledge base was assimilated into the network and analyzed through the heuristic scenario process and then transformed into a new converged form as listed above.

*Fourthly*, the heuristic scenario process offers a creative and interactive context to examine known and certain and uncertain issues as the incubation of an innovation requires.

In the first and second case studies, the process enabled social interaction among the individuals. During the process, participants were able to be in direct face-to-face contact without facilitation, they shared their explicit information through different devices (email, telephone etc.), and they participated in the facilitated scenario sessions which were essential to creative thinking, increasing the awareness of the issue, and problem-solving.

Answering the sub-question *1a) What are the central challenges in supporting the process of future-oriented knowledge creation and sharing?*

The main challenges were derived from the extensive literature analysis and the experiences gained during the study. They concern basically cultural, communicational, managerial and contextual issues. In the research projects, the participants had different backgrounds and expectations for the process. During the scenario process, cultural problems were avoided by following the procedure accurately and by planning each phase of the process considering the influence of dominant persons, offering neutral facilities by the facilitator, and creating confidential relationships between the participants by enabling careful familiarization and acquaintance. The communicational problems were avoided by facilitating the process and considering the hierarchical and dominance issues. The facilitator also acted continuously and actively to keep up the continuous communication between the participants. Management and contextual problems were avoided by using different electronic devices and facilitated meetings to support the knowledge sharing within the participants. The use of these methods were facilitated and organized by the process owner, i.e. the representative of the conducting organization of the research process (TBRC).

Answering the sub-question *1b) What are the potential benefits of knowledge convergence in the early phases of the innovation process?*

In the second case study, organizations seek knowledge and information about the future opportunities and requirements during the early phases of the innovation process. It should be noted that knowledge about the future is always based on subjective assumptions. The future is unknown, but the awareness of it may be increased by using appropriate methods and approaches. The study shows the potentials of the future-oriented knowledge by offering scenarios to compare organizational capabilities to required ones in the future. The scenarios may help organizations to find new business areas to leverage their present businesses, and they may help organizations to recognize future business opportunities and to generate new innovation ideas. In other words, they made it possible to sense and presence the emerging opportunities. The scenarios also helped organizations to communicate goals and strategies within the organizations.

In summary, it can be said that answering the question 1 and its sub-questions a and b by the means of Case studies and the literature analysis, it can be shown that the knowledge creation process in the early phase of the innovation and the heuristic scenario process are parallel processes which support each other. By using the heuristic scenario method, knowledge creation and sharing can be supported in the early phases of the strategic innovation process.

Answering the question 2: *How can utilization of the knowledge created during the early phases of the strategic innovation process in the organizations be promoted?*

*From the scenario method development point of view*, Publications 4 and 5 show that the utilization of knowledge embedded in scenarios can be promoted by the GDSS. This develops the scenario method further providing a new solution to utilize the gathered knowledge effectively. When comparing the disadvantages of the heuristic scenario process and the advantages of the GDSS method, it seems that the GDSS method promotes the utilization of future-oriented knowledge. During the second case study, organizations were able to create new innovative business ideas (presented in Publications 4 and 5) on the basis of prior knowledge and the scenarios and the knowledge embedded in them in the idea generation session. Thus, the results of the heuristic scenario process, i.e. the created tacit and explicit knowledge, were converged further on the idea level in the GDSS laboratory during the idea generation session. The created knowledge in the heuristic scenario process was utilized effectively and it achieved a more focused and concrete level comparing the initial knowledge, i.e. results of the scenario process. During the idea generation session, the created new innovative ideas were assessed and ranked important or very important for organizations' future business which also showed the applicability of the GDSS method for the utilization of knowledge. The further success of the ideas in the innovation development depends on future operations in the organization.

Answering the sub-question 2a): *How can future-oriented knowledge converge effectively into concrete innovation ideas?*

In the second and third case studies, the applicability of the GDSS method was also tested by the case based survey in the end of the session. According to conclusion of the survey the effectiveness of the GDSS method in the utilization of knowledge could be seen and the creation of new innovative ideas was possible on the basis of prior and created future-oriented knowledge, i.e. knowledge created in the scenario process and expertise. The results of the case based survey have shown that the used method may be considered as an appropriate method for this purpose. On the scale from 1 to 10, the mean of the answers were over 7 except for the questions 2, 7, 13, and 19. Questions 7 and 13 considered the usability of the GDSS software. Questions 2 and 19 were based on the respondents' knowledge and experience about the topic, and reflected their personal expectations, and not for example the organizations' they work for. However, the results support the conclusion of this sub-question. Detailed results are presented in Appendix 3.

Answering the question 3: *Which supporting knowledge management methods are potentially appropriate in the open inter-organizational innovation process considering a networked business environment?*

By answering the questions 1 and 2, the applicability of the created novel construct – the combination of the heuristic scenario method and the idea generation process – for the support of knowledge creation and sharing in the early phases of the strategic innovation process can be shown. Through this question, the main theoretical contribution, i.e. a novel construct, of this thesis can be presented.

*From the innovation management point of view*, the created new construct (procedure), the combination of the heuristic scenario and the idea generation processes (presented in Chapter 2.4), can be usefully applied in support of knowledge creation and sharing in the early phases of the strategic innovation process in an open inter-organizational context. Using this type of systematic procedure, the early phases of the innovation process can be broken down in manageable parts, and the knowledge creation and sharing in each part be supported.

Firstly, the heuristic scenario process can enable networking by applying the logic of an open innovation process. It makes it possible to create future-oriented knowledge which is essential for new innovations. It enables the convergence of tacit and explicit knowledge gathered from divergent sources inside and outside the organizational boundaries into a very applicable and analyzed form, i.e. scenarios, specific driving forces, initiative business ideas, and also new mental maps (tacit knowledge). The results of the case studies (discussed in Publications 1, 2, and 3) show the usability and appropriateness of the heuristic scenario process for these goals.

Secondly, the idea generation process continues the knowledge convergence process by supporting the utilization and analysis of the created knowledge in the scenario process. During the idea generation process, it was possible to converge the knowledge into new innovative business ideas by the participants of the innovation process. With the help of the GDSS in the idea generation process the knowledge of the scenario process achieved a more concrete level than during the scenario process was possible.

Thirdly, the construct (procedure), originally presented in Publications 4 and 5, shows its usability to support the knowledge creation and sharing process in a open inter-organizational context in real-life cases. The participating organizations were able to disseminate and assimilate the knowledge created during the procedure in their organizations and develop it further, i.e. continue the innovation process.

*From the knowledge management point of view*, the created construct provides a structured management way to establish an interactive social context. In Publications 1 and 2, the usability of the heuristic scenario method to support and manage the knowledge creation was shown. The created construct provides new insights in the theory of the knowledge creation by presenting a practical case to use a management method to enhance the performance of the knowledge creation spiral and the SECI model (Nonaka and Toyama, 2003). This study also clarifies the existence of future-oriented knowledge and its creation offering an example of praxis to manage and nurture the sense-making and opportunity recognition process by the construct.

To sum up the theoretical contribution of this study, on the basis of three separate case studies and the extensive literature analysis, new knowledge and insights in the existing literature are provided. Firstly, the developed construct reflects the demands of future research objects presented in recent innovation and knowledge management literature by offering a workable and effective method to manage knowledge development in the early phases of the innovation process. Secondly, the developed construct fills the gap between the achieved results of the heuristic scenario process and their utilization in organizations. The case studies show the advantages of the combination of the heuristic scenario method and the idea generation process by providing results of effective knowledge convergence through the construct. According to the literature analysis, the methods can be seen as complementing each other in an effective way when using them sequentially. Thirdly, by linking the knowledge creation

theory and the heuristic scenario process new understanding and knowledge were provided for the scenario methodology. With the help of this understanding, it was possible to support the knowledge management processes within the case studies to make the early phases of the strategic innovation process effective and workable. Finally, the contribution of this paper can be seen pragmatic providing an integrated construct which is developed and tested in real-life cases. The pragmatic results of this paper can be seen as the most relevant evidence that confirm the scientific results of the study (see e.g. Lukka, 2000).

## **5.2 Managerial contribution**

In consequence of the nature of the constructive approach of this dissertation, the practical managerial results are in a central position of the study (Kasanen et al., 1991; Lukka, 2000; Olkkonen, 1993). Therefore, this study contributes to practice by offering a solution to real-life managerial problems. The most practical results of the study are focused on the managerial problems of the case organizations, and their value for the organizations comes from their enhanced innovation processes and the recognized future business opportunities which eventually will increase the competitive advantage of the organizations if future circumstances are favorable for the overall business development.

Regarding knowledge creation and sharing in a networked and open environment, the case studies provide a unique management process which allows organizations to establish an open inter-organizational innovation process around a shared goal. The study gives a managerial toolbox (shown in Figure 13) for knowledge management practices to support the early phases of the innovation process in an inter-organizational context. With the help of this tool box, managers and organizations are able to be in a continuous interaction with their partners, establish new partnerships, manage the process, recognize future opportunities, and develop their capabilities to exploit these opportunities. The created new construct includes several practical managerial implications and solutions presented below.

Firstly, when considering the direct business value of the new construct for the organizations, the process provides alternative descriptions of the future business environment through the scenario method guiding strategic planning processes. During the process, new innovative business opportunities are recognized and the needed organizational capabilities are revealed to confront future requirements. The created knowledge is analyzed and new concrete innovative business ideas are generated by using the GDSS laboratory for further development in the organization's innovation processes. With these results the organizations of this study may be able to increase their future competitive advantage as well as their short-term performance in the form of enhanced knowledge utilization.

Secondly, the new construct offers a structured management process for the organizations to facilitate and support knowledge creation and sharing in an inter-organizational context, and answers the widely recognized managerial problems in knowledge management (see e.g. von Krogh, 1998; Wiig, 1999). The case studies show that the heuristic scenario method, applied for the management of knowledge creation and sharing in the collaborative and open network, provides a simple and easy way to handle the complex communicative processes making tacit future-oriented knowledge explicit. In this process, the GDSS laboratory offers a tightly structured procedure to utilize the new knowledge in the organization. The developed idea generation process makes it possible to benefit from the results of the scenario process on the company level and also support new divergent innovation processes.

Thirdly, the changing innovation paradigm addresses new challenges for the organizations' management and management practices. The developed new construct gives a pragmatic solution to operate in an open innovation environment. Within the organizations of the study, the construct provides a holistic and workable way to establish and manage an open and collaborative innovation process and to generate explicit value for all the participants of the process.

From the managerial and also theoretical point of view, one of the key preconditions of the qualitative case study research is a sufficiently long research period. In this study, the research period of more than two years provided an excellent opportunity to observe and follow the use of the construct of this research in the involved organizations and to provide new insights and understanding of the managerial practices in the involved companies and organizations. Also, the strong communicative and collaborative role of the constructive research strategy used in this thesis made it possible to examine knowledge creation and sharing within the companies and organizations. Through this knowledge and experience in different cases the managerial contribution of the thesis gains more evidence.

### **5.3 Limitations and validity of the study and suggestions for future research**

There are always some limitations in research, as in this study as well. In this chapter, the central limitations of this study are clarified and future research areas which emerged during the study are suggested.

This research is based on three case studies having a limited number of informants, i.e. representatives of the companies and organizations. Due to this, the research may have certain limitations but is not a reason to elide it. The limitations of this study are common to all qualitative case studies, and due to the constructive research strategy this study includes several specific limitations.

The key limitation of this study comes from the qualitative data analysis and settings of the cases. The collection and the analysis of the qualitative data may often be biased by the researcher's interpretations even if he uses multiple sources of evidence, as in this study. The validity of the qualitative data of this study was achieved by collecting data over a two-year research period using multiple sources of evidence, including literature analysis, informal interviews with the company representatives, observations, surveys, and participation observations. However, a rather small number of data was collected which is the direct consequence of the case study research approach. The reliability of the collected data may also be seen as a problematic issue in this case study. The reliability may have an effect on close and intensive interactions with the organizations of the study and their representatives when collecting the evidence for the research objectives of the study. Due to that, the major risk is that the researcher may lose his objectivity. Mistakes in the reliability of the study were tried to avoid using multiple investigators, the colleagues in the research projects, to analyze the evidence and using the case study protocol by documenting and presenting the data collection procedures carefully in the publications and research reports. On the other hand, close and intensive relationships are prerequisite in constructive research studies providing definite and reliable research data for the solution investigated. The fact is that the cases have been conducted in real-life organizations, and it is extremely difficult to repeat them in the exact same way. Therefore, this may have some effect on the reliability of this study.

However, this is a natural consequence of the used research strategy, namely the case study research strategy (see Yin, 2003).

The research questions also have their limitations. Due to the flexibility of the qualitative case study research design, the research questions and the research circumstances may change during the research. The research questions can be seen as very challenging and relevant from the academic and pragmatic point of view, if they have been generated by academic and commonly accepted guidelines. In this study, the research questions were derived from prior innovation and knowledge management literature and from the real-life problems and needs of the involved organizations reflecting the actual and relevant problems of the research field. This issue may not be ignored when constructive research strategy is used (Kasanen et al., 1991; Lukka, 2000).

From the constructive research approach point of view, the limitations concern the generalizability and the validation of the results. The created new construct should be evaluated on the basis of theoretical contribution and the practical results. According to Kasanen et al. (1991), the strength of the approach is in its close and active relations between the involved organization and the researcher(s) and in the strong commitment to the project by the research participants. On the other hand, these issues may lead to problems with the neutrality of the researcher and the objectivity of the academic results. In this thesis, the problems were avoided using multiple sources of evidence and especially multiple investigators. Also, three totally different cases were used to verify the evidence by developing the construct during the first and second ones and tested in the third one (see Publications 1, 2 and 3, 4, and the Research reports (Bergman et al., 2005, Partanen et al., 2004)). Another limitation of the constructive research approach is the limited number of cases. Therefore, this study has limitations in the generalizability of its results and in the normative recommendations. Hence, the managerial implications and recommendations of this thesis should be carefully assessed when taking them to other contexts. Kasanen et al. (1991) suggest that the verification of the results can be assessed by the market test, and the validity of the new construct can be shown if the manager in the company involved in the study has accepted the solution and decides to use it in his work. In this study, the new managerial construct (procedure) has been conducted in three different case studies within the companies and the procedure is accepted by the decision-making managers in the companies and they are willing to use it in their work. However, final results of the generalizability of this study can be achieved only during a long period and very strong conclusions cannot yet be drawn. In addition, Lukka (2000) stresses that the study should be clearly and economically reported which should be considered when evaluating this thesis.

From the constructive research point of view, the validity and generalizability can be tested by following the market test to estimate the potential adequacy for a larger-scale adoption and diffusion of the construct in the companies. In our study, through this test can be seen that the new construct (procedure) has achieved the level of the weak market test, or even exceeded it. Due to the fact that the results of the market test in the beginning of the test are mostly based on subjective assessments and evaluations, the validation of the generalizability of the created construct is the central challenge in this study. *In the first case study*, the scenario method was examined as a knowledge management method, and it was applied for this purpose with the company representatives (presented in Publications 1, 2 and 3). *The second case study* made it possible to develop and also to test the whole new construct (procedure) with the companies (presented in Publications 4, 5, and Research report (Partanen, 2004)). The procedure was

conducted with the companies from the beginning to the end. The representatives of them in the procedure were managers or directors as in the first case. After the procedure they were willing to repeat the procedure in their organizations and the results were disseminated by the researchers into the companies. The procedure was repeated several times within the participating companies of the research project. This can be seen as a factor that enhances the validity when evaluating the study as a constructive research study. *In the third case study*, the procedure was conducted with the research institutes and their researchers. From the constructive research point of view, the purpose of the project was only to test the procedure in terms of weak market test. According to Kekäle (2001), the weak market test evaluates the confidence of the experts in the field concerning the expected suitability and usefulness of the tested construct. Furthermore, the construct was also applied in two sequential and separate company-specific projects in a pilot company, which may show that the results of the weak market test can be exceeded. In these projects, the construct was used by the business managers and a larger group of the company's personnel. In the first project, the managers and other participants were satisfied with the results, and expressed their willingness to use the construct in their future decision-making. After the first project, the construct was used in the second similar project, which may confirm the usability of the construct for the purposes it was developed for. The managers expressed their willingness to continue the use of the construct in their work.

From the market test point of view, the participants in the research cases and the company-specific projects were in such a position in their organizations that they were able to make decisions concerning the used research methods in their organizations. However, the research concerning the created construct will be continued in our further studies to evaluate the effects of the use of the construct in the company's performance.

During the relatively long research period, the importance of the incentives and the context in the knowledge creation and sharing process was realized. In Publication 5, the reasons of the knowledge sharing and the shift of the innovation paradigm are discussed. Related to this, there are some studies (e.g. Bergquist et al., 2001; Chesbrough, 2003; von Krogh et al., 2003) which have found factors affecting open innovation processes and knowledge sharing among the participants. Due to the fact that the open innovation paradigm is still emerging, there exist numerous potential research areas in the field. However, an interesting and challenging topic for future research might be to get a more holistic understanding of the open innovation phenomenon, which could reveal some quantitative evidence of reciprocal relationships of the participants and their incentives to contribute to the open innovation process and how the knowledge utilization can be enhanced in such a context. Hopefully, this thesis encourages future researchers and practitioners to continue the work and expand understanding of this very interesting research area.

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**Appendix 1.** The basic steps of selected scenario approaches.

<b>Intuitive approach</b>	<b>Heuristic approaches</b>			<b>Statistic approach</b>
<b>(Schwartz, 1996)</b>	<b>(van der Heijden et al., 2002)</b>	<b>(Schoemaker, 1991)</b>	<b>(Meristö, 1991 and 2003)</b>	<b>(Godet, 1993)</b>
1. Exploration of a strategic issue	1. Structuring of the scenario process	1. Framing the scope	1. What are the possible worlds? -PESTE	1. Delimitation of the context
2. Identification of external key forces	2. Exploring the context of the issue	2. Identification of actors & stakeholders	2. Who are we and where are we? -Beliefs, Taboos, Core Competencies.	2. Identification of the key variables
3. Exploring the past trends	3. Developing the scenarios	3. Exploring the predetermined elements	3. Where can we go and how can we get there? -SWOT analysis.	3. Analysis of past trends and actors
4. Evaluation of the environmental forces	4. Stakeholder analysis	4. Identification of uncertainties	4. Where do we decide to go? -Vision and risk profiles.	4. Analysis of the interaction of actors and the environment
5. Creation of the logic of initial scenarios	5. System check, evaluation	5. Construction of initial scenarios	5. Strategy. -Flexibility	5. Creation of the environmental scenarios
6. Creation of final scenarios	6. Action planning	6. Assessment of the initial scenarios	6. Action plan. -Navigation marks.	6. Building the final scenarios
7. Implications for the decision-making		7. Creation of the final learning scenarios		7. Identification of strategic options
8. Follow-up research		8. Evaluation of the stakeholders		8. Action planning
		9. Action planning		
		10. Reassessment of the scenarios and decision-making		

**Appendix 2.** The evaluation questions of the innovation process used in the GDSS laboratory at LUT in the Department of Industrial Engineering and Management.

**Survey form of the GDSS session**

Ballot:

Method: 10-point scale

Options: Allow bypass

Descriptions: rate from 1 to 10, with 10 the highest value.

1. How well did the session live up to your expectations?
2. How well were the objectives of the session achieved?
3. Were the session results worth the effort spent?
4. Evaluate the effectiveness of the process.
5. How well did the process help in effectively focusing the discussion on essential matters?
6. Evaluate the effectiveness of the idea brainstorming phase.
7. Evaluate the effectiveness of the categorization phase of the idea generation process.
8. Evaluate the effectiveness of the commentary phase of the idea generation process.
9. Evaluate the effectiveness of the prioritization phase of the idea generation process.

Evaluate the following arguments:

10. The GDSS sped up and made it more effective to acquire knowledge from the participants.
11. The GDSS helped to make the identification of important development needs more systematic.
12. The GDSS helped to create a holistic understanding of the issue considered.
13. The GDSS helped to make the discussion of the matters, which were disagreed upon, more effective.
14. The GDSS provided an equal opportunity to participate in the session.
15. The usage of the GDSS was easy to learn.
16. The GDSS made it effective to select and prioritize the issues considered.
17. The GDSS helped to generate ideas extensively.
18. During the session, the generated ideas were useful from the business point of view.
19. Some of the ideas were totally new.
20. The old ideas were evaluated and recorded well enough.
21. Did the GDSS provide such value that cannot be achieved with the help of other techniques?
22. Would the results be achieved during the employed time for the session without the help of the GDSS? If yes, how?
23. Will you use the GDSS again?
24. Would you recommend the GDSS to your colleagues?
25. How could the GDSS session be made more effective? What could be done better?

**Appendix 3.** The results of the evaluation questions of the GDSS session. Organization A was from the second case study and Organization B was from the third case study.

Question number	Organization A (Nov. 17, 2003)		Organization B (Nov. 2, 2004)	
	Mean (N)	STD	Mean (N)	STD
1	7.67 (9)	1.00	8.00 (9)	1.00
2	7.67 (9)	0.87	6.89 (9)	1.69
3	7.56 (9)	1.13	7.67 (9)	1.41
4	8.00 (9)	0.71	7.67 (9)	1.22
5	8.33 (9)	1.00	7.78 (9)	0.83
6	7.56 (9)	1.67	7.33 (9)	2.00
7	6.22 (9)	1.72	7.00 (9)	1.31
8	7.67 (9)	0.71	7.56 (9)	1.01
9	8.56 (9)	1.01	7.78 (9)	1.64
10	8.89 (9)	0.78	8.11 (9)	1.27
11	7.89 (9)	1.17	8.00 (9)	1.32
12	7.89 (9)	0.93	7.11 (9)	1.17
13	6.44 (9)	1.33	6.56 (9)	1.94
14	8.22 (9)	2.11	8.78 (9)	0.83
15	9.11 (9)	0.78	9.22 (9)	1.09
16	7.67 (9)	1.12	7.78 (9)	1.30
17	7.44 (9)	0.73	7.56 (9)	1.33
18	7.89 (9)	0.93	Not asked	
19	5.33 (9)	2.24	Not asked	
20	8.11 (9)	0.78	Not asked	
21	(5)	(above)	(4)	(above)
22	(6)	(above)	(3)	(above)
23	Yes (9)		Yes (7), No (1)	
24	Yes (9)		Yes (8)	
25	(7)	(above)	(2)	(above)

Q No.	Organization A	Organization B
21	<ul style="list-style-type: none"> <li>▪ Effective use of time</li> <li>▪ Faster than traditional</li> <li>▪ More interaction needed</li> <li>▪ Effective idea generation</li> <li>▪ Anonymity</li> <li>▪ Effective prioritization and commentary phase</li> </ul>	<ul style="list-style-type: none"> <li>▪ Yes/No</li> <li>▪ Yes</li> <li>▪ Yes</li> <li>▪ Yes</li> </ul>
22	<ul style="list-style-type: none"> <li>▪ Effective use of time → No</li> <li>▪ Need to analyze the prior knowledge better</li> <li>▪ No, but inflexible process</li> <li>▪ No, but almost as good results as now might be by using traditional techniques</li> <li>▪ Excellent method to generate and collect ideas</li> </ul>	<ul style="list-style-type: none"> <li>▪ No</li> <li>▪ No, but the results might be different</li> <li>▪ No</li> </ul>
25	<ul style="list-style-type: none"> <li>▪ Deeper analysis of prior knowledge is needed</li> <li>▪ More experience in GDSS is needed</li> <li>▪ Lack of common language</li> <li>▪ Post analysis of the ideas might give more results</li> <li>▪ Further development of categorization is needed</li> <li>▪ More time for the commentary phase</li> <li>▪ More training and orientation is needed to make the process more effective</li> </ul>	<ul style="list-style-type: none"> <li>▪ More time for idea generation</li> <li>▪ Facilitation is not needed during the idea generation</li> <li>▪ Better definitions for the categories is needed</li> <li>▪ Number of samples is too low for generalization</li> </ul>



## **PART II: THE PUBLICATIONS**



**Publication 1.**

Managing knowledge creation and sharing - scenarios and dynamic capabilities in inter-industry knowledge networks.

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# Managing knowledge creation and sharing – scenarios and dynamic capabilities in inter-industrial knowledge networks

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**Abstract** Organizations are finding it more and more difficult to stay in balance with the pace of change. The continuous rise of business opportunities and the increase in global competition demands proactive knowledge management tools, new capabilities and an ability to renew and reconfigure existing capabilities. This paper presents a framework of the scenario process as a management tool for creating and sharing future-oriented tacit knowledge in knowledge networks and describes how dynamic capabilities can be developed in view of future scenarios. The theoretical framework was tested in an inter-industrial research project resulting in very promising findings about managing tacit, future-oriented knowledge.

**Keywords** Knowledge management, Organizations, Information networks

## Introduction

Despite the widely recognized importance of knowledge management, only leading corporations are reshaping their organization in order to increase capabilities in managing knowledge creation and sharing within and across the organization. Corporate management needs to be aware of possible discontinuations and surprises in their business. The continuous rise of business opportunities and the increase in global competition demands proactive knowledge management tools and new capabilities. Corporate strategies need to be more flexible and more innovative to meet these challenges forcing corporations to invest in capabilities enhancing knowledge management and ensure diffusion of knowledge throughout the organization (Wiig, 1999).

The management of processes has developed from technology push to market pull and from an interactive model to collaborative knowledge management (Amido Rogers, 1996; Corso *et al.*, 2001; Rothwell, 1994). The weight of knowledge management in business has increased vastly since the mid-1980s when Karl Sveiby and his colleagues created a method for valuing and managing intangible assets in an organization. During the past few years, knowledge management and tacit knowledge have become one of the most interesting research areas in corporate management. In practice, knowledge management processes have basically focused on managing internal processes and knowledge resources that are in an explicit form (Miller and Morris, 1999) which means that knowledge is in a codified and formally transferable form, and thus concerns the past events (Nonaka and Takeuchi, 1995). This kind of knowledge is valuable but it is difficult to create sustainable competitive advantage through explicit knowledge. The challenge for dynamic knowledge creation processes is: to gain future-oriented tacit knowledge (Aligica, 2003; Johannessen *et al.*, 1999b; Kulkki and Kosonen, 2001; Scharmer, 2001); and to

renew the specific capabilities of the company along with future-oriented tacit knowledge which is the source for and an opportunity to achieve competitive advantage in the global game (Lubit, 2001; Stähle *et al.*, 2002; von Krogh *et al.*, 2001; von Krogh and Roos, 1995).

According to the dynamic capability view of the firm (Teece *et al.*, 1997), in the changing of the operating environment superior performance depends on the ability to recognize critical changes and on the processes of renewing the firm's knowledge base and capabilities. The problem is how to manage tacit and explicit knowledge and create new capabilities in inter-organizational knowledge networks. It is crucial to understand what the corporation's present core capabilities are and to what extent they need to be developed or replaced in view of future-oriented knowledge.

From the knowledge management point of view, the scenario method offers a communicative process for structured thinking and knowledge creation implying the collective participation of a variety of people organized in learning networks to create future-oriented knowledge. During the process, factual data and human insights are brought together. The scenario process frames the issue, collects and analyzes shared tacit and explicit knowledge from the knowledge network, draws a picture of what is known, ensures the diffusion of knowledge through the network, and anticipates interactive business dynamics (Miller and Waller, 2003). This method has been utilized in business since the end of 1960s, mainly in long-term planning. In recent years, the scenario method has gained prominence as a powerful management tool and as an opportunity to facilitate corporate learning and knowledge creation and sharing (Bood and Postma, 1997; Schoemaker, 1993; van der Heijden *et al.*, 2002).

This study presents a framework for the use of the scenario method as a tool for knowledge management when utilizing tacit and explicit knowledge in inter-industrial knowledge networks. Testing the scenario method was one part of a larger research project when knowledge networks explored new business opportunities in the field of wireless technology. The project started in April 2001 and continued for three years, and the study of the scenario process was initiated in the summer 2002 continuing for one and a half years. The participants in the project formed a collaborative knowledge network to share gained knowledge during the project, and they were: two leading global pulp and paper companies; an international telecom company; an SME software company; the National Technology Agency of Finland (TEKES); and the Telecom Business Research Center at Lappeenranta University of Technology (TBRC). The project yielded very promising findings about managing tacit, future-oriented knowledge and demonstrated the usability of the scenario process as an effective method in establishing a structured and managed process for social communication and supporting ongoing knowledge creation.

#### Dynamic knowledge creation in a learning organization

The importance of understanding the business environment as a dynamic entity has been emphasized in several studies (e.g. de Geus, 1998; Miller *et al.*, 2002; Mintzberg, 2003; Prastacos *et al.*, 2002; Schwartz, 1996; Teece *et al.*, 1997; Weick and Quinn, 1999). Due to the dynamic character of the environment, organizations are finding it more difficult to stay in balance with the pace of change (Dove, 1999; Hamlin *et al.*, 2000; Hong and Kuo, 1999; Johannessen *et al.*, 1999a; Vloebergis, 2001). Learning through knowledge creation and sharing has become a crucial factor especially for knowledge-based organizations.

Weick and Quinn (1999) and Mills (2003) stress that the challenge in organizations is to understand the change in the business environment as an ongoing phenomenon facilitating innovative ideas and making it possible for people to acquire new knowledge. Especially, the learning capability of an organization has to be dynamic to be able to handle the complexity of knowledge creation (Ingelgård *et al.*, 2002; Johannessen *et al.*, 1999b; van der Heijden *et al.*, 2002). Pedler *et al.* (1991) define the learning organization as "an organization that facilitates the learning of all its members and consciously transforms itself and its context." This definition is a good starting point for describing the context of the learning process, but due to its complex nature a more holistic understanding is required. Learning also involves interaction between individuals in the organization, interaction between organizations as entities, and interaction between the organization and its contexts (Nonaka *et al.*, 2000; Wang and Ahmed, 2003). Dove

**“ Learning through knowledge creation and sharing has become a crucial factor especially for knowledge-based organizations. ”**

(1999) has also found that collaborative learning supported by a purposeful infrastructure and culture puts more diversity of thought into closer knowledge sharing.

The knowledge creation process is a continuous and cumulative learning process in which accumulated prior knowledge increases the ability to gain more knowledge and learn subsequent concepts more easily (Bhatt, 2000). Nonaka *et al.* (2000) and Nonaka and Toyama (2003) argue that essential to organizations is the capability to create knowledge continuously. The dynamic ongoing organizational knowledge creation process involves four modes of knowledge conversion: socialization, externalization, combination and internalization (Nonaka and Takeuchi, 1995). They continue that to make it work the shared and facilitated context in which individuals are able to share and create knowledge in interaction with each other and the environment is needed. A continuous knowledge creation process makes it possible to develop and increase the knowledge base and the capabilities of an organization (Blumentritt and Johnston, 1999; Teece *et al.*, 1997).

The process of creating new knowledge presumes that individuals recognize useful data and information and are then able to transform it, through some process, into knowledge that brings future value for the organization (Senge, 1990; Storey and Kelly, 2002). In this process, the role of mental model is essential (Spicer, 1998). Mental models are mental templates consisting of organized knowledge or representation of the environment. They are personal, subjective descriptions of situations formulated in abstract terms, and these models are simplifying stimuli and data on the environment. There is always a mixture of mental models in a scenario group, and the right balance of variance can be a great advantage in the scenario process. When a scenario group can form a large potential coverage of mental models participants in the scenario process look at the future and the environment from different perspectives and bring their different views to group communication stimulating creativity (De Bono, 1987; Bood and Postma, 1997).

To make organizational knowledge creation in such an inter-organizational context possible, the process has to be facilitated and managed in a structured way (e.g. Chesbrough and Teece, 1996; Gupta and Govindarajan, 2000; Inkpen, 1996; Nonaka *et al.*, 2000; von Krogh *et al.*, 2001; Wiig, 1999). Feurer and Chaharbaghi (1995) argue that the quality of knowledge that captures dynamics and uncertainties of the future environment is essential to an organization. They continue that the quality of knowledge means a flexible, creative and future-oriented knowledge creation process.

#### Capability development and scenarios

The dynamic capability view of the firm essentially considers the firm as a repository of productive knowledge. It suggests that dynamic capabilities are potential sources of sustainable competitive advantage (Teece *et al.*, 1997). Dynamic capabilities denote the firm's ability to build, reconfigure and renew resources, capabilities and routines in a changing business environment (Eisenhardt and Martin, 2000; Teece *et al.*, 1997). Organizational and technological capabilities may offer sustainable competitive advantage to a firm in rapidly changing markets only if the firm is able to recognize changes and reconfigure its asset base and processes continuously to match the requirements of the environment. A firm's short-term profitability is constrained by the current level of its stocks of assets (Dierickx and Cool, 1989) and by institutional factors such as regulation and the structure of the industry (Amit and Schoemaker, 1993). In the short term, a firm's asset base cannot be enhanced substantially because crucial knowledge-based assets cannot be acquired and taken to use overnight. Knowledge accumulation through learning is a path-dependent activity, and the creation of new capabilities takes time. Capability building involves testing and selecting new knowledge combinations and modifying knowledge systems, skills, procedures and routines (Nonaka *et al.*,

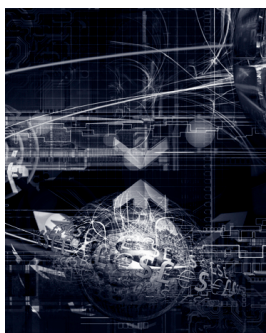
2000; Zollo and Winter, 2002). The current repertoire of a firm's capabilities is the cumulated result of its past investments in knowledge creating activities. Correspondingly, the potential profitability of a firm in the future depends on its ability to recognize promising opportunities, modify existing capabilities and develop new ones to match the requirements of the changing environment (Teece *et al.*, 1997).

To be able to identify and respond to new opportunities, firms need the ability to search, assimilate and transform knowledge (Cohen and Levinthal, 1990; Zahra and George, 2002). Capability developing calls for well-organized knowledge searching and acquisition procedures. Organizations can be seen as interpreting and sensemaking systems (Daft and Weick, 1984). Langlois (1997) argues that an organization's ability to interpret signals and perceive opportunities is a matter of fit between the environment and the organization as a cognitive system. An organization's cognitive system determines what information is recognized as meaningful and how opportunities are perceived. What is important for organizational renewal and the creation of appropriate capabilities is that the decision makers in firms interpret and respond correctly to the messages they receive. From the dynamic capability viewpoint, to be successful in a changing world, a firm needs a perceptual ability to see ways to create and improve capabilities and to recognize opportunities for applying capabilities in a value-generating way (Langlois, 1997). A firm's perceptual ability is affected by the tools and systems supporting its decision making. Thus, the choosing of knowledge management procedures and strategy making tools should not be trivialized.

An essential challenge in the management of organizational knowledge is to know when and where to direct collective attention in conditions of limited attentional resources. Developing new organizational and technological capabilities requires time and resources, and therefore investments have to be made on the basis of weak signals or expectations of the evolution of the environment. Firms have to invest in capability building before they know exactly how valuable the new capabilities will be. Time compression diseconomies (Dierickx and Cool, 1989) and path-dependence in capability development drive firms should be active before new capabilities are needed in practice. In an uncertain and radically changing selection environment, to match the firm's resource and capability portfolio with environmental opportunities, the decision makers have to evaluate, reconfigure and redeploy the firm's knowledge base and capabilities continuously and recognize environmental changes. The scenario process may support decision making in these choice situations. Moran and Ghoshal (1999) claim that before a particular resource deployment can be seen as an element of a firm's productive opportunity set three conditions must be met: the combination has to be enabled, motivated and perceived. The use of the scenario method facilitates especially the fulfillment of the last two necessary conditions.

Individuals and organizations try to make sense of the environment they are facing and adjust to environmental changes through mental models. They are employed in theory-driven information processing in which new information is interpreted through earlier experiences. Mental models exist on an individual level, but they can be also shared, group or organization level knowledge structures (Porac *et al.*, 1989; Walsh, 1995). Organizational actions and cognition reinforce each other, as actions are based on mental models, and executed actions reshape organizational cognitive maps. Over time, this self-reinforcing feedback loop narrows the attention and channels the interest to familiar knowledge sources. If business goes satisfyingly there is considerable risk of becoming insensitive to changes in the market (Prahalad and Bettis, 1986). As decision-makers continuously receive information about current customers, they may elide emerging markets and potential new customers (Danneels, 2003). Thus, managers need tools for systematic deliberate environmental scanning to overcome this deficiency.

Exploratory search activities are essential for the identification and valuation of new capabilities. In the short run, exploitation of existing routines, knowledge and capabilities is essential for the survival of the firm, but in the long run, so is also the generation of new knowledge and capabilities (March, 1991; Metcalfe and James, 2000). If a firm concentrates only on strengthening existing capabilities there is a risk that its core capabilities harden into "core rigidities" (Leonard-Barton, 1992), and the organization loses the flexibility and adaptability needed to respond to changes. Because of changes in technologies, consumer preferences,



## “ The knowledge creation process is a continuous and cumulative learning process. ”

regulations and other market shifts, firms have to reconfigure their capability portfolio continuously. Metcalfe and James (2000) see the essence of the firm fundamentally as a bundle of transformation processes. Capabilities are developed through learning processes and the integration of routines.

In the scenario process, weak signals and tacit or intangible knowledge are transformed into a more explicit form through dialogue among the participants. The operations of information sharing and observation consolidation together with knowledge transformation and transfer processes help to break down existing assumptions. Tacit individual knowledge and local meanings are converted into a language of shared terms and concepts. Thus, the scenario process is not only a method for forecasting, but also a remarkable tool for reframing mental models and supporting collaborative learning. Central organizational learning activities such as orientation, reflection and exploration (Amin and Cohendet, 2000) can be supported by the use of the scenario method.

### Scenario process in knowledge management

The scenario approach is an ongoing communicative learning process that enables periodical revising of corporate strategies in the light of current business environment (Masini and Vasquez, 2003; Millett and Randles, 1986; Schwartz, 1996; van der Heijden *et al.*, 2002). The fundamental idea behind scenario planning is to provide a structured way to create dynamic interaction between the environment and the organization to cover a broad range of future possibilities to confront future uncertainties and expand people's thinking (Ellis and Shpielberg, 2003; Schoemaker, 1993; Wack, 1985a; Weick and Quinn, 1999). According to Schwartz (1996), the scenario process makes it possible to share and reassemble personal knowledge to build a holistic understanding between the internal and external environment of an organization. The scenario process helps to make sense of a wide variety of unstructured, complex and contradictory knowledge which has both tacit and explicit dimensions. Scenarios that are drawn through different personal experiences and perspectives have a multidisciplinary and multidimensional character and help organizations and individuals to develop and broaden mental maps of possible future realities and understand the fundamental drivers of business, market and technological trends and changes (Masini and Vasquez, 2003; Schoemaker, 1991, 1992, 1993; Teece, 1998; Wack, 1985b). According to Grant (2003) and Chermak (2003), the primary contribution of scenario planning is to promote a process of strategic thinking and organizational knowledge creation through learning. Grant continues that organizations need to have channels and forums for communication and knowledge sharing and they should be capable of promoting a dialogue between the different levels of organization. Nonaka and Toyama (2002, 2003) and Nonaka *et al.* (2000) state that to create new meanings through interaction the participants in the process need to have a shared, physical context, i.e. ba. The scenario process involves organizational leaders and managers, R&D centers, associations, different groups of experts and many other stakeholders in the form of a structured and managed network to share knowledge and to create alternative presentations of the future on the basis of this shared knowledge (Roubelat, 2000).

These networks vary from intra-organizational working groups to inter-organizational virtual networks. The common task of the networks is to produce new knowledge and enhance the performance of the participating organizations. When managing knowledge, organizations must specialize and fragment knowledge and expertise but at the same time integrate them into a certain task (Collinson, 2001). This leads organizations to form collaborative, inter-organizational learning knowledge networks around a common goal which offers a place or some degree of coordinated structure. This fosters participants to share their knowledge and create new knowledge through interaction between individuals throughout the organization (Amido Rogers, 1996; Bennett III, 1998; Debackere *et al.*, 1994; Leonard and Sensiper, 1998;

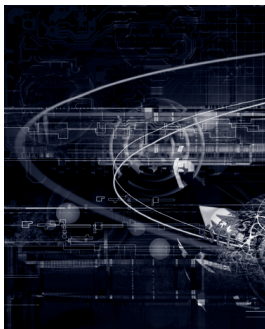
Lubit, 2001; Mudambi, 2002; Nonaka and Toyama, 2003; Roubelat, 2000). Creation of new knowledge in these networks requires a managed process to facilitate dialectic social communication in a physical context and to ensure learning and knowledge accumulation in organizations (Blumentritt and Johnston, 1999; Buckley and Carter, 2002; Kash and Rycroft, 2002; Mentzas *et al.*, 2001; Nonaka and Toyama, 2003; Weisenfeld *et al.*, 2001). According to Chesbrough and Teece (1996), Collinson (2001), de Meyer (1999) and Weisenfeld *et al.* (2001), networks need to be managed and coordinated from someone's point of view in order to succeed. Scenario creation is always an intentional and structured process for a certain task and point of view.

Van der Heijden *et al.* (2002) and Wilson (2000) state that the scenario process is considered a successful management tool in a communicative social context. The scenario process has been developed to help manage knowledge creation and sharing through interaction between individuals and organizations. The scenario process is a method for steering complex and creative group innovation and decision processes (Millett and Randles, 1986; Schoemaker, 1991, 1993). It provides a framework for rational discussion about alternative views emerging inside and outside the organization (Schoemaker, 1993). Scenarios reflect beliefs, expertise and intuition of individuals and organizations concerning the future, i.e. future-oriented knowledge. Scenarios are shared collective representations of the possible future of an organization and its environment (Roubelat, 2000; Wack, 1985b). These representations reveal a potential variety of emerging opportunities to turn them into capabilities.

The challenge for the management of such processes is to empower and harness the skills, knowledge and experience learned inside and outside the networks of the organization (Schwartz, 1996; van der Heijden *et al.*, 2002). Learning from the business environment is an organizational ability to experiment, continually to explore new opportunities for creating new sources of success, and to change behavior (Bergman *et al.*, 2004; Chermak and van der Merwe, 2003; van der Heijden *et al.*, 2002). According to Grant (2003), in corporate strategies the scenario process enhances sensitivity to emerging discontinuities in a corporation's evolution and ensures short-term flexibility and stable long-term development of business. In other words, scenarios provide a method for discovering and comparing firm-specific capabilities with future requirements, and making it possible to face the situations of complex rapid change (Schoemaker, 1992).

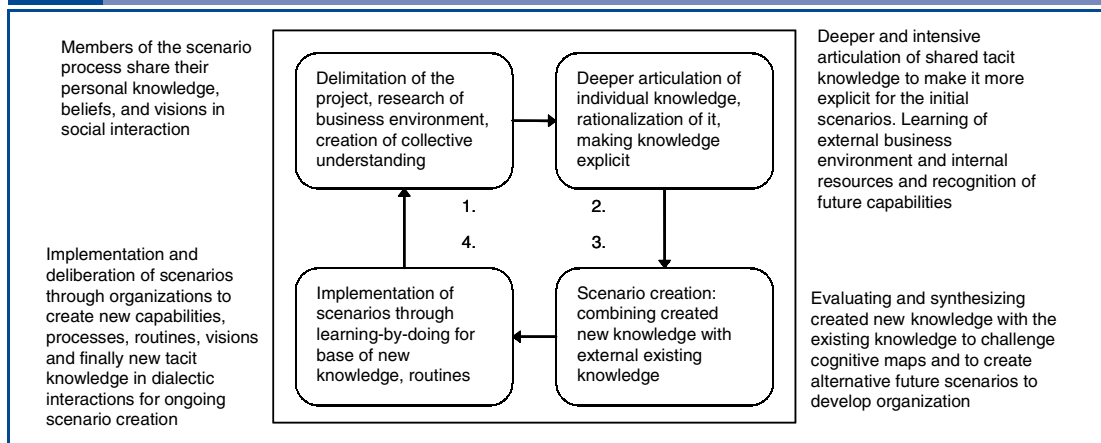
#### Phases of the scenario process

According to Masini and Vasquez (2003), creating scenarios means carrying out an ongoing process, i.e. establishing a project periodically or when needed. The scenario process builds an interactive and structured social context for an organizational communication process. It has a certain structure and phases common to all approaches (Godet, 1993; Masini and Vasquez, 2003; Schoemaker, 1993; Schwartz, 1996; van der Heijden *et al.*, 2002). Phelps *et al.* (2001) argue that the scenario process can be conceptualized into four stages: from the delimitation of the focus to interactive knowledge sharing and creation, and from resulting combinations of new knowledge in the form of scenarios to organizational learning through the implementation of the scenarios (see Figure 1).



In the first phase of the scenario process, a varying number of individuals from different organizations form a knowledge network for a certain task to create and share new knowledge. The starting point of the scenario process is the identification of the knowledge gap among the members of the network to frame the issue towards a common goal (Schwartz, 1996; van der Heijden *et al.*, 2002). According to Leonard and Sensiper (1998) and von Krogh *et al.* (2001), understanding the purpose is essential when creating collective tacit knowledge for a certain goal. Determination of the knowledge gap includes the evaluation of the project or decision field and the allocation of resources to the process. Individuals with different backgrounds and knowledge bases begin to share their tacit and explicit knowledge creating collective tacit knowledge around the focus. They have person-to-person discussions, group meetings and informal spontaneous conversations where they are able to share their experiences and challenge existing interpretations producing a shared language and vision. If necessary, the main knowledge network can be enlarged by new members to bring new knowledge and insight into the process. In other words, the scenario process builds a place and structures to

**Figure 1** Dynamic knowledge creation and sharing in the scenario process



create new knowledge through interaction between individuals and the organization, and between individuals and the external environment (Nonaka *et al.* 2000; Nonaka and Toyama, 2002, 2003).

During the second phase, the participants of the scenario process continue the articulation of tacit knowledge. They perform scenario sessions and use brainstorming and other structured thinking methods to find out the most valuable knowledge (driving forces, stakeholders and actors in the business environment, current trends, best practices, existing organizational knowledge concerning the issue etc.) for the scenario creation. The number of participants in the sessions can also be temporarily increased by inviting experts from a certain field to bring novel insight into the process and to exploit external knowledge sources, for instance universities, external partners and clients. Seminars, interviews, Delphi panels and surveys can be used to broaden the knowledge network (van der Heijden *et al.*, 2002). Through these sessions and meetings tacit knowledge will become more explicit. The participants share their beliefs and knowledge, study the conjectures of the business environment, rationalize the environment surrounding them and express their future visions. This knowledge is a combination of past and present knowledge that reflects experts' and actors' beliefs about the development in the future, i.e. future-oriented "not-yet-embodied" knowledge (Kulkki and Kosonen, 2001; Scharmer, 2001).

The third phase is the scenario construction, in other words, the integration of new knowledge. During this phase, the externalized (articulated and analyzed) tacit knowledge is in an explicit form, and it will be examined and processed in closer detail. The created new knowledge is combined with existing explicit external and internal knowledge of an organization. The integrated new and existing explicit knowledge determines the present operative/business environment. It also points out resources and knowledge bases where organizations are able to operate and draws alternative future scenarios as to where they should create capabilities to succeed. The present mental maps and organizational visions can be challenged and reconfigured on the basis of alternative scenarios determining the present and future framework of organizations enabling them to determine their present capabilities and identify future requirements. Weak signals and drivers of future development can be identified and followed as triggers for a certain scenario or a specific event.

The last phase of the scenario process is the implementation of the created scenarios. This created new knowledge will be transferred and communicated into the organizations of the network creating additional value for the network by means of being shared and learned by doing. The internalization of scenarios makes it possible to rethink organizational processes,

create and develop new capabilities, enhance the decision making and action planning and gain leverage for the common vision of the knowledge network, etc. The scenario process stimulates strategic thinking and challenges present routines and mental maps, and leads to continuous and cumulative knowledge creation and learning processes (Bennett III, 1998; Masini and Vasquez, 2003; van der Heijden *et al.*, 2002; Wack, 1985b). Organizations can formulate strategies that are aware of environmental changes and exploit future opportunities within an acceptable risk level (Miller and Waller, 2003). The scenarios can be used as a communication tool to diffuse explicit future-oriented knowledge throughout the organization and accelerate the process of organizational learning (Bood and Postma, 1997). This phase makes it possible to ensure an ongoing knowledge creation process and continuous scenario planning.

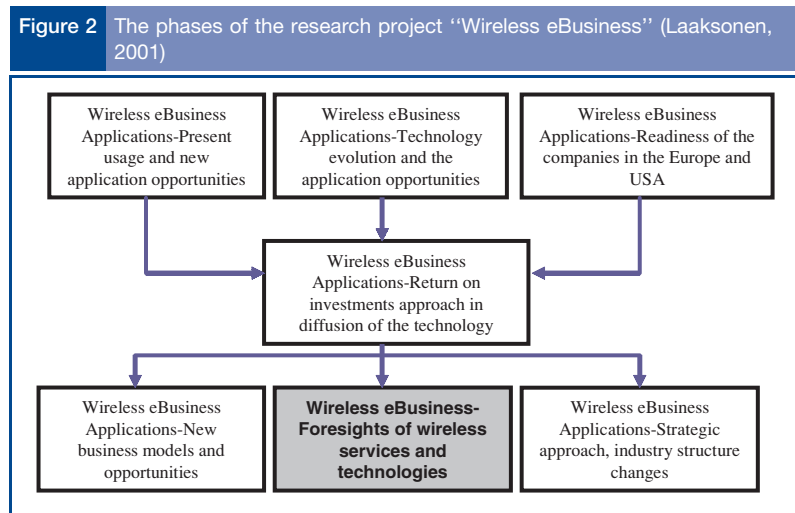
**Case: Scenario process and knowledge management in an inter-industrial research project – examining new business opportunities around wireless communication technology**

*Background of the research project*

This section introduces the use of the scenario process in knowledge management. The scenario process was part of a larger research project aiming at the better understanding of the management of the corporate strategy process and providing industrial foresight. The research project consisted of seven separate phases (see Figure 2) of which the first four phases provided background knowledge for the following phase “foresights of wireless technology”. In this phase, the scenario process was conducted to manage the creation of new knowledge on the basis of explicit and tacit knowledge gathered during the preceding phases of the research project and to facilitate the interaction between the participants. During the scenario process, new knowledge about the future business opportunities of wireless technology was created, new requirements for future capabilities identified and learning within the collaborative network facilitated. The participants in the research project were two leading global pulp and paper companies, StoraEnso and UPM Kymmene, the international telecom company TeliaSonera, the SME software company Modultek, the National Technology Agency of Finland and the Telecom Business Research Center at Lappeenranta University of Technology (TBRC). The project started in April 2001 and continued for three years. The management and facilitation of the research project was conducted by the experts of the TBRC.

*Description of the scenario process in the research project*

The scenario process was initiated in summer 2002 and continued for one and a half years. The participants in the research project formed a multi-disciplinary collaborative knowledge network



to build alternative future scenarios. The knowledge network consisted of ten researchers of the TBRC and five permanent representatives of the participating companies. This knowledge network acted as the domain of knowledge creation in the scenario process.

From the beginning of the research project the scenario process enabled a dialectic communication process and knowledge creation and management in the knowledge network. The scenario process was based on social interaction between the participants. Group and person-to-person meetings were conducted periodically during the process. In these meetings the participants of the knowledge network shared their gathered information and knowledge. The researchers shared their knowledge with the company representatives, and they contributed into the process sharing the existing company-specific tacit knowledge. The participants also communicated informally in face-to-face meetings in the participating companies and via telecommunication devices to complement the knowledge base. During this first phase, the overall focus of the scenarios was determined, the knowledge gap identified and the shared vision "new business opportunities of wireless communication technologies" was presented.

In the second phase, the participants continued the articulation of tacit knowledge. They had periodical meetings with the company representatives, and intensive brainstorming sessions were performed among the researchers. This enabled a deeper articulation and externalization of the tacit knowledge of the knowledge network and integration with the existing company-specific tacit knowledge and the background information from the preceding phases of the project. The process produced a collective understanding about the dynamics of the industry and technology, e.g. the driving forces, the stakeholders and main actors of the business environment, current trends, best practices of the ICT industry as well as existing organizational knowledge concerning the issue. The created collective tacit knowledge was used for background information and as knowledge in the scenario creation. This knowledge was based on deep examination of the development of wireless technology and appliances and on the investigation of new business models in close cooperation with the participating companies. During this collaborative research work, the companies had excellent opportunities to share their company-specific knowledge and experiences in the knowledge network and gain new knowledge for their own use. This phase resulted in a common understanding of the future requirements of the industry. The present and future industrial capabilities were identified, and a comparison with the best practices of the industry was made. Holistic collective understanding of the issue was attained for further, more systematic processing.

After the second phase, the researchers formed a smaller scenario team to communicate and share their externalized knowledge and to combine it with the existing explicit knowledge gathered in the previous phase. During this phase, the scenario team examined intensively the gathered background information and the created new knowledge. They had daily scenario sessions to share their ideas, information and knowledge to produce collective representations, in other words, to combine the created new knowledge and existing explicit knowledge. These representations were presented in periodic meetings where the company representatives had an opportunity to contribute to the scenario process and share their knowledge, beliefs and visions within the knowledge network.

For the creation of initial scenarios, the knowledge network was enlarged in the participating companies. A Web-survey was conducted to collect additional knowledge from the experts in the companies. A questionnaire was used in which experts were asked to evaluate the most important drivers for the future wireless business environment. The drivers (altogether over 300) were identified and selected in scenario sessions and periodic meetings during the research project. The final questionnaire included 79 arguments selected by the scenario team. The Web-survey was sent to 60 selected experts in the participating companies, 46 of whom returned their answers. On the basis of the Web-survey and the created new explicit knowledge, alternative future scenarios were constructed and articulated in the final concluding knowledge network meeting before implementation in the participating companies.

**“ As innovation cycles are shortening and the technology is changing rapidly, corporations have to create flexibility. ”**

The final step in the scenario process was the implementation of the alternative scenarios in the participating companies in their businesses. This phase enabled the internalization of the created explicit knowledge during the scenario process and the development of new capabilities through learning by doing. In other words, the scenario process made it possible to keep alive the continuous spiral of knowledge creation and diffusion of knowledge in a corporate network during the research project. The scenario-based knowledge creation and sharing process became routine in the participating companies and served as the basis for continuous knowledge creation.

The scenarios have entered the company implementation process, and the reports of the experiences on this phase will be available later and reported separately.

#### **Results and conclusion**

This study has suggested guidelines for corporate knowledge management and proactive knowledge creation in a networked business environment. The problem with knowledge management often lies in the fact that corporations and individuals do not understand the fundamentals of the knowledge creation process.

We noticed that if corporations become familiar with knowledge creation they can both develop appropriate knowledge and leverage and utilize it further in the business processes of the entire company. Dynamic knowledge creation and sharing require appropriate methods and practices for the managing of tacit and explicit knowledge. The scenario method proved to be a capable management tool for this. During the scenario process, the participants were able to challenge their mental maps and transcend existing individual and organizational boundaries. The scenario process also helps to overcome communication barriers.

As innovation cycles are shortening and the technology is changing rapidly, corporations have to create flexibility. They need the ability to learn from the market by recognizing customers' latent needs and methods to manage scarce capabilities. Ability to exploit existing capabilities and knowledge base is important for success, but corporations also need dynamic capabilities which are employed when a firm acquires knowledge and builds new capabilities for future needs. In a changing environment, the ability to sense and seize new opportunities (Teece, 2000) and to build and reconfigure knowledge-based assets is crucial for the firms' long term competitiveness.

In the development of new capabilities corporations need tools and routines for systematic information processing, knowledge creation and knowledge sharing. In this study it became clear that the scenario method is a successful tool enabling the proactive management of knowledge and fostering the diffusion of knowledge in large inter-industrial business networks. The scenario process made it possible to examine company-specific capabilities and recognize environmental changes which is important for organizational renewal and the creation of appropriate abilities in the participating companies.

The scenario method has traditionally been used for anticipating future development and drawing alternative descriptions of the future. This study demonstrates the usability of the scenario process as an effective method for establishing a structured and managed process for social communication and for supporting continuous knowledge creation.

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## **Creating future capabilities – Scenario process in inter-industrial knowledge networks**

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### **Abstract**

*It is well known that the dynamics in business are changing. Companies need to be aware of changes in their business environment, have an ability to recognize and exploit opportunities through their rare and distinctive resources and capabilities. This depends on their dynamic ability to reinvent their capabilities, business models, and strategies as circumstances ongoing change. This paper studies the framework for sustaining the renewal of core capabilities in an inter-organizational context. Firstly, the dynamic capability view is introduced. Secondly, organizational knowledge creation through communication and learning are examined, and the basis of future-oriented knowledge is explained. This study demonstrates the knowledge creation process in an inter-industry context. The paper clarifies the real advantages and problems of the process introducing the framework for creating future capabilities.*

**Keywords:** capabilities, knowledge creation, mental models, communication, scenario

## **1 Introduction**

Companies operating in a changing environment face the danger that their core capabilities harden into "core rigidities" (Leonard-Barton, 1992). Core capabilities involve accumulated behaviors and beliefs based on earlier success. Knowledge embedded in routines, processes, techniques and systems is derived from multiple sources over the years. Highly specialized skills tend to become stable which over time leads to a loss of metalearning expertise (Lei et al., 1996). The entire organization may create organizational defensive routines, which are anti-learning and lead to "skilled incompetence" (Argyris, 1999). Organizational actions and organizational cognition reinforce each other: actions are based on individual-level, group-level and organization-level mental models i.e. mental templates consisting of organized knowledge or representation of the environment (Walsh, 1995). The actions taken reshape mental models. Over time, this self-reinforcing feedback loop narrows the attention and channels the interest to familiar knowledge sources. If business is satisfying, there is a considerable risk of becoming insensitive to changes in the market. If the company's capabilities and knowledge base lose their dynamic quality, the company becomes unable to find the flexibility and adaptability needed to respond to environmental changes. The ability to build and integrate new capabilities and reconfigure the existing ones is critical, when the operating environment is in a state of flux. To succeed in that, deeply embedded knowledge sets have to be constantly challenged and renewed.

The knowledge-based view of the company or the capability-based approach sees the company essentially as a repository of productive knowledge (Grant, 1996; Kogut and Zander, 1992; Teece et al., 1997). The company's knowledge-based assets are its potential source of competitive advantage. However, when the operating environment changes rapidly, also the company's knowledge base has to absorb new knowledge so that the company is able to match its capabilities and products with altered requirements and changing market needs. Due to changes in technologies, consumer preferences, regulations, and other market shifts, companies have to reconfigure their capability portfolio continuously. Thus, potential competitive advantage rests on dynamic capabilities referring to the company's processes enabling the adaptation to the changing environment. Company's dynamic capabilities are the ability to build, reconfigure and renew resources, capabilities and routines in a changing business environment (Teece et al., 1997). The development of capabilities calls for well-organized knowledge-

searching and acquisition procedures. The company's capabilities are developed through learning processes and the integration of routines. According to Zollo and Winter (2002), the company's dynamic capabilities reflect its tacit experience accumulation processes and explicit knowledge articulation and codification activities.

Feurer and Chaharbaghi (1995) argue that the quality of knowledge that captures dynamics and uncertainties of the future environment is essential to an organization, which means flexible, creative and future-oriented knowledge creation process. To make organizational knowledge creation in an inter-organizational context possible, the process needs to be facilitated and managed in a structured way (Chesbrough and Teece, 1996; Gupta and Govindarajan, 2000; Inkpen, 1996; Nonaka et al., 2000; von Krogh et al., 2001; Wiig, 1999). Von Krogh (1998) also reminds that knowledge creation in organizations is a fragile process which needs careful consideration and the establishment of enabling conditions. In the scenario process, the relevant accumulated experience of participants is articulated and, to some extent, codified. The issue under scenario examination channels the knowledge articulation process. Hence, the scenario process is one of the methods that can be used deliberately to question established ways of thinking and to support organizational learning.

Methodologically, this study uses a constructive approach which was well suited, because the aim of the study was to create and to test a framework in a real-life context. The idea in the constructive approach is to design a new construct and test its capability in real-life cases resulting in a new construct which is linked with present theories and practices. The construct of this study is based on the scenario process applied for knowledge management in a limited context. The results of the study are evaluated on the basis of the newness and applicability in the progress of scientific knowledge and practice.

## **2 Inter-organizational knowledge creation**

Knowledge creation in the organizational level depends strongly on individuals organized together to share their personal knowledge and to learn from other individuals' knowledge (Ford and Chan, 2003). In other words, knowledge is created in a dynamic social interaction amongst individuals, organizations and the environment (Nonaka et al., 2000). Bergquist et al. (2001) have noted that knowledge creation is a

collective process of understanding the surrounding environment. In the organizational level, knowledge creation is related to working communities in which individuals are able to act through direct experiences (Inkpen, 1996; Nonaka and Toyama, 2003; von Krogh et al., 2001). In the working communities, individuals with different backgrounds, experiences and mental models are bound together to share and create knowledge for organizational purposes (Inkpen, 1996; Leonard and Sensiper, 1998; Malone, 2003). Working communities provide a physical context for the knowledge creation process (Leonard and Sensiper, 1998; Nonaka and Toyama, 2003) where knowledge creation starts at the individual level, goes through the conversion within the group level and finally accumulates into the organizational level as a continuous process (Inkpen, 1996). Interaction between individuals is not limited to a particular working community, but is linked with the environment and other communities across organizational boundaries (Nonaka and Toyama, 2003). These interactive linkages enable the transfer of knowledge between individuals and different organizations, and the creation of interpretation of internal and external environment for the basis of new knowledge (Nonaka and Toyama, 2003). Interaction between individuals and the organization, and individuals and the environment expands the knowledge creation context into an inter-organizational network structure and holds them together in a form of network (Debackere et al., 1994; Weick and Browning, 1986). Knowledge creative networks in organizations provide the means of coping with complexity through individuals and groups. Kash and Rycroft (2002) state that knowledge networks are formed to create new knowledge for the renewal of organizational capabilities to provide new insights in technological and market development for new innovations, and to ensure long-term efficiency within the organization.

Organizational communication, based on interaction between individuals sharing their personal knowledge, connects individuals with the community, thus making them more involved in the community over time (Debackere et. al., 1994). The purpose of such communities is to ensure the collaboration of professionals and the creation of specific knowledge for problem-solving (von Krogh et. al, 2001). As communities involve a number of individuals from different organizations working on the same task under a shared vision, they have access to a wider organizational knowledge base, the connections become more interactive, and more holistic interpretations are formed (Daft and Weick, 1984; Inkpen, 1996; Malone, 2003; Weick, 1987). In these working

communities and among individuals with different organizational experiences and cultures, knowledge bases increase divergent thinking in a dialectic process which drives the creation of innovative new ideas and new knowledge (Bennett, 1998; Leonard and Sensiper, 1998). Weick (1991) also defines knowledge creation in an organizational learning process as a result of groups of individuals creating collective interpretations.

Nonaka and Takeuchi (1995) and Nonaka and Toyama (2003) present the framework for the knowledge-creation process as dialectic thinking and acting in a shared context. Different intra- and inter-organizational working communities offer a context where creative social interaction can take place and a dialogue occurs between tacit and explicit knowledge inducing new knowledge (Nonaka et al., 2000). The knowledge creation process is a continuous and cumulative process in which accumulated prior knowledge increases the ability to gain more knowledge and learn subsequent concepts more easily (Bhatt, 2000).

## **2.1 Barriers and enabling conditions in communication and collaborative knowledge creation**

Communication can be defined as a dialectic process; it is subjective, perceptual, and nonverbal as well as verbal, and general or contextual, rather than specific (Goldhaber et al., 1979; Nonaka and Toyama, 2003). In the organizational context, communication can be seen as “the exchange of information between a sender and a receiver and the inference of meaning between organizational participants” (O’Reily and Pondy, 1979: 121). In this paper, the sociological perspective of communication is emphasized; to overcome individual cognitive limits, knowledge must be shared through a process of socialization. This demands collaborative knowledge creation also with players that are outside the direct control of the firm (Sawhney and Prandelli, 2000).

According to von Krogh (1998), “when we create new knowledge we make sense out of a new situation by holding justified beliefs, committing ourselves to this new situation, and, most importantly, by enhancing our potential to act in a new situation.” The first steps in knowledge creation hinge on individuals being able to share and publicly justify their personal true beliefs about a situation with other team members. Von Krogh (1998) has found four barriers to the public justification processes in sharing personal knowledge. *The first* one is a need for a legitimate language and vocabulary, which

means that language should be known and acceptable to all team members and to the company. *The second* barrier is constituted by organizational stories and habits that are based on history, or routines that are difficult or impossible to question. *The third* barrier consists of formal procedures that represent embedded experiences and successful solutions to complete tasks. These core capabilities may lead to “core rigidities” (Leonard-Barton, 1992) if they work against public justification of individual beliefs in directing communication and defining planning steps. *The fourth* and the most fundamental barrier is constituted by company paradigms. A company’s strategic intent, vision or mission statement, strategies and core values constitute its paradigm. For political and cultural reasons, individuals will find it difficult to justify personal beliefs that are not in accordance with the ruling paradigm.

Organizational structure can also constitute an enabling or preventing environment for knowledge sharing and communication. Organizational structure refers to the network of relationships and roles existing throughout the organization. Some structures, because of their extreme formality or cumbersome size and complexity, act as communication blockages, filtering and distorting potentially useful information. On the other hand, more informal structures tend to allow more information flow across the network paths than people can handle, which leads to overload. When it comes to communication, the major implication of structure is this: what kind of structure is most suitable for present organizational needs, so that important information flows freely without overloading relevant decision makers. (Goldhaber et al., 1979)

According to Miller (1999), communication in bureaucracies takes on specific characteristics. The contents of communication are normally task-related and discourage social communication and innovation. The direction of communication will typically be routed up and down the organization chart, and horizontal communication will only be encouraged among employees of the same level. The contents will typically be in the form of orders, rules and directives, and will result in little feedback. The written mode of communication will be the most prevalent one and will focus on rules and procedures for efficient organizational functioning. The style of communication will probably be formal, and even when managers ask for employee input, it is likely that these managers will not act on the employees’ opinions. Thus, bureaucratic structure seldom leads to active knowledge sharing and creation.

As for the process function, knowledge managers can lead and facilitate knowledge creation and accumulation, and sharing of tacit knowledge activities by socially nurturing a “good *ba*” (physical, virtual, mental environment or any combination of them) for converting individual knowledge into organizational knowledge (Nonaka and Konno, 1998). An enabling condition for communication and knowledge creation is a dynamic, open knowledge environment which generates the ability for organizational self-renewal and radical innovativeness (Ståhle and Grönroos, 2000).

## **2.2 Future-oriented knowledge**

Organizational knowledge creation concerns interaction between tacit and explicit knowledge that develop in a complex web of relationships and social activities among individuals. Nonaka and Takeuchi (1995) define explicit knowledge as knowledge that can be expressed in formal, systematic language and shared in a form of data, and also concerning past events. In contrast, tacit knowledge concerns present “here-and-now” knowledge which is available in direct experiences in discussions, routines, values and emotions. Nonaka and Takeuchi (1995) state that both types of knowledge are complementary and essential to knowledge creation. But to create sustainable competitive advantage, organizations need to make sense of the changing environment and create future-oriented “not-yet-embodied” knowledge (Kulkki and Kosonen, 2001; Millet, 2003; Scharmer, 2001; Schoemaker, 2000; Schwartz, 1996; van der Heijden et al., 2002).

Bell (1997) has stated some fundamental assumptions for future studies: Firstly, something currently nonexistent can exist in the future. Secondly, there is no certain information about the future, which is why the future cannot be observed. He continues that the future is not predetermined, because future outcomes can be influenced by proactive measures. Future outcomes are consequences of some actions of certain actors based on knowledge created from information about the environment. Ingvar (1985) has noted that all human actions are based on future-oriented plans/scenarios which he calls “memories of future”. In other words, future-oriented knowledge concerns expert or/and actor knowledge, beliefs and intuition about the development of the issue and its conjectures (Aligica, 2003; Johannessen et al., 1999; Kulkki and Kosonen, 2001; Scharmer, 2001). Also Nonaka et al. (2000) and von Krogh et al. (2001) mention the

proactive knowledge creation around the self-transcending tacit knowledge reaching beyond personal boundaries. Bennett (1998) and van der Heijden et al. (2002) argue that tacit knowledge gathered through years of experience in the form of intuition makes it possible to develop new interpretations of environmental causalities concerning the future. Future-oriented “not-yet-embodied” knowledge enables the challenging of the present organizational-level mental models and a better understanding of the complexities of the emerging internal and external environment (Schoemaker, 1991), and becomes prior knowledge to confront the uncertain but (now) known environment. The future-oriented knowledge can be seen, as Cohen and Levinthal (1990) state, as prior knowledge that enables the assimilation and the use of new knowledge, in this case, emerging in the future.

### **2.3 Reconstructing mental models**

In this paper, learning will be interpreted as double-loop (Argyris, 1999). In a learning process, the role of an individual is essential due to the fact that organizations do not perform actions producing learning. Organizations learn only through individuals acting as organizational agents producing behavior that leads to learning. The process presumes that individuals recognize useful data and information, and are then through some process able to transform it into knowledge that brings future value for the organization (Argyris, 1999; Senge, 1990; Storey and Kelly, 2002). Understandably, organizations have a possibility to create conditions that may influence what individuals frame as a problem, design a solution and produce action to solve a problem (Argyris, 1999). The concept of collaborative learning also holds a major role in the scenario process due to the fact that collaborative learning in organizations can foster knowledge creation. As Dove (1999) has found out, collaborative learning supported by a purposeful infrastructure and culture causes more diversity of thought in closer knowledge exchange.

The concept of the mental model is not a new one, and it was cited in the 40's for the first time (Spicer, 1998). These models are personal, subjective descriptions of situations formulated in abstract terms, and they simplify stimuli and data on the environment. Mental models also exist below an individual's level of awareness (Senge, 1992; Spicer, 1998). There have been several studies on the importance of the subject, but only from

the beginning of the last decade the extraction of mental models has been recognized as a crucial function in learning (Bood and Postma, 1997; van der Heijden, 1992).

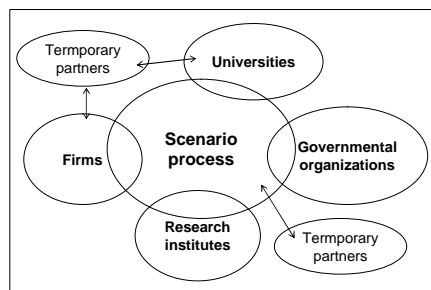
As Spicer (1998) has stated, mental models are built and developed during a lifetime and shaped by experience, social and cultural background and education. The role of the mental model is crucial in learning: at the individual level, these determine what kind of data is collected, which methods are used in analyzing them and how the outcomes of the analyses are interpreted. These can be developed or extracted by gaining experience and learning from it. Also, the terms assimilation and accommodation are essential in extracting the managers' mental models. Assimilation is the process in which people impose their own mental models on the environment. Accommodation is the other side of the coin: people adapt their mental models to the world they live in (Bood and Postma, 1997). It is also known that people do not easily change or elicit their mental models. But when they do, they usually assimilate and accommodate at the same time.

Due to the fact that every person has a special mental model, there is always a kind of mixture of models in the scenario group. The right balance in the variance in mental models can be a great advantage in the scenario process. When a scenario group can form a large potential coverage of mental models, participants of the scenario process look at the future and the environment from different perspectives, and bring different views for the work. People with different views communicating with each other stimulate creativity (Bood and Postma, 1997). It should also be remembered that the key of success is the right balance of different kinds of mental maps. For example, if the maps are too identical, there is always the risk of group-think (see Janis, 1982) which undermines or paralyses the effective strategic learning process. Therefore, mental models have to be the primary focus in the scenario analysis remembering that scenarios may facilitate communication and elicit managers' mental maps.

### **3 Scenario process in inter-organizational knowledge networks**

The process of creating new knowledge presumes that individuals recognize useful data and information and are then through some process able to transform it into knowledge that brings future value for the organization (Senge, 1990). According to Schwartz (1996), the scenario process makes it possible to share and reassemble personal knowledge to build a holistic understanding between the internal and external

environment in an organization. Scenario process works as a facilitated and structured context which makes it possible for individuals to be an intermediate (or interface) in interaction between the internal and external environment (Cohen and Levinthal, 1990; Kulkki and Kosonen, 2001). The scenario process helps us to understand a wide variety of unstructured, complex and contradictory knowledge that has both tacit and explicit dimensions. The scenarios drawn through different personal experiences and perspectives have a multidisciplinary and multidimensional character, help organizations and individuals to develop and broaden mental models of possible future realities, and understand the fundamental drivers of business, market and technological trends and changes (Masini and Vasquez, 2003; Schoemaker, 1991; 1992; 1993; Wack, 1985). Scenarios provide a method for comparing company-specific capabilities with future needs, and enable decision-making in situations of complex rapid social change (Schoemaker, 1992). Scenarios make individuals' implicit assumptions about the future explicit by stimulating strategic thinking and communication, and they improve the flexibility of the response to environmental uncertainty (e.g. Godet and Roubelat, 1996; Schwartz, 1996; van der Heijden et al., 2002; Wack, 1985). Wack (1985) continues that scenarios make it possible to challenge present assumptions and mental models. In this sense, scenarios can be seen as a communication tool encouraging to the exchange personal experiences in a social context, and learning from it.



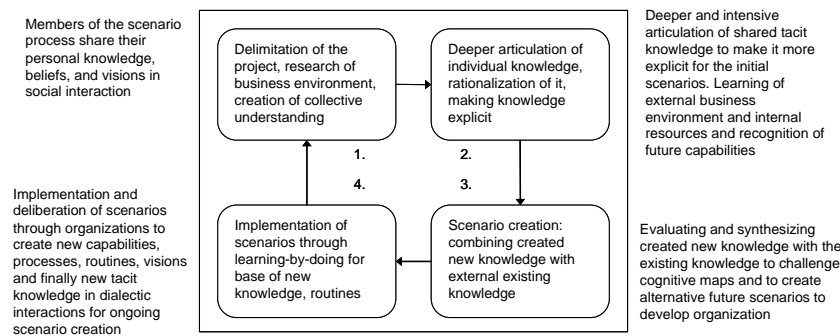
**Fig. 1.** Knowledge sharing network as a dynamic shared context of the scenario process

According to Grant (2003), organizations need to have channels and forums for communication and knowledge sharing, and they should be capable of promoting a dialog inside an organization as well as between an organization and the environment. The scenario process involves organizational leaders and managers, R&D centres, associations, different groups of experts and many other stakeholders in the form of a

structured and facilitated network, as a “*ba*”, to share knowledge and to create alternative interpretations of the future on the basis of shared knowledge (Fig. 1) (Roubelat, 2000). It provides a framework for creative discussion in a shared context about alternative views emerging inside and outside an organization (Schoemaker, 1993) and becomes a process enabling the group to create representations on the basis of shared knowledge (Roubelat, 2000). In this sense, the scenario process can be seen as a social construction of knowledge incorporating social and cognitive perspectives.

### 3.1 Creating scenarios

According to Masini and Vasquez (2003), creating scenarios means carrying out an ongoing cumulative process. The scenario process helps to create an interactive and structured social environment for an organizational communication process. It has a certain structure and phases common to all approaches (e.g. Godet, 1993; Masini and Vasquez, 2003; Schoemaker, 1993; Schwartz, 1996; van der Heijden et al., 2002). According to Phelps et al. (2001), the scenario process can be conceptualized into four stages (1) starting from the delimitation of the focus to (2) interactive knowledge sharing and creation, and (3) from resulting combinations of new knowledge in the form of scenarios to (4) organizational learning through the implementation of the scenarios.



**Fig. 2.** Scenario process and continuous knowledge creation.

The scenario process is started (Fig. 2) by organizing a working group consisting of members from participating organizations which connects the organizations into a form of knowledge sharing network (Fig. 1.) (Roubelat, 2000). In the scenario process, a working group serves as a shared context where individuals from participating organizations may act through direct experiences (Nonaka et. al., 2000). A working

group consists of experts, actors and other stakeholders with multidisciplinary backgrounds who reflect upon the futures of a network and whose knowledge is useful concerning the issue (e.g. Kuusi, 1999; Schwartz, 1996; van der Heijden et al., 2002; von Krogh et al., 2001). In the working group meetings, participants identify the knowledge gap between the network and the environment and between the individuals through direct interaction creating shared collective tacit knowledge for the basis of the scenario process and knowledge creation. A working group creates a common language and practices for the process and sets a goal around a loose vision.

A working group continues articulating shared knowledge in intensive discussions, seminars and face-to-face meetings. The working group identifies the past and present patterns, trends and changes around the issue, and it may be temporarily expanded to bring new knowledge and insight into the process by inviting e.g. economists, social and cultural specialists, experts of in technology etc. This phase provides an understanding of the causalities in the environment and connects organizations to it. The environmental driving forces and their backgrounds are assessed, stakeholders of the issue are identified, and the required capabilities for the future are analysed. The initial scenarios make the tacit knowledge of the working group explicit.

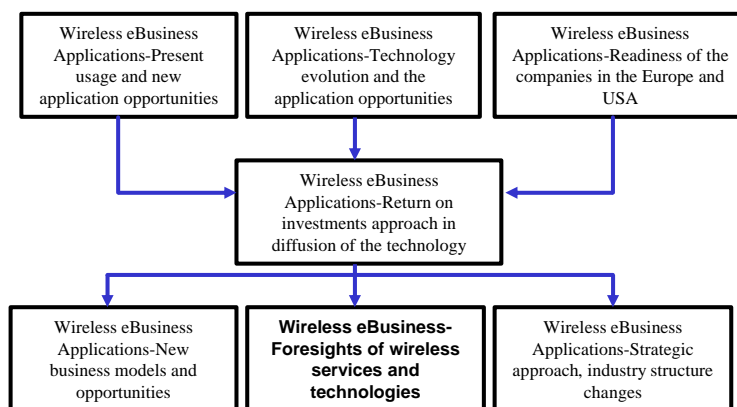
When new knowledge is created during the intensive communication among the participants of the process and made explicit (initial scenarios), the scenario creation is continued by integrating the existing explicit organizational or collected external knowledge (predetermined elements, business regularities, technology trajectories, organizational capabilities etc.) into created new knowledge (Nonaka and Toyama, 2003; Schoemaker, 1992). The final alternative scenarios are created through evaluation and combination of gathered knowledge during the preceding phases. The scenarios reflect the beliefs and intuition of the knowledge network concerning the future. They are shared collective representations of the possible developments in the organization's progress and environment (Roubelat, 2000; Wack, 1985). Scenarios make it possible to assess organizational capabilities in a new light, leading organizations to action and decisions (Godet, 2000).

The final phase of the scenario process is the implementation of the scenarios. They are disseminated and implemented into the organization through communication. Scenarios

make it possible to evaluate organizational capabilities against the future needs and to develop them (Mason, 2003; Schoemaker, 1992). Furthermore, they serve as a platform for the evaluation of new innovations and business ideas to clarify their success and market potentials. The scenario process stimulates thinking and challenges present routines and mental models, and leads to continuous and cumulative knowledge creation and learning process (van der Heijden et al., 2002; Masini and Vasquez, 2003). As a communication tool, scenarios diffuse explicit future-oriented knowledge throughout the organization and become the basis for new scenarios.

#### 4 Case: Scenario process in inter-industrial knowledge network: examining new business opportunities in the field of wireless communication technology

##### 4.1 Background of the research project



**Fig. 3.** The phases of the research project “Wireless e-Business” (Laaksonen, 2001).

This section introduces the scenario process in a research project for knowledge management in an inter-industrial knowledge network. The scenario process was a part of a larger research project aiming at better understanding of the management of the corporate strategy process and providing foresights for the industry. The research project consisted of seven separate phases (Fig. 3). The first four phases provided background knowledge for the phase “Foresights of wireless technology” in which the scenario process was conducted to manage the creation of new knowledge on the basis of explicit and tacit knowledge gathered during the preceding phases of the research project, and to facilitate the interaction between the participants in the research project. During the

scenario process, new knowledge about the future business opportunities of wireless technology was created, new requirements for future capabilities were identified, and learning within the collaborative network was facilitated. The participants in the research project were two leading global pulp & paper companies, StoraEnso and UPM Kymmene, the international telecom company TeliaSonera, the SME software company Modultek, the National Technology Agency of Finland, and the Telecom Business Research Center at Lappeenranta University of Technology (TBRC). The research project started in April 2001 and continued for two years, with the TBRC being in charge of the management and facilitation of the research project.

#### **4.2 Description of the scenario process in the research project**

*At the beginning* of the research project, the scenario process enabled a dialectic communication process and knowledge creation and management in the collaborative knowledge network. The scenario process was based on social interaction between the participants in the working group, during which group and person-to-person meetings were conducted periodically. In these meetings, the participants in the knowledge network shared their personal and gathered additional information and knowledge. The researchers shared the gained and analyzed project-specific knowledge with the company representatives who contributed to the process, sharing the existing company-specific tacit and explicit knowledge. The participants also communicated informally in face-to-face meetings in the participating companies and via telecommunication devices to complement the knowledge base. During this first phase, participants in the knowledge network held an intensive working group meeting to analyze the knowledge gap between the companies and the environment resulting in an overall focus of the scenario process around the shared loose vision “new business opportunities for wireless communication technologies”. The preliminary targets were to identify future capabilities and business opportunities to sustain the companies’ long-term business operations, and also to enhance inter-industrial collaboration in business.

*In the second phase*, the participants continued the articulation of shared tacit knowledge. They had periodical working group meetings once a month and the researchers had intensive brainstorming sessions at least once a week. These enabled a deeper articulation and externalization of the tacit knowledge of the knowledge network and integration with the existing company-specific tacit knowledge and the background

information from the preceding phases of the project. The process produced a collective understanding about the dynamics of the industry and technology, e.g. the driving forces, the stakeholders and the main actors in the business environment, current trends, best practices of the ICT industry, as well as existing organizational knowledge concerning the issue. The created collective tacit knowledge was used as background information and knowledge in the scenario building. This knowledge was based on deep examination of the development of wireless technology and appliances, and the investigation of new business models in close cooperation with the participating companies. During this collaborative research work, the companies had excellent opportunities to share their company-specific knowledge and experiences with the knowledge network and gain new knowledge and insights for their own use. This phase resulted in a common understanding of the future requirements for the industry. The present and future industry capabilities were identified and compared with the best practices of the industry. A holistic collective understanding of the issue was attained in the form of initial scenarios for further and more systematic processing.

*After the second phase*, the researchers formed a smaller “scenario team” to communicate and share their externalized knowledge on the knowledge network and to combine it with the existing explicit knowledge gathered in the previous phase. During this phase, the scenario team examined intensively the gathered background information and the created new knowledge. They had daily scenario sessions to share their ideas, information and knowledge to produce collective representations, in other words, to combine the created new knowledge and the existing explicit knowledge. These representations i.e. preliminary scenarios were presented in periodic meetings where company representatives had an opportunity to contribute to the scenario process and share their knowledge, beliefs and visions within the knowledge network.

For the creation of final scenarios, the knowledge network was extended in the participating companies. A web-survey was conducted to collect additional knowledge from the experts in the companies. A questionnaire was used in which experts were asked to evaluate the most important drivers for the future wireless business environment. The drivers (altogether over 300) were selected in the scenario sessions and periodic meetings. The final questionnaire included 79 arguments selected by the scenario team. The web-survey was sent to 60 selected experts in the participating

companies, 46 of whom returned their answers. On the basis of the web-survey and the created new explicit knowledge, alternative future scenarios were created and articulated in the final knowledge network meeting (combination) before the implementation in the participating companies. During the network meeting, the future business opportunities were analysed and the required capabilities for them were compared with the existing company-specific resources and capabilities.

*The final step in the scenario process* was the implementation of the alternative scenarios in the participating companies in their operations. The scenario process was an excellent opportunity for the companies to challenge their present mental models and to create new interpretations of the business environment and technology development. This phase enabled the internalization of the created explicit knowledge during the scenario process and the development of new capabilities through learning by doing. Scenarios made it possible to assess present practices and R&D investments, and even provided knowledge for strategy planning. In other words, the scenario process made it possible to keep alive the continuous spiral of knowledge creation and diffusion of knowledge in a corporate network during the research project. The scenario-based knowledge creation and sharing process gave an initiation to act and gain new knowledge in a structured and facilitated way in collaborative inter-industrial relationships and to serve as the basis for continuous knowledge creation.

## **5 Discussion**

This study agrees with Mintzberg (1994) on the point that the organizational development and strategy making is a continuously adjusting process. Weick and Quinn (1999) also claim that changes in the business environment are an ongoing phenomenon. On the basis of this, we believe that approaching the organizational renewal process through the dynamic capability view (e.g. Teece et al., 1997; Zollo and Winter, 2002) and the knowledge-based view (Nonaka and Takeuchi, 1995) leads to continuous reconstruction in an organization. Due to the fact that capabilities are path-dependent and tightly related with present routines and practices, continuous learning and communication are essential for challenging individual and organizational mental models. According to several researchers and practitioners, knowledge creation and social communication include many barriers. In this study, the scenario process was applied to facilitate social communication and future-oriented knowledge creation in

order to sustain the social interaction and future-oriented capability development. According to Schwartz (1996), the scenario process creates a strategic conversation and makes it possible to challenge present assumptions and mental models. Van der Heijden (2000) states that the scenario process allows us to reflect different perceptions of the issue, creating room for people to hear the arguments of others and to engage in a comparison of different view points. To become justified and legitimized, new knowledge needs to be reviewed through some process. Regardless of many advantages, the scenario approach has some disadvantages which we need to be aware of. According to Godet (2000) and van der Heijden (2000), the scenario approach is time-consuming, and the implementation always requires a strong support and participation from the organization's management. One risk is to have too much consensus or so called "group-think" which hinders the broadening of perspectives and decreases the differentiation of ideas. If participants are not familiar with the approach, the organizational hierarchical relationships might hinder the delicate conversation. The scenario process is always human-driven and is exposed to biases.

## **6 Conclusion**

This study has suggested guidelines for organizational knowledge management and proactive capability development. The problem with knowledge management often lies in the fact that organizations and individuals do not understand the fundamentals of the knowledge creation process.

We noticed that if organizations become familiar with knowledge creation, they can both develop appropriate knowledge and renew their capabilities, and utilise them further in the business objectives of the overall organization. Knowledge creation and sharing need appropriate methods and practices for the management of tacit and explicit knowledge. The scenario process proved to be a capable management tool for knowledge creation and sharing. During the scenario process, the participants were also able to challenge their mental models and cross the existing individual and organizational boundaries. The scenario process also helps to overcome communication barriers.

It is also well known that as innovation cycles are short and the technology is changing rapidly, organizations need to create flexibility, ability to learn from the market by recognizing customers' latent needs, and to manage scarce capabilities. They need

abilities to utilise their existing capabilities and knowledge base, but they also need dynamic capabilities which are employed when a company acquires knowledge and builds new capabilities for future needs. In a changing environment, the ability to sense and seize new opportunities (Teece, 2000) and to build and reconfigure knowledge-based assets is crucial for the long-term competitiveness of organizations.

In the development of new capabilities, companies and other organizations need tools and routines for systematic information processing and knowledge creation. During the research project, it became clear that the scenario approach is a successful tool that enables the proactive management of knowledge and fosters the communication of knowledge in large business networks. The scenario process made it possible to examine the company-specific capabilities and recognize environmental changes which was important for organizational renewal and the creation of appropriate capabilities in the participating companies.

The scenario approach has traditionally been used for anticipating the future development and drawing alternative descriptions of the future. This study demonstrates the usability of the scenario process as an effective method to establish a structured and managed process for social communication and to support the on-going knowledge creation.

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## Managing the exploration of new operational and strategic activities using the scenario method—assessing future capabilities in the field of electricity distribution industry<sup>☆</sup>

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### Abstract

Organizations are finding it more and more difficult to stay in balance with the pace of change in these days. The continuous rise of business opportunities and increase of global competition demand proactive strategy making, recognition of new opportunities, and an ability to continuously renew the capabilities to face the changing business environment. The radically changing business environment of the electricity distribution industry in Finland opens up new interindustrial business opportunities and forces organizations to renew their strategies and operations. To exploit the emerging opportunities, organizations need to have methods and practices, which help them to be aware of changes in the business environment and to facilitate the development of their capabilities. This paper presents the scenario process as a tool for assessing the requirements of the changing business environment, and identifying the capabilities needed in alternative future scenarios resulting suggestions for the companies as well as for the authorities where to direct their future activities.

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*Keywords:* Scenarios; Capabilities; Strategy; Future opportunities; Management

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### 1. Introduction

Due to the changing business environment, organizations find it difficult to understand the effect of changes to their own business models. The essence is to identify the organizational resources and capabilities differing from the rivals, to

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recognize the external forces driving the changes, to develop the capabilities towards them, and finally to exploit the capabilities through business processes by creating new products and services (e.g. Ray et al., 2004; Teece et al., 1997; Wernerfelt, 1984; Winter, 2003). Organizations need to understand the business environment as a dynamic entity under ongoing changes. Schoemaker (1992) states that when assessing the changing environment and identifying new capabilities and opportunities, the managerial judgement, creativity, and sense-making abilities are in a central position. Organizational renewal is seen as a natural consequence of its resilience in a changing environment (Hamel and Välikangas, 2003). Organizations should adopt such a perceptual approach that makes it possible to be flexible and agile in a changing and uncertain environment (Ellis and Shpielberg, 2003). Therefore, systematic and competent methods and tools for the assessment of the strategic issues are essential and should be examined in companies and in the field of academic research.

Methodologically this study uses a constructive approach which was very suitable because the aim of the study was to create and to test a framework in a real-life context. The idea in the constructive approach is to design a new construct and test its capability in real-life cases resulting in a new construct which is linked with present theories and practices. The procedure of this study is based on combining two qualitative approaches—scenario method and capability view—to facilitate the organizational strategic management process. The study provides theoretical basis of the approaches and demonstrates the practical usability of the combination.

In this paper, the need for the exploration of operational and strategic activities is examined, and the scenario process is presented for the assessment of the business environment and capability development. We will first discuss the importance of understanding the business environment as a dynamic entity providing new opportunities and the need for recognizing them. Then we will explain the essence of capabilities in the organizational renewal process. Next we will explain the development paths in radically changing electricity distribution industry in Finland

and the need for capability development and recognition of future opportunities. Finally, we will present the scenario process applied as a method for the identification of the forces driving the changes in the electricity distribution industry, and the recognition of capabilities needed to exploit the future opportunities.

## 2. Dynamic environment and emergent opportunities

The importance of understanding the business environment as a dynamic entity has been emphasized in several studies (e.g. de Geus, 1998; Miller et al., 2002; Mintzberg, 2003; Prastacos et al., 2002; Schwartz, 1996; Teece et al., 1997; Weick and Quinn, 1999). Also the ongoing ability to recognize the intersections between organizational emerging asymmetries and the new opportunities of the business environment is important (Miller, 2003; Blomqvist et al., 2002). The traditional boundaries in dynamic business environment are changing offering new opportunities for creative and imaginative actors (Hinterhuber and Friedrich, 2002; Weick and Quinn, 1999). In their recent study, Hamel and Välikangas (2003) also noticed the need for innovative resilience that denotes capability-leverage and market creation. Teece et al. (1997) state that when developing an organization and its capabilities, continuous interaction between internal resources and competences, and the external environment is essential to build sustainable competitive advantage. In other words, the competitiveness of organizations depends on their strategic awareness and changeability concerning the future development (O'Connor and Veryzer, 2001; Laakso et al., 1998). Markets and innovation systems are becoming global and knowledge sharing activities have emerged as an important theme (Spencer, 2003; Hacklin et al., 2004; Saarenketo et al., 2003). According to Weick and Quinn (1999), the challenge in organizations is to understand the change in the business environment as an ongoing phenomenon facilitating innovative ideas and making it possible for people to acquire new knowledge. Mintzberg (1994) argues that strategy

making requires holistic understanding and is a continuously adjusting process. He continues that new innovations and new strategies are emergent and they can develop with or without organizational intent. Organizations are surrounded by a very large variety of strategic choices (Laakso et al., 1998). According to Feurer and Chaharbaghi (1995), strategy making needs a dynamic approach driven by the opportunities of the future. To succeed, organizations need to revise their assumptions of the future environment faster than their competitors (de Geus, 1988) and to increase sensitivity to emerging discontinuities in their evolution paths (Grant, 2003). Strategy making should be understood as a proactive means to provoke a desired change (de Jouvenel, 2000).

### 3. Developing organizational capabilities

To be able to identify and respond to emerging changes in the business environment, capability developing calls for well-organized knowledge searching and acquisition procedures (Jantunen, 2002). Organizations can be seen as interpretation and sense-making systems (Daft and Weick, 1984; Cohen and Levinthal, 1990). Langlois (1997) argues that an organization's ability to interpret signals and perceive changes is a matter of the fit between the environment and the organization as a cognitive system. In a broad sense, an organization's cognitive system consists of its routines (Nelson and Winter, 1982), which determine what information the organization recognizes as meaningful and how it perceives opportunities. What is important for organizational renewal and the creation of appropriate capabilities is that the decision-makers in organizations interpret and respond correctly to the messages they receive. Recognition of emerging new opportunities and their potential value rides on understanding how the organization itself differs from its rivals in the capabilities it possesses and exploits (Miller et al., 2002). From the dynamic capability viewpoint, to be successful in a changing world, an organization needs a perceptual ability to see ways to create and improve capabilities and to recognize opportunities for applying capabilities in a value-

generating way (Langlois, 1997; Teece et al., 1997). An organization's perceptual ability is affected by the tools and systems supporting the decision-making it uses. Thus, which management procedures and strategy making tools to use is not a trivial issue.

Developing new organizational and technological innovations requires time and money, and therefore investments have to be made on the basis of weak signals or expectations of the evolution of the environment. Organizations have to invest in capability building before they know exactly how valuable the new innovations will be. Time compression diseconomies (Dierickx and Cool, 1989) and path-dependence in capability development drive organizations to be active before new capabilities are needed in practice (Kash and Rycroft, 2002). In terms of Godet (2000) and de Jouvenel (2000) organizations must be proactive, not only explore new opportunities but also create them. In an uncertain and radically changing selection environment, to match the organization's resource and capability portfolio with environmental changes, organizations have to continuously evaluate, reconfigure and redeploy the organization's resources and capabilities and recognize environmental changes (Preez and Pistorius, 1999; Teece et al., 1997). Moran and Goshal (1999) claim that before a particular resource deployment can be seen as an element of an organization's productive opportunity set, three conditions must be met: The combination has to be enabled by the management, motivated by an impending result and incentives, and perceived by some kind of a process as workable. Scenario making facilitates especially the fulfillment of the latter two necessary conditions.

### 4. Development of business environment in electricity distribution industry

The development of business environment in electricity distribution industry is largely governed by the common European legislative framework. Rapid development of the industry started in the 1990s when first attempts to create internal electricity markets were made. The key driving

force of the electricity market deregulation in Europe was to promote the competitiveness of the European Union Member States' economies. In the early 1990s the electricity prices of industrial customers in Europe were approximately 40% higher than the corresponding prices in the USA (EC, 2000). Deregulation has been successful in the sense that industrial customers have experienced an overall decrease of the electricity prices over the last decade.

In 1996 the common guidelines for the internal market in electricity were set by EU legislation in Directive (96/92/EC). The goal was to introduce competition in generation and the selling of electricity to end-customers. Transmission and distribution of electricity were to remain natural monopolies. By the end of 1990s it was concluded that the implementation of the internal market in electricity should be accelerated. As a result, Directive (2003/54/EC) was given in 2003.

#### 4.1. Restructuring the electricity industry

In recent years, the electricity industry has experienced considerable structural changes, and they will continue in the future, as well. Earlier the whole supply chain of electricity, including generation, transmission, distribution and the selling of electricity to end-customers, was considered a natural monopoly, and it was often operated by a

vertically integrated company. In fact, national transmission grids and local distribution networks are still considered to possess characteristics of natural monopolies because one company can usually operate at lower average costs per customer than two companies with parallel networks. However, similar assumptions do not apply for electricity generation and selling. In these two operations, competition was seen as a useful tool to promote efficiency and, as a result, deregulation followed. Consequently, it is then necessary to break the vertical integration of the supply chain in order to avoid cross-subsidies between the monopoly part of the market and the deregulated part of the market, see Fig. 1.

During the deregulation process, electricity distribution sustained its monopoly position. Regulation was introduced to protect customers' rights with respect to prices and quality of monopoly services, and to meet the requirements of other stakeholders as well. The electricity distribution industry is witnessing the entrance of several new players in the market, mainly by acquisitions. However, their interests are usually more in the deregulated part of the electricity market, i.e. in selling electricity to end-customers, than in electricity distribution itself. Owning distribution networks was primarily seen as a useful tool in capturing markets in selling electricity.

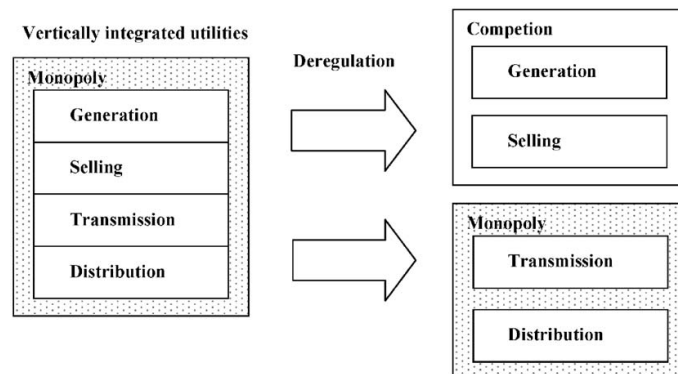


Fig. 1. Deregulation on the electricity industry.

#### 4.2. Reorganizing the electricity distribution business

Reorganizing the business structures in electricity distribution seems to be next major challenge of the industry. There are several operations, which are not the core business of electricity distribution—delivering electricity to end-customers—but are still closely connected to it. Such operations include, for example, constructing and maintaining electricity networks, metering the energy consumption of customers, billing the customers and performing the tasks of the network operator. These operations could be separated from the core business and outsourced to service providers. Reorganization has already taken place to some extent and new service providers have entered the market. However, the number of players is often too small for markets to work efficiently.

Depending on the regulatory model, regulation can either promote or slow down the reorganization process of electricity distribution. For example, the present rate-of-return regulation applied in Finland does not encourage the separation of operations. There is a guaranteed return on every investment that increases the asset base and also the capital invested in the service provision is part of the rate-of-return calculation. To give incentives for cost reduction, the regulator set efficiency targets for distribution companies. However, cost reductions that exceed the regulator's target do not bring additional benefits to the regulated distribution companies but they have to reduce prices instead.

The outcome of the present regulatory regime is that distribution companies can recover all costs of performing service operations if they are part of the regulated monopoly. However, there are signs indicating that the situation might be changing, e.g. companies from other industries are entering to the market and regulatory changes are emerging. First, the regulator is moving towards more incentive revenue cap regulation. Under this kind of regulatory regime distribution companies are given stronger incentives for efficiency improvements because companies themselves benefit from the excess cost savings. Concentrating on the core business and outsourcing others might be one

way of improving efficiency. Second, distribution business is considered a low risk business so the regulated return on capital is rather low, approximately 5% at present. In nonregulated service markets the risks would be higher but there would also be possibilities to earn higher profits. Distribution companies have typically been owned municipalities and the social aspects have played an important role when defining strategies. However, the commercial aspects have recently gained popularity even among municipal owners. The ongoing development might result in changes in the distribution industry structure, e.g. the separation of asset ownership, asset management and services, see Fig. 2a.

The industry structure in Fig. 2a would open up new opportunities for innovative companies especially in the service markets. These companies tend to be the pioneers of the whole industry and they might already seek for emerging potential opportunities and develop capabilities aligned with them, which might bring them additional competitive advantages in the future.

To grow capabilities that sustain their competitive advantage, organizations need to continuously recognize the changes in business environment and understand the forces behind them (Kess and Haapasalo, 2002). In this research project, the scenario process was used as a change agent (e.g. Ford and Ford, 1995; Weick and Quinn, 1999) to support the assessment of underlying mental models, people, knowledge, relationships, and assets that may give rise to future advantages in the changing electricity distribution industry, and recognition of new business opportunities in electrical industry.

#### 5. Scenario process—a method for exploring the dynamic environment

Creating new knowledge presumes that individuals recognize useful data and information, and are then able to transform it, through some process, into knowledge that brings future value for the organization (Senge, 1990). The fundamental idea behind scenario planning is to provide a structured way to create a dynamic

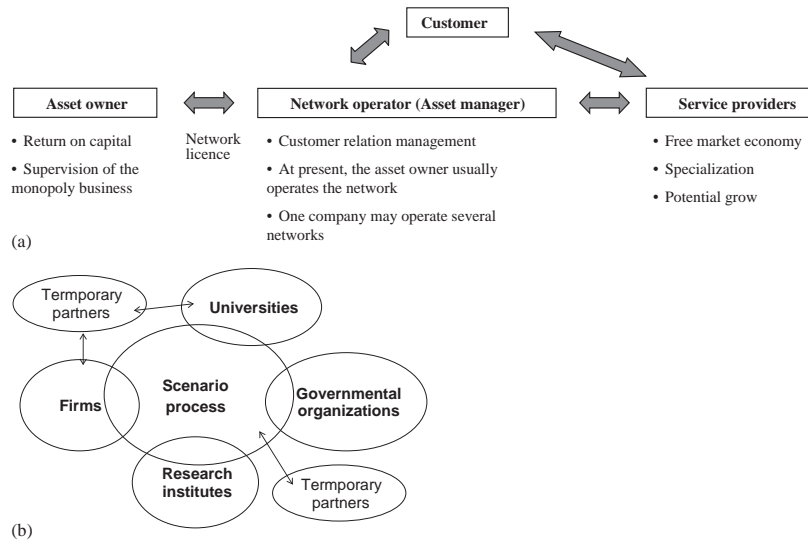


Fig. 2. (a) Reorganizing the electricity distribution business. (b) A general setup of stakeholders in a typical scenario process.

interaction between the environment and an organization to cover a broad range of future possibilities to confront the future uncertainties and expand people's thinking (Ellis and Shpielberg, 2003; Schoemaker, 1993; Wack, 1985a, b; Weick and Quinn, 1999). According to Godet and Roubelat (1996), Schwartz (1996), and Wilson (2000) scenario planning makes it possible to share and reassemble personal knowledge to build a holistic understanding between the internal and external environment of an organization. Scenario planning makes explicit the implicit assumptions of individuals about the future, stimulating strategic thinking and communication (Mintzberg, 1994), which improves organizational flexibility of response to environmental uncertainty, leading them to make better actions concerning the future. The use of scenario planning reflects the proactive orientation of an organization (Godet, 2000). Scenarios explore the simultaneous impact of various uncertainties by changing multiple variables at a time, and describe very complex models that cannot be formally modelled (Coates, 2000; Schoemaker, 1997). Scenario planning makes it possible to

assess the competitive landscape and strategic segments of an organization in a new light and renew organizational capabilities towards the future needs under a created future strategic vision (Godet, 2000; Schoemaker, 1997; Teece et al., 1997). According to Feurer and Chaharbaghi (1995) the key question to the success of an organization is the quality of knowledge that captures the dynamics and uncertainties of the future environment, which means a flexible, creative, and future-oriented knowledge creation process. Scenario planning can be a catalyst for extracting value from capabilities by channelling them towards new opportunities.

A typical scenario planning involves organizational leaders and managers, R&D centres, associations, different groups of experts and many other stakeholders in the form of a structured and facilitated network to share knowledge and to create alternative presentations of the future (Fig. 2b) (Roubelat, 2000; Schoemaker, 1995). In terms of Nonaka et al. (2000, 2003) knowledge creation is a dynamic synthesizing process through interaction between individuals, and individuals and the environment in a shared context. Scenarios

reflect beliefs, expertise, and intuition of individuals and organizations concerning the future (Aligica, 2003; Bood and Postma, 1997; Johannessen et al., 1999; Kulkki and Kosonen, 2001; Scharmer, 2001). Scenarios are shared collective representations of the possible future of an organization and its environment (Roubelat, 2000; Wack, 1985b). These representations reveal a potential variety of emerging opportunities to turn them into capabilities.

The scenarios drawn through different personal experiences and perspectives have multidisciplinary and multidimensional character, help organizations and individuals to develop and broaden the mental models of possible future realities, and understand the fundamental drivers of business, market and technological trends and changes (Masini and Vasquez, 2003; Schoemaker, 1991, 1992, 1993; Teece, 1998; Wack, 1985b). In other words, scenarios provide a method to discover and compare firm specific capabilities with the future requirements, and make it possible to face the situations of complex rapid change (Schoemaker, 1992). Hamel and Välikangas (2003) argue that organizations should have capacity to change before the need for change becomes too obvious.

## 6. Scenario creation

According to Masini and Vasquez (2003), creating scenarios means carrying out an ongoing cumulative process, establishing a project periodically or when needed. The scenario process helps create an interactive and structured social environment for an organizational communication process, enabling exploration and discussions of the emerging future. The scenario process has a certain and common structure involving a varying number of steps (e.g. Schwartz, 1996; Masini and Vasquez, 2003; Schoemaker, 1993; van der Heijden et al., 2002). Phelps et al. (2001) argue that the scenario process can be conceptualized into four stages: From (1) the delimitation of the focus to (2) interactive knowledge sharing and creation, forming the scenario context, and (3) from resulting combinations of new knowledge in the form of scenarios to organizational develop-

ment through (4) the implementation of the scenarios (Fig. 4).

### 6.1. Preparation of a scenario process: Background analysis and delimitation of the focus

The scenario process starts by organizing a working group from the participating organizations by connecting the organizations into the form of a knowledge sharing network (Fig. 2b) (Roubelat, 2000). The working group identifies the knowledge gap between the network and the environment, and between the individuals of the working group. This phase may require a long research period and several meetings depending on the goals of the scenario process. The analysis of the industry explains the dynamics of the external business environment (shown in Fig. 3). In this phase, the shared collective knowledge base, a common language and practicalities for the basis of the scenario process and knowledge creation are provided. During this phase, the scope and the goals around a shared loose vision are created (Godet, 2000; von Krogh et al., 2001).

### 6.2. Knowledge base construction

The articulation of shared knowledge is continued by having intensive sessions within the working group and face-to-face meetings to rationalize the knowledge created in the preceding

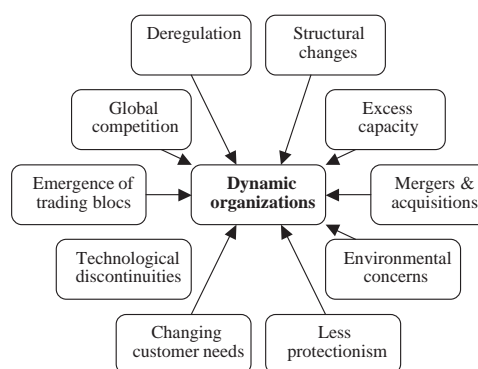


Fig. 3. Framework of the analysis of a generic business environment (adapted from Prahalad and Hamel, 1994, p. 7).

phase. The working group can be enlarged by inviting temporary partners to bring new knowledge and insight into the process, e.g. economists, social and cultural specialists, technological experts etc. Surveys or Delphi panels can also be conducted to examine wider opinions about the development of the issue (van der Heijden et al., 2002; von Krogh et al., 2001). When the backgrounds have been examined, the stakeholders, driving forces, and the required capabilities of future business are recognized, the working group explores their significance and logical implications (Schwartz, 1996; van der Heijden et al., 2002). In the end of this phase, the disseminated and articulated tacit knowledge within the working group is transformed into explicit knowledge and is represented in the form of initial scenarios.

### 6.3. Scenario creation

The scenario process is continued by integrating the existing explicit organizational and collected external knowledge into created new knowledge (Godet and Roubelat, 1996; Nonaka and Toyama, 2003; Schoemaker, 1992). The final alternative scenarios are created through the evaluation and combination of knowledge gathered during the preceding phases on an intuitive, *heuristic* or statistic basis (Masini and Vasquez, 2003; Schoemaker, 1997). The goal is to identify the logics of the business environment that are important and relevant to the issue, and then organize the possible outcomes of the scenarios around these logics (Schoemaker, 1993; van der Heijden et al., 2002). This phase provides alternative scenarios of the future related to the issue considered. The scenario creation process enhances organizational learning, reveals blind spots of decision-making challenging the present assumptions, and simplifies the complex reality.

### 6.4. Implementation of scenarios

The scenarios make it possible to evaluate organizational capabilities against the future requirements, and develop new capabilities and renew existing ones to meet them (Mason, 2003; Schoemaker, 1992). The scenarios also serve as a

platform for the evaluation of new innovations and business ideas to assess their possibilities and market potentials, e.g. making “what if questions”. The scenario process stimulates strategic thinking and challenges present routines and mental models, and leads to continuous and cumulative knowledge creation and learning process (Bennett, 1998; Masini and Vasquez, 2003; van der Heijden et al., 2002; Wack, 1985b). Finally, the scenarios are used as a communication tool to diffuse explicit future-oriented knowledge throughout the organization and accelerate the process of organizational learning (Bood and Postma, 1997) Fig. 4.

## 7. Case: Assessing future business opportunities for the capability development in the field of electrical engineering and electricity distribution through the scenario process

### 7.1. Background of the research project

This section introduces the scenario process in a research project. The scenario process was part of a larger research project aiming at providing a vision of the development of the electricity distribution business environment, which is changing radically due to deregulation in Finland and the EU. The research project consists of two separated parts: 1. New business models and 2. Information management in networks. In this phase of the research project, the scenario process was conducted to assess the development of the electricity distribution industry in the future. During the scenario process, new knowledge about the future business opportunities of the electricity distribution and electrical engineering were created, new requirements for the future business environment were identified, and four alternative scenarios were provided, resulting in a vision of the industry development. The participants of the research project were the global electrical engineering company ABB, the international energy company Fortum, the international telecom company TeliaSonera, two local electrical distribution companies Koillis-Satakunnan Sähkö and Tampereen Sähkölaitos, seven SME software and

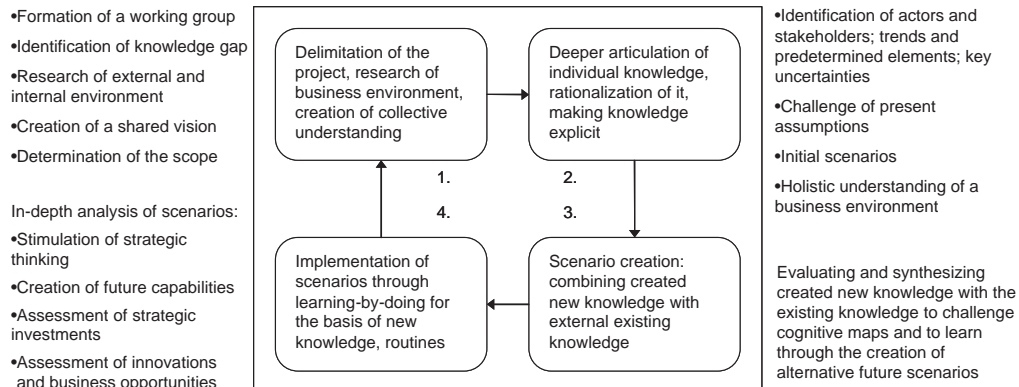


Fig. 4. Ongoing scenario process and knowledge creation.

electrical engineering companies: Eltel Networks, Empower, Enermet, MX Elextrix, Process Vision, Telewice and Wimotec, the National Technology Agency of Finland (TEKES), Lappeenranta University of Technology, and Tampere University of Technology. The research project started in January 2003 and will continue for 3 years.

### 7.2. Description of the scenario process in the research project

The scenario process started in August 2003 and continued for 4 months. The participants of the research project formed a cooperative knowledge network to provide background knowledge for the research project and the scenario process. The working group of the scenario process consisted of experts with different backgrounds (electrical engineering, product economics, information technology, business administration). Seven researchers came from Lappeenranta University of Technology and six researchers from Tampere University of Technology. The working group of experts acted as the domain of knowledge creation in the scenario process representing the stakeholders' view in the case.

- *Preparation of a scenario process: Background analysis and delimitation of the focus.* An exhaustive industry analysis, presented above

in Section 4, revealed a lack of future strategies and visions in the organizations. The organizations have enjoyed a relatively stable and benign environment, and the emerging changes confuse them rather than open up new opportunities. According to the industry analysis, the working group set the goals for the scenario process around the loose-shared vision: "New business models for the service operations in electricity distribution industry". The main goal was to assess the future development of the electricity distribution business in radically changing markets during the next 10 years by providing alternative future scenarios, and to recognize the capabilities needed in the future for the basis of business model generation in the following phase of the research project in January 2004.

- *Knowledge base construction*, the working group held an intensive 2-day scenario session to create alternative scenarios. Firstly, the working group of experts explored the competitive landscape of the industry and identified four main developing areas in the industry, shown in Fig. 5.

Secondly, the working group explored their backgrounds and found out the key driving forces (altogether 136) that would affect the development of the main development areas. The driving forces guiding the capability development were divided into 12 *main issue areas in capability development*

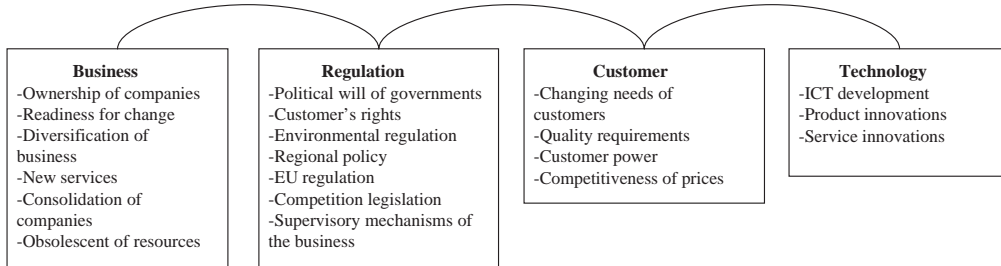


Fig. 5. The main developing areas of the electricity distribution industry in Finland.

(shown in Table 2) to provide a set of groups that are internally related and separate from other groups. Next, their significance and impacts on the industry were examined. Based on the working groups' own expertise and on other experts' opinions, the created common understanding around these issues areas revealed that the technology would seem to be in a mature phase and, therefore, new significant technological innovations could not be expected in the future. It also seems that the business activity and customers' behaviour are dependent on the structural changes of the industry. As a conclusion, the two dimensions for the scenarios were selected by identifying the most impacting issue areas in capability development relating to the development of the industry to facilitate and support the discussion and ideation in the scenario process: *Regulation and industry structure*. Then, by setting the limits for the alternative futures (i.e. limits for the dimension and scenarios): Regulation vs. open markets, multiple service providers vs. monopoly organizations, the four alternative initial scenarios reflecting the interpretations of the group, were determined and named (Fig. 6).

- *The scenario creation* provided four alternative scenarios concerning the development of the electricity distribution business during the next 10 years. The basic elements of the scenarios are represented in Table 1. Each of them captures alternative developments in the driving forces from the capability groups of the developing areas of the industry: The horizontal axis

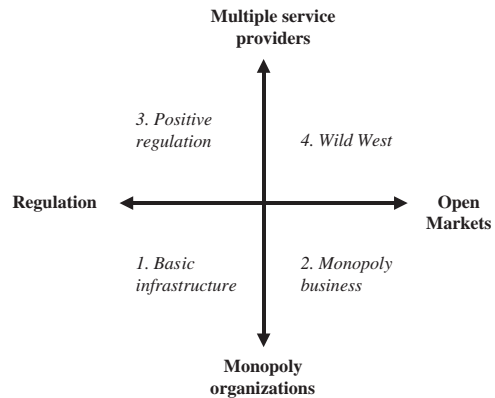


Fig. 6. Four initial future scenarios in electricity distribution business within the limits of two main issue areas in capability development.

depicts alternative developments in regulation varying from tightly regulated markets to open (unregulated) markets, and the vertical axis depicts developments in industry structures varying from monopoly to diverged and specialized business.

- *The implementation of scenarios*, included evaluation of the alternative scenarios and the future capabilities. The evaluation was conducted after the scenario session within the working group of experts during the next 3 months. Each scenario has its specific framework (limits, drivers, stakeholders, etc.), which determine the most valuable and needed

Table 1  
Basic elements of future scenarios of the development of the electricity distribution business

<p><i>3. Positive regulation</i></p> <ul style="list-style-type: none"> <li>● Integrated regulations in the EU</li> <li>● Local monopolies over networks</li> <li>● Competition legislation</li> <li>● Developing markets in services business</li> <li>● Quality control of electricity by authority</li> <li>● Decreasing prices due to regulative actions</li> </ul>	<p><i>4. Wild West</i></p> <ul style="list-style-type: none"> <li>● Unregulated electrical distribution and networks</li> <li>● Effective markets of service business</li> <li>● Investors are active in industry investments</li> <li>● Price and quality differentiation</li> <li>● Quality problems in outlying districts</li> </ul>
<p><i>1. Basic infrastructure</i></p> <ul style="list-style-type: none"> <li>● Undeveloped markets of service business</li> <li>● Local regulation</li> <li>● Decreasing rents</li> <li>● Low R&amp;D intensiveness</li> <li>● Stable and controlled prices</li> </ul>	<p><i>2. Monopoly business</i></p> <ul style="list-style-type: none"> <li>● Unregulated industry and market</li> <li>● Diffusion of companies into conglomerates</li> <li>● Vertical integration of companies</li> <li>● Emergence of local energy co-operatives</li> <li>● Customer segmentations</li> </ul>

capabilities for the companies. Knowing the future development (scenarios), companies are able to recognize the most important groups of capabilities and decide to what extent to develop existing capabilities or to acquire new ones. In this sense, the capabilities are dependent on the emerging scenario. The evaluation process consisted of two parts: (1) Assessment of the present and future value networks in each scenario to find out the opportunities and mechanisms of value creation, and (2) assessment of the identified future capabilities in each scenario to exploit the emerging opportunities. In the first part, the created value network descriptions revealed the connections and transactions between the actors of the industry, and also the business potential of each actor in the scenarios. In the second part, the most important capabilities were selected on the basis of several qualitative characteristics based on the prior knowledge of experts (e.g. Prahalad and Hamel, 1990; Schoemaker, 1992; von Krogh and Roos, 1995): Slow evolvement through collective learning and knowledge sharing, path dependence of the development, imperfectly imitable characteristics, complements to existing capabilities, and rareness among rivals. The evaluation provided a comprehensive understanding of the present industry patterns and their possible future development paths, and revealed *the key issue areas in capability development* ranked in

each scenario (shown in Table 2). If the companies of the electrical engineering and electricity distribution industry focus their attention on the most important capability areas and develop their capabilities to confront the requirements in the selected future, they may sustain their future competitive advantage.

## 8. Results and discussion

The overall focus of the research project was to determine and examine the main development areas of the business environment in the electricity distribution industry and provide some visions about the future opportunities for the case companies on the basis of the created scenarios. The scenario process was conducted by the working group of experts independently from the actors (companies) to provide a result which would be unbiased and independent of the case companies' strategies or politics.

According to the study, the changing business environment of electricity distribution in Finland may have four different development paths. Each of them would cause different requirements for the organizations. Descriptions of the end states of each scenario are presented below:

- *Scenario 1* “basic infrastructure” would be quite similar to the present situation. The industry

Table 2

Importance of key issue areas in capability development in each scenario for the electrical engineering and electricity distribution industry in Finland during the next 10 years

The key issue areas in capability development	Importance of issue areas in scenarios (1 = most important and 4 = least important)			
	Scen. 1	Scen. 2	Scen. 3	Scen. 4
1. Locality of business	1	4	2	3
2. Industry structure	1	2	3	4
3. Ownership of assets	4	1	3	2
4. Return of capital	4	3	2	1
5. Regulative knowledge in market	3	2	1	4
6. Regulative knowledge in rents	2	3	1	4
7. Knowledge in social policy	1	3	2	4
8. Changing customer demand	2	4	1	3
9. Competitiveness of electric energy	3	4	2	1
10. R&D management and automation	4	2	1	3
11. Human resource management	2	4	1	3
12. Environmental legislation	4	1	3	2

would be led by national interests and controlled by national authorities. The markets would be very closed and national. Authorities would regulate tightly the rents of the companies and only a few main players could operate in markets.

- *Scenario 2* “*monopoly business*” would be the consequence of unsuccessful deregulation in the EU. Some national monopoly corporations might have an opportunity to take over the faster and earlier deregulated but still undeveloped markets with the help of a monopoly position at the home market. This might lead to ineffectiveness, low quality and political disagreements.
- *Scenario 3* “*positive regulation*” might lead to open and effective markets. The markets would be opened in a controlled way in the whole EU. Supportive and dynamic regulation systems to enhance competition within the industry would be created. The quality requirements, prices of electricity, effectiveness of companies, and rents of companies would be in balance and real open markets would exist in the EU.
- *Scenario 4* “*wild West*” might lead to decaying infrastructures, fragmented business landscape, and the transfer of regulative control from authorities to markets due to the very fast and uncontrolled deregulation of the industry. In

other words, the basic values of the industry would be effectiveness, maximum returns of employed capital, and superior short-term competitive advantage.

The working group of experts continued the study by assessing the present and the identified future capabilities of the industry and ranked the main issue areas in each scenario according to their importance for the companies. In *scenario 1* “*basic infrastructure*”, the companies should be able to ensure stable prices and quality of electricity, maintenance of infrastructure, and good political connections, which may require capabilities from the areas 1, 2, and 7 (Table 2). Authorities would consider the industry as a basic service supporting the other industries. *Scenario 2* “*monopoly business*” might require fusions of the companies and a broad regulative knowledge in changing markets. The convergence of the industry would increase national regulation and protection, e.g. through environmental issues. The key to success would be the ability to acquire dominant market position. The scenario would demand the capabilities from the areas of 2, 3, 5, and 12 (Table 2). *Scenario 3* “*positive regulation*” is the most challenging. The requirements would concern technological, economic, and regulative issues to ensure competitive advantage in open and

effective markets. The key to success would be the ability to proactively create new markets. In this scenario, capabilities should be developed in several different areas (Table 2). In *scenario 4* “*wild West*”, the requirements would basically concern economic issues. The basic question would be how to manage the decreasing rents and fragmenting markets, and secondly how to gain economic power to be fast and agile. In this scenario, companies should create capabilities in the areas 4, 9, and 12 (Table 2).

Due to the fact that the external business environment will change in the electricity distribution industry, organizations and authorities should redirect their actions and reconfigure their capabilities to match these changes. The energy market authorities in Finland should change the rules of the industry by deregulation. The ultimate goal would be to separate the ownership of assets from production and service business to ensure real competition in the markets. From the authorities’ point of view, *scenario 3* “*positive regulation*” might fulfil their goals. In order to achieve the goals, they should *proactively* create controlling and regulative systems, which would support and motivate the companies to develop their capabilities of importance and lead the companies into this future environment.

From the companies’ point of view, the changing industry will need totally different business knowledge and will open totally new business opportunities, not only for the distribution companies, but especially for the electrical engineering companies opening new applications for their present and future products. If the companies agree with the goals of the authorities, they should concentrate developing their capabilities to meet the requirements of *scenario 3* “*positive regulation*”. This might need very different kinds of capabilities than in the present environment. They might also lead to different positions in business landscape (e.g. Porter, 1980, 1985), which would be totally different than in present the relatively benign business environment. The changing industry needs a more dynamic approach to strategy development. Companies should be concurrently capable to exploit the current markets and create new ones. Opportunities will emerge in the

intersections of the electrical engineering and electricity distribution businesses, creating a totally new market for “*service providers*”.

Altogether, the alternative scenarios offer a possibility to anticipate the future development and make it possible to invest in the most likely one, but do not exclude the options from other scenarios, which should also be followed in order to be prepared. The main issue areas in capability development are fortunately overlapping in alternative scenarios. Due to that, this might lead to the interpretation that the overlapping ones are common and important in all scenarios.

## 9. Conclusion

This study suggested guidelines for organizational renewal and proactive strategic actions by presenting the theoretical basis for this procedure and demonstrating its applicability in the case. The problem with organizational renewal often lies in the fact that organizations and individuals do not understand the fundamentals of the changing business environment and intersections of internal capabilities and external requirements. They are confused with the broad variety of opportunities offered by the fast changing environment.

Scenario process made it possible to integrate and analyse the gathered knowledge during the research project aiming at exploring the future opportunities. The scenario process run by experts was shown to be helpful, as it provided explicit assumptions of the changing environment for the use of authorities as well as companies. The facilitated process made it possible to manage the group dynamics and avoid the “group-think” effect on decisions and perceptions. Providing such common representations based on the divergent information and knowledge collected from actors and experts makes it possible to lay a foundation for long-term strategic development.

To develop new capabilities, organizations need tools and routines for systematic information processing and knowledge sharing. During the research project, it also became clear that the scenario process is a successful tool enabling the proactive management of knowledge and fostering

diffusion of knowledge in business networks. The scenario process made it possible to examine the industry-specific capabilities and recognize the forces behind the environmental changes, which is important for organizational renewal and the creation of appropriate capabilities in the participating companies.

The scenario method has been traditionally used for anticipating future development and drawing alternative descriptions of the future. This study demonstrated the usability of the scenario method as an effective method to establish a structured and managed process to support the capability development in a changing environment, and enabled the creation of a more complete picture of the reality through multiple perspectives. In a changing environment, the ability to sense and seize new opportunities (Teece, 2000) and to build and reconfigure knowledge-based assets is crucial to the long-term competitiveness of firms.

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**Publication 4.**

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### **The exploration of future service innovations in the radically changing business environment within the electricity distribution industry**

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#### **Abstract**

The radically changing business environment in the electrical distribution industry analogous to the telecommunication industry in the beginning of the 90's in Finland opens up totally new inter-industrial opportunities and forces organizations to renew their strategies and operations. In this study, two qualitative approaches – a scenario method and an electronic GDSS method– were applied to assess the future development of the business environment and to generate totally new innovation ideas. This study provides guidelines for future-oriented innovation management and organizational renewal. Results of the study are based on an inter-industrial research project coordinated and facilitated by the National Technology Agency of Finland.

#### **1 Introduction**

The rise of importance of intangible capital has evidently characterized recent economic development, covering an extensive range of areas and industries [6]. Those firms that have traditionally been distinctively technology firms meet new challenges in a knowledge-based economy. The relative importance of new combinative and coordinative capabilities is growing stronger as firms enter a radically changing operating environment. Regulatory change fosters possibilities for firms that are able to identify opening opportunity gaps in the industry before others do. Still, this is not enough. Firms also need an ability to fill these gaps with new innovations and business activities. Because the development of new organizational capabilities is path-dependent activity, i.e. new knowledge-based assets and systems cannot be created overnight, crucial for success is that early identifiers are also early movers. Firms have to invest in capability building before they know exactly what capabilities are most profitable in a new competitive landscape. What is important for organizational renewal and for the creation of appropriate capabilities and new innovations is that decision makers in organizations interpret and respond correctly to the messages they receive [37].

The radically changing business environment in the electricity distribution industry analogous to the telecommunication industry in the beginning of the 90's in Finland opens up totally new inter-industrial business opportunities and forces organizations to renew their strategies and operations. Mintzberg [33] argues that strategy making requires holistic understanding and is a continuously adjusting process. He continues that new innovations and new strategies are emergent and they can develop with or without organizational intent. Organizations are surrounded by a very large variety of strategic choices [22]. To exploit the emerging opportunities, they need to have methods and practices that help them to be aware of changes in the business environment and to facilitate the development of new innovations.

Transcending prior knowledge and mental reference models makes it possible to act in new situations and to exploit new opportunities [66].

The company's ongoing ability to recognize intersections between organizational emerging asymmetries and the new opportunities of the business environment [29], and to match their resources and processes to the changing institutional requirements and the needs of the market are all crucial for success [57]. Capabilities that have been 'core competences' [41] in the past, may become 'core rigidities' [26] when the operating environment is in a state of flux. As the electricity distribution industry is restructured, also the companies operating in the electricity industry have to restructure their activities, reconfigure existing assets and develop new capabilities [7, 30, 43, 52, 57, 65]. Such changes offer new opportunities for creative and innovative actors [18, 65].

## 2 Methodology

*The purpose of this paper* is to present a framework for the recognition and incubation of totally new service innovations in the radically changing business environment. The created new initial service innovations will be assessed against the future scenarios and capability development needs based on the results of an inter-industrial research project. Firstly, the scenario process is examined as a method for assessing the future requirements of the changing business environment and for identifying the capabilities needed in alternative future scenarios. Secondly, the Group Decision Support System (GDSS) laboratory is applied for the idea generation and assessment of future service innovations by the lead users in the industry.

*Methodologically* this study uses a constructive approach which was very suitable because the aim of the study was to create and to test a framework in a real-life context. The idea in the constructive approach is to design a new construct and test its capability in real-life cases resulting in a new construct which is linked with present theories and practices. The construct of this study is based on combining two group working approaches – the scenario method and the electronic GDSS – to facilitate the first phases of the innovation process. The results of the study are evaluated based on the newness and applicability in progress of scientific knowledge and practice. Demonstrating the practical usability of the construct is also important in evaluating the results.

During the research project, the scenario process provided a structured way to create a dynamic interaction between the environment and the organization to cover a broad range of future possibilities to confront future uncertainties and to expand people's thinking [49, 62, 63, 65]. The scenario process based on the approaches developed by Schwartz [52], van der Heijden [59] and Schoemaker [47, 49] enabled organizations to view their changing competitive landscape and strategic segments in a new light and to renew their organizational capabilities to meet future needs, leading them to recognize new opportunities and create new innovations. In terms of Mintzberg [33], strategic thinking generates an integrated perspective on the organization. After the scenario process, the lead users in the electronic GDSS laboratory sessions [25] brainstormed ideas for new service innovations [10]. These ideas were classified in different categories. Finally, the generated innovation ideas were evaluated against alternative future scenarios and capabilities.

The research project coordinated by the National Technology Agency of Finland and two university research centers provided totally new service innovation ideas for the participating

companies which were a global international electrical engineering company, an international energy company, an international telecom company and local electrical distribution companies. The evaluation of the innovations revealed their business potentials and the need for organizational capability development in order to utilize them. Combining the scenario process with electronic GDSS sessions makes it possible to transcend organizational boundaries and concentrate on developing future innovations.

### 3 Changing business environment in the electricity distribution industry

The development of the electricity distribution industry is largely governed by the common European legislative framework. The rapid development of the industry started in the 1990's when first attempts to create internal electricity markets were made. The key driving force of the electricity market deregulation in Europe was to promote the competitiveness of the European Union Member States' economies. In the early 1990's, the electricity prices for industrial customers in Europe were approximately 40 per cent higher than the corresponding prices in the USA (EC 2000). Deregulation has been successful in the sense that industrial customers have experienced an overall decrease in electricity prices over the last decade.

In 1996, the common guidelines for the internal market in electricity were set by EU legislation in a Directive (96/92/EC). The goal was to introduce competition in generation and supply of electricity. Transmission and distribution of electricity were to remain natural monopolies. By the end of 1990's, it was concluded that the implementation of the internal market in electricity should be accelerated. As a result, another Directive (2003/54/EC) was given in 2003.

*Restructuring the electricity industry.* Over the last decade, the electricity industry has experienced considerable structural changes. This process has been strongly driven by EU legislation. Earlier, the whole value chain from electricity generation to supplying end customers with electricity through transmission and distribution networks was considered a natural monopoly. In the first phase of deregulation in the electricity industry, the emphasis was in breaking the vertical integration of electricity generation, supply, transmission and distribution as shown in Figure 1.

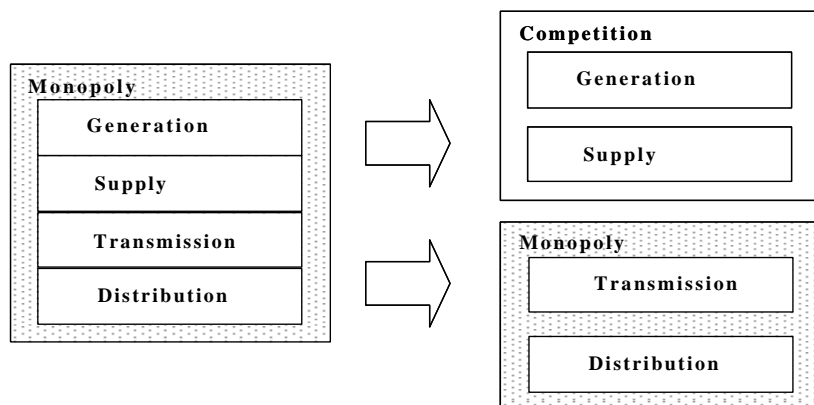


Figure 1. Restructured electricity industry.

During the first phase of restructuring, the electricity distribution industry remained a natural monopoly. Regulation was introduced to prevent the monopoly companies from overcharging

their customers, and some new players entered the market. Their interests were usually more in the deregulated electricity supply than in the electricity distribution. Owning distribution networks was primarily seen as a useful tool capturing markets in the electricity supply. However, electricity distribution is also an important business sector as such because today's information societies are highly dependent on reliable electric power systems. This makes the electricity distribution networks an essential part of the society's infrastructure.

The industry has now moved into the second phase of restructuring by starting to break the natural monopoly in specific parts of the distribution industry. The rate-of-return regulation applied in Finland focuses on the return on capital of the distribution companies. If the return does not exceed the reasonable level defined by the regulator, the distribution tariffs are considered reasonable and no over-charging has occurred. In the rate-of-return regulation the network assets are the primary subjects of regulation. Other operations, which are not the core business of electricity distribution industry but are closely linked to it, could be separated from asset owning as shown in Figure 2.

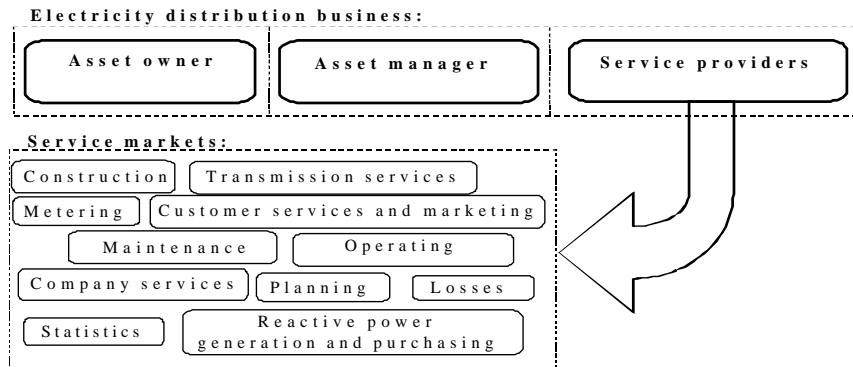


Figure 2. Restructured electricity distribution business.

The industry structure shown in Figure 2 opens up new opportunities for totally new innovations. The service markets are no longer subject to regulation and companies are allowed to earn as much profit as they can. Obviously, the risks in these open markets are higher than in the strictly regulated electricity distribution business in which the allowed return on capital is often low, approximately 5%.

Construction, manufacturing, metering, maintenance and network operating are examples of operations in which it is possible to create efficient service markets. The current regulative framework does not force the separation of these operations but some of them are already outsourced to some extent even though the number of service providers is often inadequate for efficient competition. However, the innovative companies that tend to be the pioneers of the whole industry are already seeking for emerging potential opportunities and developing capabilities aligned with them which might bring them additional competitive advantage in the future. *The scenario method* is a useful tool in creating new knowledge of the future requirements of the business environment in the electricity distribution industry. *The innovation process* can then be used to identify the business opportunities of distribution companies, service providers and equipment manufacturers within possible scenarios.

To sustain their competitive advantage, organizations need to be continuously aware of changes in their business environment and to understand the forces behind them. Being a *lead*

*user* in the industry requires ability to use appropriate methods and tools for supporting the assessment of the emerging technologies, markets, and the utilization of the gathered knowledge in the form of new innovations. Only new radical innovative service solutions will give rise to future business in the radically changing electricity distribution business environment for both electricity distribution and electrical engineering industries.

#### **4 Renewal of organizational capabilities**

In the changing operating environment, the ability to match firm's resources and processes to the institutional requirements and market needs is crucial for success [57]. As the electricity distribution industry is restructured, also the firms operating in the electricity industry have to restructure their activities, reconfigure existing assets and develop new capabilities. Capabilities that have been 'core competences' [41] in the past may become 'core rigidities' [26] when the operating environment is in a state of flux. This risk can be overcome with structured assessment methods and development processes. Innovative capabilities in the firm consist of knowledge, structures and processes which are employed when the firm creates new knowledge and embeds it into new equipment and products or services.

Langlois [24] argues that an organization's ability to interpret signals and perceive changes is a matter of fit between the environment and the organization as a cognitive system. In a broad sense, an organization's cognitive system consists of its routines [34] which determine what information the organization recognizes as meaningful and how it perceives opportunities. Also non-routine information scanning and deliberate knowledge creation activities are important for the renewal of the firm's knowledge base. For the firm's innovative capabilities, the ability to recognize the value of information, to assimilate new knowledge and to apply it to commercial ends is a crucial one [4, 67]. Thus, innovative capabilities are linked to the way a firm creates new knowledge.

Time compression diseconomies [9] and path-dependence in capability development drive organizations to be active before new capabilities are needed in practice [20]. In terms of Gode [14] and de Jouvenel [8], organizations must be proactive: not only explore new opportunities but also create them. The scenario process promotes firm's future orientation and proactiveness.

#### **5 The scenario process - a method for assessing the dynamic environment**

Creating new knowledge presumes that individuals recognize useful data and information, and are then able to transform it, through some process, into knowledge that brings future value for the organization [53]. The fundamental idea behind scenario planning is to provide a structured way to create dynamic interaction between the environment and the organization to cover a broad range of future possibilities to confront future uncertainties and expand people's thinking [49, 62, 63, 65]. The use of scenario planning reflects the proactive orientation of an organization [14]. Scenarios explore the simultaneous impact of various uncertainties by changing multiple variables at a time, and describe very complex models that cannot be formally modelled [3, 51]. Scenario planning makes it possible to assess the competitive landscape and strategic segments of an organization in a new light and renew organizational capabilities towards future needs [14, 51, 57]. According to Feurer and Chaharbaghi [11], the key question to the success of an organization is the quality of knowledge and its utilization which means a flexible, creative and future-oriented knowledge

creation process. Scenario planning can be a catalyst for extracting value from capabilities by channelling them towards new innovations.

Scenario planning involves organizational leaders and managers, R&D centers, associations, different groups of experts and many other stakeholders in the form of structured and facilitated groups to share knowledge and to create alternative presentations of the future [45, 50]. In terms of Nonaka et al. [36,35] knowledge creation is a dynamic synthesizing process through interaction between individuals and the environment in a shared context. Scenarios reflect beliefs, expertise and intuition of individuals and organizations concerning the future [1, 2, 19, 46]. They help organizations and individuals to develop and broaden mental models on possible future realities, and understand the fundamental drivers of business, market and technological trends and changes [27, 47, 48, 49, 55, 63]. In other words, scenarios provide a method for discovering and comparing firm-specific capabilities with future requirements, and make it possible to face the situations of complex rapid change [48]. Hamel and Välikangas [17] emphasize that organizations should have the capacity to change before the need for change becomes too obvious.

### 5.1 Scenario creation

According to Masini and Vasquez [27], creating scenarios means carrying out an ongoing cumulative process, establishing a project periodically or when needed. The scenario process has a certain and common structure involving a varying number of steps, e.g. [52, 14, 27, 49, 59]. Phelps et al. [38] argue that the scenario process can be conceptualized as having four stages: from the delimitation of the focus to interactive knowledge sharing and creation, forming the scenario context, and from resulting combinations of new knowledge in the form of scenarios to organizational development through the implementation of the scenarios (Figure 4).

*1. Preparation for the scenario process: background analysis and delimitation of the focus.* The scenario process starts by organizing a working group within the participating organizations [45]. The working group in the scenario process serves as a shared context where individuals from the participating organizations may act through direct experiences [36]. The working group consists of experts, actors and other stakeholders with multidisciplinary backgrounds who are often *lead users* in the industry, e.g. [21, 52, 59, 60]. They reflect upon the futures of a group, providing new insight and perspectives.

The working group identifies a knowledge gap between the group and the environment and between the individuals in the working group. In order to fill the identified knowledge gap, the working group explores holistically the backgrounds of the past and present business environment in the industry around the issue of the scenario process [59]. This phase may require a long research period and several meetings depending on the goals of the scenario process. The analysis of the industry explains the dynamics of the external business environment (shown in Figure 3). In this phase, the shared collective knowledge base, a common language and practicalities for the basis of the scenario process and knowledge creation are provided producing a goal and a shared vision for the scenario process [14].

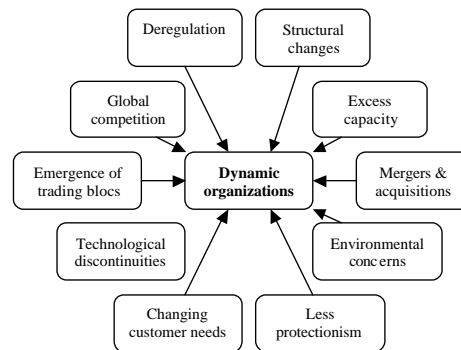


Figure 3. Framework of the analysis of a dynamic business environment [42].

2. *Knowledge base construction.* The working group has intensive sessions and face-to-face meetings to rationalize knowledge created in the preceding phase. During this phase, the working group provides a holistic understanding of the current causalities in the environment and connects the organizations into it [47, 49]. The working group determines the main forces that are changing the business environment as well as the key environmental uncertainties, such as the future direction of technology, competitors' behaviour, regulation and market risks. This may require additional research. When the background has been examined and the stakeholders, driving forces and the required capabilities for future business have been recognized, the working group explores their significance and logical implications [52, 59]. At the end of this phase, the gathered new knowledge is evaluated within the working group and is represented in the form of initial scenarios.

3. *Scenario creation.* The final alternative scenarios are created through the evaluation and combination of knowledge gathered during the preceding phases on an intuitive, *heuristic* or statistic basis [27, 51]. The goal is to identify the logic of the business environment which is important and relevant to the issue, and then organize the possible outcomes of the scenarios around this logic [49, 59]. This phase provides alternative scenarios of the future related to the issue considered. The scenario creation process enhances organizational learning, reveals blind spots in the decision-making providing new insight and foresight for further business processes.

4. *Implementation of scenarios.* The scenarios are disseminated and implemented into the organization through communication. According to Millet [32], the scenarios work for new innovations and organizational decision-making, e.g. R&D priorities, new products and services, financial investments, and provide a context for long-term strategic planning. The scenarios make it possible to evaluate organizational capabilities against future requirements, and develop new capabilities and renew existing ones. They serve as a platform for the creation of new innovations and business ideas and the assessment of their market potentials [28, 48].

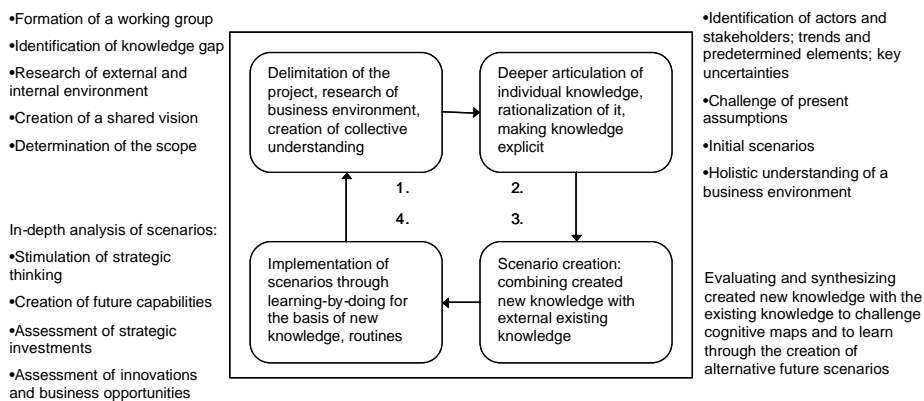


Figure 4. Ongoing scenario process and knowledge creation.

O'Connor and Veryzer [37] state that when exploring and creating new innovative ideas it is essential to have appropriate methods and tools for linking expertise and future opportunities. Innovations seek information about technological and market changes in the future [64]. Hamel and Prahalad [16] remind that organizations are dependent on foresights and the capabilities to exploit them.

## 6 Supporting the lead user innovation process

When technology and the market are in a state of flux, the main challenge is to link future market opportunities and technological capabilities. In such a situation, future-oriented knowledge and visioning capabilities are needed for new innovative ideas [18, 37]. When creating new innovations, the understanding of changes in the business environment, capabilities in problem solving and an enabling context are essential for a successful innovation process [37].

Development of new innovations requires both insight and foresight. Von Hippel [60] has developed the *lead user* method based on expertise within an industry, technology or products to exploit market and technological knowledge in new product development processes. Von Hippel [60] argues that 'people who are familiar with conditions which lie in the future' are able to interpret the organizational environment and to create a holistic understanding of it through the information and experience they have. Lead users are capable of bringing "hidden" information about the needs and solutions from the leading edge of the target market and technologies into the innovation process. Hinterhuber and Friedrich [18] also stress the importance of leadership in knowledge acquiring. To make such people act together, it is essential to have efficient group working tools [10].

According to Cooper [5], idea generation in the innovation process is the most critical phase and reflects the organization's proactive orientation. Haman [15] states that the innovation process should challenge present mental models and search for and give new insight into the process. Essential to idea generation is to have rich understanding of the issue and ability to make sense of it [5]. Ideas initiate the whole innovation process and can create or break a new innovation project. Ideas also need to be created and evaluated through some method to become exploitable and commercially successful [54].

In this study, the electronic GDSS (group decision support system) was used as a tool to enhance communication and cooperation between the participants, i.e. *lead users* during the idea generation sessions. According to Gallupe and Cooper [13], electronic brainstorming support systems help groups to generate, disseminate, evaluate and act on ideas. They have also noticed that such systems eliminate communication barriers and improve the management of the use of time. Typically, brainstorming groups consist of 6-10 persons discussing a specific problem. During electronic brainstorming, participants enter ideas on a computer simultaneously and anonymously on a depicted topic. The objective of the GDSS is to reduce the process losses in conventional decision-making, disorganized and unfocused activity, the dominance of any participants and the social pressure to conform [12, 58]. When providing such contexts for the *lead users*, it can be ensured that many more ideas are thought of and expressed and evaluated [13].

### 6.1 *Generating ideas in the GDSS laboratory by the lead users*

During the early phases of the innovation process, the developed idea generation process in the electronic GDSS laboratory [23] supports the group of *lead users* to communicate and act productively in a structured way and to select appropriate targets for further innovation development. Cooper [5] states that the idea generation phase is considered so important by many organizations that it should be facilitated formally in the innovation process. The results of the idea generation process are strongly dependent on the knowledge level of the participants. Therefore, the background analysis and the selection of the participants in the process should be done carefully. Due to that, the idea generation process is conducted by the lead users of the industry, and the process is integrated into a larger research context, in this case the scenario process, to ensure a holistic understanding of the issue and the commitment of the participants to the electronic GDSS process. According to Elfvengren et al. [10], utilizing the holistic understanding of the issue and the lead users in the GDSS process provides significant results in idea generation.

The developed idea generation process consists of seven sequential phases (Figure 5) and begins with a planning meeting and an introduction of the process when the goal and the agenda of the session are defined. The orientation and introduction phase activates the participants in the process. The main part of the process is idea generation including several separate phases. During idea brainstorming, participants generate simultaneously new innovative ideas around an issue after which the ideas are clarified and specified. Then the generated ideas (approx. 50-70 per one session) are clustered under main categories, and additional information is given on them. When the generated ideas are categorized, they are evaluated and prioritized according to the importance of the future needs in the participating organizations. Prioritization of the ideas is done by the participants in the process i.e. the lead users on the basis of background research and their own expertise. The idea generation session ends with the assessment of the process providing valuable information for the development of the idea generation process and the electronic GDSS. Finally, the most important and promising new innovative ideas for the participants are evaluated and implemented in their business processes.

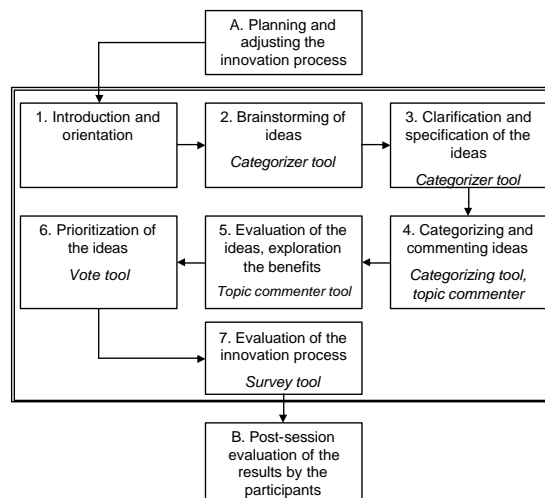


Figure 5. The structure of the idea generation process in the electronic GDSS session [23].

## 7 Case: Exploring new service innovations for future business opportunities in the field of electrical engineering and electricity distribution

### 7.1 Background for the research process

This section introduces a construct of the scenario method and the electronic GDSS in an innovation process. They were part of a larger research project aiming at providing new innovative business ideas for the electricity distribution business which is changing radically due to deregulation in Finland and the EU. During the research project, the aim of the scenario process was to create new knowledge about requirements for the future business environment, to identify future business opportunities and to provide four alternative scenarios resulting in a vision for the development of the industry. The scenario process worked as a knowledge base for idea generation at the electronic GDSS. The participants in the research project were the global electrical engineering company ABB, the international energy company Fortum, the international telecom company TeliaSonera, two local electrical distribution companies Koillis-Satakunnan Sähkö and Tampereen Sähkölaitos, seven SME software and electrical engineering companies: Eltel Networks, Empower, Enermet, MX Elatrix, Process Vision, Telewice and Wimotec; the National Technology Agency of Finland (TEKES), Lappeenranta University of Technology and Tampere University of Technology. The research project started in January 2003 and will continue for three years.

### 7.2 Description of the innovation process

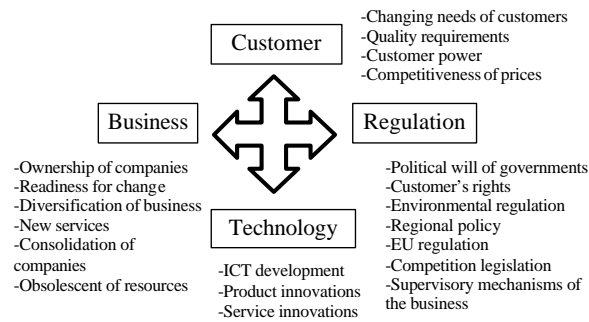
#### 7.2.1 The first phase of the innovation process: scenario process

The innovation process started with the scenario process in August 2003 and continued for four months providing the knowledge base for the idea generation process. The participants in the research project formed a cooperative knowledge network to provide background knowledge for the project. The working group of the scenario process consisted of experts with different backgrounds (electrical engineering, product economics, information technology, business administration). Seven researchers came from Lappeenranta University

of Technology and six researchers from Tampere University of Technology. The working group of experts acted as the domain of knowledge creation in the scenario process.

*The analysis of the industry served as a preparation for the scenario process.* The exhaustive industrial analysis, presented above in Section 4 and conducted before the scenario process, revealed a lack of future strategies and visions in the organizations which have enjoyed a relatively stable and benign environment, and the emerging changes confuse them rather than reveal new opportunities. According to the industrial analysis, the working group set goals for the scenario process around a loose shared vision which was named “New innovative ideas for the service operations in electricity distribution industry”. The main goals of the process were to create alternative future scenarios of the development of the industry, identify capabilities enabling the development and provide knowledge base for the electronic GDSS process.

*During the second phase of the scenario process,* the working group held an intensive two-day scenario session to create alternative scenarios. Firstly, the working group of experts explored the competitive landscape of the industry and identified four main developing areas and the key drivers affecting the development of the industry, shown in Figure 6.



*Figure 6. The key drivers of the electricity distribution industry in Finland.*

Secondly, the working group explored their backgrounds and found out driving forces (altogether 136) that would affect the development of the key drivers. The driving forces were grouped into twelve main *capability areas* (shown in Table 2), and their significance and logical implications for the industry were examined. Finally, the initial scenarios were created by determining the limits and naming them (Figure 7).

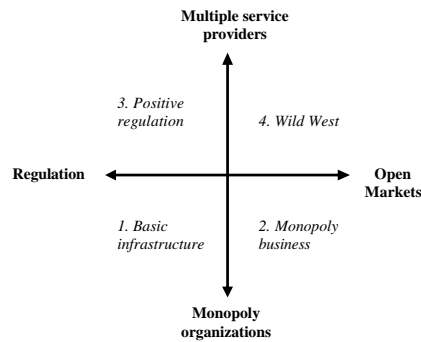


Figure 7. Four initial future scenarios in the electricity distribution business.

In the next phase, the scenario creation provided four alternative scenarios concerning the development of the electricity distribution business during the next ten years. The basic elements of the scenarios are presented in Table 1. Each of them captures alternative developments in the driving forces of the business environment.

<p><i>3. Positive regulation</i></p> <ul style="list-style-type: none"> <li>-Integrated regulations in the EU</li> <li>-Local monopolies over networks</li> <li>-Competition legislation</li> <li>-Developing markets in service business</li> <li>-Quality control of electricity by authority</li> <li>-Decreasing prices due to regulative actions</li> </ul>	<p><i>4. Wild West</i></p> <ul style="list-style-type: none"> <li>-Unregulated electrical distribution and networks</li> <li>-Effective markets in service business</li> <li>-Investors are active in industry investments</li> <li>-Price and quality differentiation</li> <li>-Quality problems in outlying districts</li> </ul>
<p><i>1. Basic infrastructure</i></p> <ul style="list-style-type: none"> <li>-Undeveloped markets in service business</li> <li>-Local regulation</li> <li>-Decreasing rents</li> <li>-Low R&amp;D intensiveness</li> <li>-Stable and controlled prices</li> </ul>	<p><i>2. Monopoly business</i></p> <ul style="list-style-type: none"> <li>-Unregulated industry and market</li> <li>-Diffusion of companies into conglomerates</li> <li>-Vertical integration of companies</li> <li>-Emergence of local energy co-operatives</li> <li>-Customer segmentations</li> </ul>

Table 1. The basic elements of the future scenarios of the development in the electricity distribution business.

In the final phase, the implementation of scenarios included evaluation of alternative scenarios and future capabilities. The evaluation was conducted during the next three months after a scenario session within the working group of experts. The evaluation process consisted of two parts: 1) the assessment of the present and future value networks in each scenario to find out the opportunities and mechanisms of value creation, and 2) the assessment of identified future core capabilities in each scenario to exploit emerging opportunities. In the first part, the created value network descriptions revealed connections and transactions between the actors of the industry, and also the business potential of each actor in the scenarios. In the second part, the most important capabilities, *core capabilities*, were selected on the basis of several qualitative characteristics, e.g. [41, 48, 61]: slow evolvement through collective learning and knowledge sharing, path dependency of the development, imperfectly imitable characteristics, complements to existing capabilities and rareness among rivals. The evaluation provided a comprehensive understanding of the present industry patterns and their possible future development paths, and specified *the needed core capability developing areas* (shown in Table 2) in each scenario where future opportunities will emerge if the companies of the electrical engineering and electricity distribution industry focus their attention on them.

The key areas of core capability development	Importance of capabilities in scenarios (1 = most important and 4 = least important)			
	Scen. 1.	Scen. 2.	Scen. 3.	Scen. 4.
1. Locality of business	1	4	2	3
2. Industry structure	1	2	3	4
3. Ownership of assets	4	1	3	2
4. Return of capital	4	3	2	1
5. Regulative knowledge in market	3	2	1	4
6. Regulative knowledge in rents	2	3	1	4
7. Knowledge in social policy	1	3	2	4
8. Changing customer demand	2	4	1	3
9. Competitiveness of electric energy	3	4	2	1
10. R&D management and automation	4	2	1	3
11. Human resource management	2	4	1	3
12. Environmental legislation	4	1	3	2

Table 2. The key areas of core capability development in electrical engineering and the electricity distribution industry in Finland during the next ten years.

### 7.2.2 The second phase of the innovation process: idea generation process

In this phase, the idea generation process was conducted in the electronic GDSS laboratory of the Department of the Industrial Engineering and Management at the University of Lappeenranta. Two separate one-day idea generation sessions were carried out with the company representatives. In the first session, in November 2003 the participants were from an international energy company (company A) and in the second session, in December 2003, from an electrical engineering company (company B). The company representatives were *lead users* who have a strong effect on the strategic and operational decisions in their companies. The lead users were selected according to their personal abilities and expertise concerning the issue, i.e. new business innovations in electricity distribution.

The idea generation process followed the steps introduced above (Figure 6.) in both sessions. The process started with an in-depth discussion of the results of the scenario process and the implications of the revealed opportunities for the development of the industry. In the electrical GDSS session, the participants i.e. the *lead users*, were asked to brainstorm new innovative ideas for the electricity distribution industry which would lead to further business concept development. During the 45 minutes of the first session they generated 58 new business ideas, and during the second session 61 new business ideas. The generated ideas were discussed in detail and their advantages and disadvantages concerning the issue were evaluated. The evaluated ideas were then categorized by grouping ideas with similar characteristics together to make it easier to prioritize them according to their significance to the company, shown in Table 3.

The significance of all the ideas for the issue was assessed by discussing their details after which ideas were prioritized within the categories. The participants used a voting tool prioritizing the ideas on a scale of 1 to 10. The categories were named to show how the content depicts the future service business opportunity areas. The prioritized categories were then analyzed against alternative scenarios and core capability areas for further development and commercial exploitation in the business processes of the participating companies.

Company A	No. of ideas	Average importance of ideas	Company B	No. of ideas	Average importance of ideas
1. Regulative knowledge	9	8,08	1. Regulative knowledge	6	8,06
2. Human resource management	8	8,00	2. Investment and maintenance services	8	8,00
3. Management of the value chain	10	7,50	3. New technological solutions	8	7,40
4. Innovative technological solutions	13	7,36	4. Account management services	6	6,98
5. Service providing operations	16	7,18	5. Electricity measurement services (EMS)	12	6,96
6. Exploitation of external services	5	6,74	6. Internal business intelligence	12	6,70
			7. Content development for EMS	12	6,64

Table 3. The prioritized idea categories to create and improve future business operations.

The results of the idea generation session for both companies are comparable. The executed electronic GDSS sessions were conducted in similar circumstances. Both sessions had the same goal, meeting agenda, background information and knowledge. The applied electronic GDSS laboratory has been used successfully in analogous research projects and innovation processes (see [10, 58]).

## 8 Analysis of the results and discussion

The overall focus of the research project was to assess the future consequences of the deregulation of the electricity distribution market to the business environment and organizations related to the industry, and methodologically also to provide new insight for existing strategic planning theories and practices. During the scenario process, the working group of experts analyzed the industry independently from the actors providing a plausible vision of the development of the industry for the next ten years based on the scenarios. The idea generation sessions in the GDSS laboratory were conducted by the lead users of the companies (*actors*) on the basis of the scenarios and their personal prior knowledge. Integrating the results of the scenario process and the idea generation sessions makes it possible to decide which innovation ideas to emphasize in view of their synergies over capabilities and resilience under each scenario.

### 8.1 Analysis of the scenarios and capabilities

According to the study, the changing business environment in electricity distribution in Finland may have four different development paths. Each of them would cause different technological and economic requirements for the organizations. Descriptions of the end states of each scenario are presented below:

- *Scenario 1 “Basic Infrastructure”* would be quite similar to the present situation. The industry would be led by national interests and controlled by national authorities. The market would be very closed and national. Authorities would regulate tightly the rents of the companies and only a few main players could operate in the market.
- *Scenario 2 “Wild West”* might lead to decaying infrastructures, fragmented business landscape and the transfer of regulative control from authorities to the market due to the very fast and uncontrolled deregulation of the industry. In other words, the basic values of the industry would be effectiveness, maximum returns of employed capital, and superior short-term competitive advantage.
- *Scenario 3 “Positive Regulation”* might lead to open and effective markets. The market would be opened in a controlled way in the whole EU. Supportive and dynamic regulation systems to enhance competition within the industry would be

created. The quality requirements, prices of electricity, effectiveness of companies, and rents of companies would be in balance and real open markets would exist in the EU.

- *Scenario 4 “Monopoly Business”* would be the consequence of unsuccessful deregulation in the EU. Some national monopoly corporations might have an opportunity to take over the faster and earlier deregulated but still undeveloped markets with the help of a monopoly position at the home market. This might lead to ineffectiveness, low quality and political disagreements.

The study was continued by assessing the present and future capabilities of the industry through the scenarios. The working group of experts evaluated the key areas of the identified core capabilities (Table 2) needed in the future and revealed the main future requirements for the industry in each scenario. In *scenario 1 “Basic Infrastructure”*, the companies should be able to ensure stable prices and the quality of electricity, the maintenance of infrastructure and good political connections. Authorities would consider the industry as a basic service supporting other industries. *Scenario 2 “Monopoly Business”* might require corporate mergers and a broad regulative knowledge in the changing market. The convergence of the industry would increase national regulation and protection, e.g. through environmental issues. The key to success would be the ability to acquire a dominant market position. *Scenario 3 “Positive Regulation”* is the most challenging one. The requirements would concern technological, economic and regulative issues to ensure competitive advantage in open and effective markets. The key to success would be the ability to create proactively new markets and to be continuously innovative. In *scenario 4 “Wild West”*, the requirements would basically concern economic issues. The basic question would be how to manage the decreasing rents and the fragmenting market, and secondly how to gain economic power to be fast and agile.

#### 8.1.1 *Analysis of the capabilities and the idea categories*

The results of the scenario process and the idea generation process were then analyzed comparing the fit between the core capabilities and innovation ideas in each scenario (e.g. [31, 44, 48]). The qualitative analysis of the results was conducted among the experts. The experts studied in greater detail the technical and economic requirements of the ideas and compared them with the requirements of the capabilities and the limits of the scenarios systematically by juxtaposing the scenarios and ideas. The fit between the capabilities and ideas provided information on how the needs of ideas and the identified core capabilities would match with each other. According to the “fit analysis”, the idea categories were linked with future core capability areas in each scenario (shown in Table 4). These linkages provide information about the newness, complexity and potential of the innovation ideas. Firstly, the idea categories which have several linkages with future core capability areas can be assumed to be very complex and their novelty will be very high. Secondly, the potential of the idea categories was evaluated by assessing the linkages with the most important core capability areas in each scenario. This revealed the idea categories which might be the most promising and challenging for exploitation in future business processes.

The idea categories of the companies A & B	Links to core capability areas [№ 1-12]			
	Scen. 1.	Scen. 2.	Scen. 3.	Scen. 4.
A1. Regulative knowledge	6,7	5,12	5,6,7	12
A2. Human resource management	7,11	10	7,10,11	
A3. Management of the value chain	1,2	2,3	1,4,9	3,4,9
A4. Innovative technological solutions	8	10	8,9,10	9
A5. Service providing operations	2,8	2,10	8,10	
A6. Exploitation of external services	2,7,11	2,10	4,7,9,10,11	4,9
B1. Regulative knowledge	6	5,12	5,6,7	12
B2. Investment and maintenance services	2,8	2,10	4,9	3,4
B3. New technological solutions	8,11	10	8,9,10,11	9
B4. Account management services	8,11	3	4,8,11	3,4
B5. Electricity measurement services (EMS)	2,8	2,10	2,8,9,10	9
B6. Internal business intelligence	8,11	3,2,5	4,5,8,11	3,4
B7. Content development for the EMS	2,8	2,10	8,9,10	9

Table 4. The fit of the core capabilities (ranked 1<sup>st</sup> or 2<sup>nd</sup>) and the innovation ideas on the basis of the similarities in technological and economic requirements in each scenario.

### 8.1.2 Discussion

Due to the fact that the external business environment will change radically in the electricity distribution industry, organizations and authorities are forced to redirect their actions to match these changes. The energy market authorities in Finland are following EU directives and are changing the rules of the industry through deregulation in the front line. The ultimate goal is to separate the ownership of assets from the production and service business to ensure real competition in the market. From the technological point of view the market is not in a state of flux. Technology is in a mature phase, and new radical technological innovations will not emerge in the foreseeable future. But the challenge is to recognize the radical changes in business operations and models. The market is transforming from a relatively benign and regulated one to an open market economy system opening new radical innovations for the service providing sector.

In this case, authorities have adopted an intentional role. From the authorities' point of view, *scenario 3 "Positive Regulation"* might fulfil their goals. In order to achieve the goals, they should *proactively* create such controlling and regulative systems that would support and motivate companies to develop their capabilities and new innovations leading them into this future environment.

From the companies' point of view, the changing industry will need totally different business knowledge and will open totally new business opportunities, not only for the distribution companies, but especially for the electrical engineering companies. If the companies agree on the goals of the authorities, they should concentrate on such core capabilities that enable them to develop new innovative service business ideas and meet the requirements of *scenario 3 "Positive Regulation"*. This might lead to different positions in business landscape (e.g. [39, 40] which would be totally different from the present relatively benign business environment. The real advantage would be found in the management's vision to consolidate the organizational resources into capabilities that empowers organizations to exploit emerging opportunities.

When comparing the innovation idea categories and the core capability areas, it became evident that companies will concentrate on the capabilities which enable the development of new business models. Some capabilities overlap in multiple idea categories showing emerging opportunities for success in future business. Choosing the vision among those that make sense

with the help of the created future scenarios, companies will be able to direct their resources and capabilities to products and markets having potential for success.

Altogether, the aim of the authorities is to direct the development of the industry towards an open and dynamic market by creating new positively supporting regulations. The changing industry needs a more dynamic approach for strategy development. Companies should be capable of concurrently exploiting the current market and creating new ones, i.e. being innovative and creative. Opportunities will emerge in the intersections of the electrical engineering and electricity distribution businesses, creating totally new innovations for “*service providers*”.

## **9 Conclusion**

This study suggested guidelines for strategic thinking and the early phases of the innovation process. The problem with organizational renewal often lies in the fact that organizations and individuals do not understand the fundamentals of the changing business environment and the intersections of internal capabilities and external opportunities. They are confused with the broad variety of opportunities offered by the fast changing environment.

The scenario approach has been traditionally used for anticipating future development and drawing alternative descriptions of the future. This study demonstrated the usability of the scenario approach as an effective method for establishing a structured and managed process to support the innovation development in a changing environment. The scenario process run by experts was shown to be helpful, as it provided explicit assumptions of the changing environment in a narrative form. The scenario process made collective learning and strategic thinking among the participants possible resulting in common representations, i.e. long-term strategic visions of the emerging future. During the research project, it also became clear that the scenario process is a successful tool enabling the identification and examination of the industry-specific capabilities and the recognition of the forces behind environmental changes which is important for organizational renewal and the creation of appropriate core capabilities.

The idea generation process conducted at the electronic GDSS laboratory with the lead users was a very promising method to enhance the innovation process. It provided an effective way to create new innovative ideas for the business use. The electronic GDSS offered very structured and effective tools to exploit participants' prior knowledge and to integrate it with new knowledge. During the electronic GDSS sessions, the generated innovation ideas were able to be evaluated against the determined requirements and then be submitted to the next phase of the innovation process. The electronic GDSS is an effective way to perform qualitative assessments and analyses during the early phases of innovation processes.

The authors found that combining two different qualitative approaches – the scenario process and the GDSS process – made it possible to integrate and analyze the gathered knowledge during the research project aiming at exploring future innovations. In a changing environment, the ability to sense and seize new opportunities [56] and to build and reconfigure knowledge-based assets is crucial to the long-term competitiveness of firms.

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# Management of controlled open innovation process

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**Recent regulatory change will have a radical impact on the whole structure of the electricity distribution industry in the EU. The new situation opens up opportunities for new types of innovative ideas. To be able to utilize the radically changing business environment, organizations are forced to transform their practices and enter the open innovation process. This study demonstrates the innovation management methods – scenarios and the group decision support system – for the creation of the controlled innovation process in an open innovation context. The study clarifies the real advantages and problems of the process introducing a framework for its utilization in electrical engineering and electricity distribution companies.**

## 1. Introduction

Innovation is always formed in a social system. It is about the knowledge sharing and creation in a social context. Innovation is a process which can occur in the course of carrying out various business activities. The creation of today's complex and systemic innovations requires the merging of knowledge from diverse perspectives. According to Leonard and Sensiper (1998), the innovation process is an interactive process of creative individuals sharing their knowledge within a group. Nonaka and Toyama (2003) state that the creation of new knowledge is a process through which an organization interacts with individuals and the environment to transcend emerging contradictions facing the organization.

The innovation process has been considered a closed process controlled by the organization. Recent research (e.g. Bergquist & Ljungberg, 2001; Chesbrough, 2003; von Krogh et al., 2003) has acknowledged the shift from the closed innovation paradigm to an open one. According to Chesbrough (2003), the open innovation process is based on the knowledge acquisition and exploitation in parallel with external and internal sources. The idea of using external sources is not new. In fact, it has existed decades for example in partnerships and alliances. The key is to enable the

creation of an open innovation process from which all the participants will benefit.

To establish an open innovation process requires appropriate methods and practices. Chesbrough and Teece (1996) argue that shared innovation processes need to be controlled and structured. They continue that open exchange of knowledge that fuels the innovation process may give rise to conflicts between the participants or deflect the process. To make an open innovation process work and to exploit the advantages of such conditions, coordination and management is needed (Buckley & Carter, 2002; Chesbrough & Teece, 1996; Gassmann & von Zedtwitz, 1998). This also means that participants are able to benefit from the results of the innovation process and to exploit them in their own business processes, e.g. in the form of new products, services, new knowledge or through intellectual property right (Pisano, 1990; Shapiro & Varian, 1999).

Utterback and Afuah (1998) state that innovation is a function of personal interaction enabled by flexible organizational structures and skilled and capable people in an encouraging environment. According to von Krogh et al. (2001), creating new ideas or innovations from rare and scarce resources the participants with an interest and skills in doing something new need to build a community around a shared vision. Such communities should act as a shared context where participants, i.e. individuals and organizations, can work in an open environment. Furthermore, Judge *et al.* (1997) state that the management's

ability to create a sense of community is an important factor in creating goal-directed communities for innovation. Their study also showed that the most innovative units were goal-directed communities where strategic objectives and context were developed allowing a great amount of freedom within the context. Several studies (e.g. Bergquist & Ljungberg, 2001; von Krogh et al., 2003) found that open innovation communities are working under a shared and often very loose idea or vision. Such open innovation communities are also very often controlled by someone. Bergquist and Ljungberg (2001) state that joining in an open innovation community or process and providing useful input must bring mutual value.

This study is part of a larger research project and reviews *the innovation process* which enables participants to act in an *open* and *loosely* managed environment. The purpose of this study is to clarify the real advantages and problems of the open innovation process introducing a framework for the utilization of the open innovation process. The study consists of two parts: the scenario process and the idea generation process. The aim of the scenario process is two-fold. Firstly, it serves as a shared open context to share and create new knowledge among the participants. Secondly, it provides new information and knowledge about the market and technological development for the business processes of the participants and the idea generation process. We continue with the idea generation process which is conducted in the electronic group decision support system (GDSS) laboratory enabling open idea brainstorming within the participating companies. The goal of the idea generation process is to utilize new knowledge created during the scenario process and provide new innovative ideas for the use of participating companies.

Methodologically this study uses a constructive approach which was very suitable because the aim of the study was to create and to test a framework in a real-life context. The idea in the constructive approach is to design a new construct and test its capability in real-life cases resulting in a new construct which is linked with present theories and practices. The construct of this study is based on combining two group working approaches to facilitate the open innovation process in a limited context. The results of the study are evaluated based on the newness and applicability in progress of scientific knowledge and practice.

The overall goal of the research project is to examine the radically changing business environment in the electricity distribution industry analogous to the telecommunication industry in the beginning of the 90's in the EU, and the new inter-industrial business opportunities which force organizations to renew their strategies and operations. The research project is coordinated by the National Technology Agency of Finland and two university research centers. The participating companies in the project are a global international electrical engineering company, an international energy company, an international telecom company, two local electrical distribution companies, and seven SME electrical engineering companies. The project started in January 2003 and will continue for three years.

## 2. Open innovation paradigm

Recent innovation literature has emphasized the importance of external knowledge sources and utilization of networks in the innovation process (Caloghirou et al., 2004; von Hippel, 1988; George et al., 2002; Spencer, 2003). Firms rarely innovate alone, and they are increasingly dependent on their customers (e.g. lead users), suppliers, and other external resources as initiators of product improvement and sources of new ideas. According to Chesbrough (2003), the innovation paradigm has changed fundamentally from a closed innovation system to a more open one in which firms' external knowledge sources and resources have a central role. In the open innovation paradigm, firms utilize external and internal ideas, use external channels to generate value from their internal ideas and capabilities, and configure their business models to profit from innovations (Chesbrough, 2003). However, successful innovation requires control in the open innovation paradigm, and even more than in the closed innovation paradigm, as firms have to reconfigure structures and processes continuously to match with a changing business environment. Firms need capabilities and well-designed processes to manage knowledge flows and coordinate relationships with innovation partners. Thus, innovation management means also orchestrating complex social processes in which interaction between different actors creates new knowledge and reveals new business opportunities. Still, there are limits in the effective use of external sources. Laursen and Salter (2004) found that too much openness in the search for new ideas may have a negative impact on performance. Hence, even though firms can benefit from the wide and deep external search of ideas, they also need a clear vision of useful knowledge sources and tools for processing knowledge.

The importance of connections with external actors is of great concern especially when innovations are systemic. As the regulatory change will have a strong impact on the whole structure of the electric distribution industry in the EU, the new situation opens up opportunities for new types of innovations. Until this, innovations in electricity distribution have been essentially technological and to large extent independent discrete innovations. When regulatory constraints are loosened, the institutional transformation offers possibilities to develop new ways to operate. As a consequence of industrial change, the nature of the products and services provided in electricity distribution may change. Destabilization stimulates the growth of the role of services and the development of new business models, social innovations and other types of systemic innovations. The role of openness is crucial for the generation and successful exploitation of ideas in such conditions.

The characteristics of knowledge in a certain domain related to innovation management have an impact on knowledge governance mechanisms. The conversion of tacit knowledge into explicit knowledge in the domain of scientific and technological knowledge requires reciprocity in the communication between parties (Antonelli, 2002). Essential to the success of the open innovation process is that collective activities during knowledge creation process(es) are structured and that there is a coordinator who keeps the process in line. The exchange of tacit future-oriented knowledge is facilitated when knowledge-creating actors are motivated to commit to a common goal in a given knowledge domain. Thus, knowledge creation and sharing

objectives can be the initiating forces that build up communities, such as epistemic communities in the sense of Cowan et al. (2000: 234): "Such communities, which may be small working groups, comprise knowledge-creating agents who are engaged on a mutually recognized subset of questions, and who (at the very least) accept some commonly understood procedural authority as essential to the success of their collective activities." The roles and objectives of different participants may vary, but in the epistemic community the actors are adhered to a shared knowledge interest.

In the media, special cases of open innovation, namely open source software development projects (especially Linux) have sometimes been seen as idealistic endeavors aiming to oppose commercial, private benefit seeking proprietary software developing firms. However, also alternative or at least complementary explanations exist. Is the development of open source software driven by benevolence or benefits? The recent literature has considered the possible motives that conduct the behavior of participants in open source development projects (Bergquist & Ljungberg 2001; Lerner & Tirole 2002; Hertel et al., 2003; Lakhani & von Hippel, 2003). The developers get personal rewards from their free contribution to the work, and these rewards can be, for example, learning, perfecting expertise, feeling of indispensability, enhancing the reputation and pure fun and enjoyment. Also, many of these benefits are dependent on belonging to the developer community (von Krogh, 2003). When broadened to the organizational level, the same issues of incentives to participate in an open innovation process are also relevant.

Kogut and Metiu (2002) argue that for some easily coded and distributed digital products the open source model is simply a more efficient production model than the closed, in-house innovation development model. Thus, the central reason for the existence of certain open innovation solutions may be that in some situations the open innovation model offers more benefits for less cost and risk than the closed innovation model. Furthermore, as in the new product development the ability to create new knowledge by combining separate information pieces and knowledge blocks is important (Cohen & Levinthal, 1990; Zahra & George, 2002; Zander & Kogut 1995). Without openness some useful knowledge may never be created. Thus, openness is not only some praiseworthy attribute of an organization but in the economical sense rather a useful device in its innovative capacity. Hence, we argue that even potential competitors may contribute to the knowledge creation in the same open innovation process when the setting is not a zero-sum game, but rather a win-win situation.

In our case study, the innovation process consists of two main phases. In the first phase, the participants engage in processes managed essentially by open innovation logic. This phase is composed of the scenario process and the idea generation process after which the participating companies utilize the knowledge and generated ideas in their internal R&D or in networked innovation activities depending on their objectives. Thus, our example of the innovation process

contains collaborative *open* knowledge creation activities and somewhat more *closed* internal knowledge exploitation activities.

### 3. Controlled open innovation process

According to Judge et al. (1997), there exists a dilemma in the innovation process: the process should be simultaneously open and tightly managed. Many promising innovation ideas are carried out in an open and unstructured context, but in such conditions the innovation is easily driven into a dead-end and the continuity of the process might be lost. The balance between control and freedom and openness and closeness is needed. Chesbrough and Teece (1996) argue that the innovation process and context call for coordinative mechanisms. However, a successful innovation process rise from the recognition of an opportunity in a creative and open-minded working environment where participants in the process are able to transcend their personal as well as organizational boundaries (Leonard & Sensiper, 1998; O'Connor & McDermott, 2004). In terms of van de Ven (1986), the innovation process is a developmental and implementational process in an interactive social context. He claims that the idea development, participants, social interactions, and context need to be considered as central managerial tasks in the innovation process. Recent studies (e.g. Chesbrough, 2003; Lansiti & Levien, 2004; O'Connor & McDermott, 2004; Spencer, 2003; von Krogh et al., 2003) stress that future innovations are dependent on more open and holistic knowledge searching and management practices. Due to that, new innovative approaches are needed in innovation management to facilitate the exploitation of distributed knowledge (Francis et al., 2003; Miller & Morris, 1999).

#### 3.1. Facilitating knowledge sharing

Knowledge sharing in a distributed and open environment is a fragile process and need to be managed and controlled (von Krogh et al., 2001). According to Sawhney and Prandelli (2000), the knowledge sharing environment should be understood as a partially open process where the participants are able to work in a widely inter-connected and loosely managed context. Due to the fact that innovation results from the work by a group of individuals, appropriate management methods are in a central position when carrying out an ongoing innovation process. In our study, the scenario method has been used for the facilitation of an open and creative social context for the innovation process.

According to Roubelat (2000), the scenario process makes it possible to share and exploit knowledge in a goal-oriented and controlled network. The scenario process enables the build-up of an interactive social process where individuals, often *lead users in the industry*, are able to share and reassemble personal knowledge to create a common understanding between the internal and external environment in an organization (Godet, 2000; Schwartz, 1996; van der Heijden et al., 2002; Wack, 1985a,b). In other words, it works as a facilitated and structured context enabling a group of individuals to be intermediaries (or interface) in the interaction between the internal and external

environment (Kulkki & Kosonen, 2001) connecting the participants into a community which involves a number of individuals from different organizations working on the same task under a shared vision. In such a community, individuals have access to a wider organizational knowledge base, the connections become more interactive, and more holistic interpretations are formed (Daft & Weick, 1984; Inkpen, 1996; Malone, 2003; Weick, 1987). In these working communities and among individuals with different organizational experiences and cultures, knowledge bases increase divergent thinking in a dialectic process which drives the creation of innovative new ideas and new knowledge (Bennett, 1998; Leonard & Sensiper, 1998).

During the scenario process, individuals from different organizations perform group working activities in an open but controlled context (Roubelat, 2000). In the scenario process, control means working for a common goal under common rules, and openness means the commonly accepted partnerships under the approval of the process owner (e.g. facilitator, sponsor, organization etc.). The scenario process can be conceptualized in four phases (Phelps et al., 2001): starting from the delimitation of the focus and process to interactive knowledge sharing and creation, and from resulting combinations of new knowledge in the form of scenarios to the implementation of the scenarios (shown in Figure 1).

2. *Acting in a shared and open knowledge group.* The working group has intensive sessions and face-to-face meetings to share their personal knowledge and experiences. During this phase, the working group provides a knowledge sharing context connecting the participants into the inter-organizational network (Schoemaker, 1993). The working group creates a holistic understanding of the current causalities in the environment and links the organizations into it, and determines the main forces that are changing the business environment as well as the key environmental uncertainties, such as the future direction of technology, competitors' behavior, regulation and market risks (Schoemaker, 1991). In this phase, the working group often turns out limited with regard to its knowledge resources and capabilities. The new participants or "visitors" can be invited to bring new knowledge and insights into the process. When prior knowledge has been examined and the stakeholders, driving forces and the required capabilities for future business have been recognized, the working group explores their significance and logical implications (Schwartz, 1996; van der Heijden et al., 2002). At the end of this phase, the common new knowledge is evaluated within the working group and is represented in the form of initial scenarios.

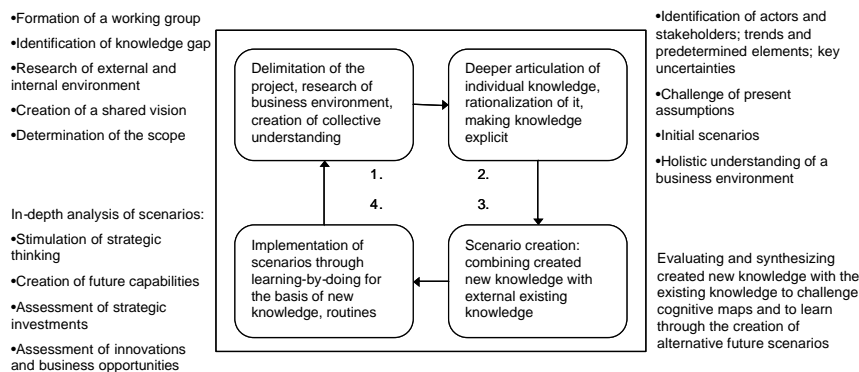


Figure 1. Ongoing scenario process and knowledge creation in the innovation process.

1. *Creation of the knowledge sharing group, background analysis and delimitation of the focus.* The scenario process starts by organizing a working group within the participating organizations by the facilitator of the process (Roubelat, 2000). The working group consists of experts, actors and other stakeholders with multidisciplinary backgrounds who are often *lead users* in the industry (e.g. Kuusi, 1999; Schwartz, 1996; van der Heijden et al., 2002; von Hippel, 1996). They reflect upon the futures of a group, providing new insight and perspectives into the innovation process. In this phase, the shared collective knowledge base, a common language and practicalities for the basis of the scenario process and knowledge creation are provided producing a goal and a shared vision for the scenario process (Godet, 2000).

3. *Scenario creation.* The final alternative scenarios are created through the evaluation and combination of common and shared knowledge on an intuitive, *heuristic* or statistic basis (Masini & Vasquez, 2003; Schoemaker, 1997). The goal is to identify the logic of the business environment which is important and relevant to the issue and the network, and then organize the possible outcomes of the scenarios around this logic (Schoemaker, 1993; van der Heijden et al., 2002). This phase provides alternative scenarios of the future reflecting the visions of the participatory organizations and individuals contributing to the process.

4. *Implementation of scenarios.* The scenarios are the results of the partially open knowledge sharing process. In this sense, the scenario process can be seen as part of an open innovation process providing access to the distributed and scarce knowledge, which can be utilized later in the

individual organizations for their own purpose to benefit from the process and scenarios. Scenarios serve as a platform for the creation of new innovation and business ideas and the assessment of their market potentials (Mason, 2003; Schoemaker, 1992).

### 3.2 Creating value from common knowledge

When innovation is systemic and dependent on knowledge of a wide network of participants, methods to utilize and extract value from the acquired “network” knowledge are needed (Chesbrough, 2003; Sawhney & Prandelli, 2000). Bergquist and Ljungberg (2001) and also Kogut and Metiu (2002) call for mutual reward and utilization mechanisms for the distributed innovations.

Organizations join in an open innovation process only if they are able to benefit from the creativity, diversity, and know how of other members. In other words, if the process is perceived as a win-win situation, the members will contribute to the process. In such processes, participants are often the most advanced organizations and individuals, i.e. *lead users* (von Hippel, 1996), and very protective of their expertise and knowledge. Therefore, extracting value from the open innovation process is often considered a difficult or even impossible task for the members of such process. Making it possible for the participants of the open innovation process to utilize the results of the process in their own business processes, they might be more willing to share their knowledge and expertise with others. In this study, the electronic GDSS was combined with the open knowledge sharing process to make it possible to transfer the results of the open innovation process to the company level.

The electronic GDSS is developed to facilitate the interactive group work for the effective utilization of expertise of a wide variety of actors and to build up a creative and open-minded environment (Elfvingren et al., 2002; Finlay & Marpels, 1992; Gallupe & Cooper, 1993). In our study, the electronic GDSS laboratory at Lappeenranta University of Technology was applied to support the idea generation of selected *lead user* groups (Laaksonen et al., 2001). It allows to disseminate and analyze the knowledge gathered during the open innovation process in a structured way and to select appropriate targets for further innovation development in the companies.

In the electronic GDSS laboratory, the number of the participants is very limited which also enables the control of the knowledge transfer in the open innovation process. Typically, GDSS brainstorming groups consist of 6-10 persons discussing a specific problem. During the electronically supported brainstorming, participants enter ideas on a computer simultaneously and anonymously on a depicted topic. The GDSS reduces the process losses in conventional decision-making, disorganized and unfocused activity, the dominance of any participants and the social pressure to conform, and enables a productive utilization of prior knowledge (Torkkeli & Tuominen, 2002).

During the idea generation process in the electronic GDSS laboratory, the created common knowledge of the open innovation process is exploited and the new innovative product and service ideas are created for the companies. The idea generation in GDSS laboratory allows participants of the open innovation process to perform the GDSS session as an internal process or to continue the open innovation process with present or new participants.

The developed idea generation process consists of seven sequential phases (Figure 2) and begins with a planning meeting and an introduction of the process when the goal and the agenda of the session are defined. The orientation and introduction phase activates the participants into the process. The main part of the process is the idea generation including several separate phases. During idea brainstorming, participants simultaneously generate new innovative ideas around an issue after which the ideas are clarified and specified. Then the generated ideas (approx. 50-70 per one session) are clustered under main categories, and additional information is given on them. When the generated ideas are categorized, they are evaluated and prioritized according to the importance of the future needs in the participating organizations. Prioritization of the ideas is done by the participants in the process i.e. the lead users on the basis of background research and their own expertise. The idea generation session ends with the assessment of the process providing valuable information for the development of the idea generation process and the electronic GDSS. Finally, the most important and promising new innovative ideas for the participants are evaluated and implemented in their business processes.

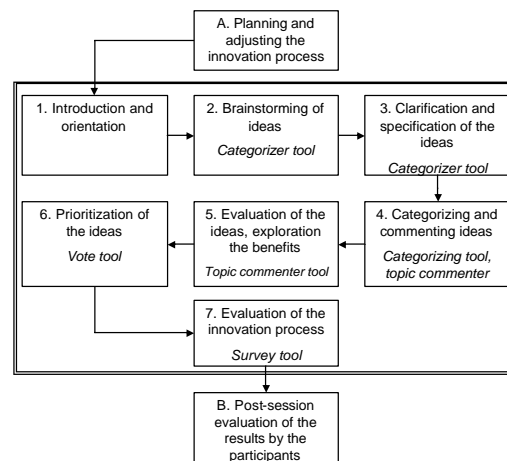


Figure 2. The structure of the idea generation process in the electronic GDSS session (Laaksonen et al., 2001).

## 4. Establishing a controlled open innovation process in the electricity distribution industry

This section introduces the scenario and the electronic GDSS methods in establishing a controlled open innovation process. The innovation process was part of a larger research project aiming at providing new innovative business ideas for the electricity distribution business which is changing

radically due to deregulation in the EU. During the research project, the aim of the scenario process was to create an open knowledge sharing context for the participating companies to reveal the requirements for the future business environment, to identify future business opportunities and to provide four alternative scenarios resulting in a vision for the development of the industry. The scenario process performed as a common knowledge base for idea generation in the electronic GDSS laboratory. Generated innovative business ideas of GDSS sessions were transferred into company-specific processes for constructing prospective innovations, e.g. R&D projects and marketing operations. The phases of the process are illustrated in Figure 3.

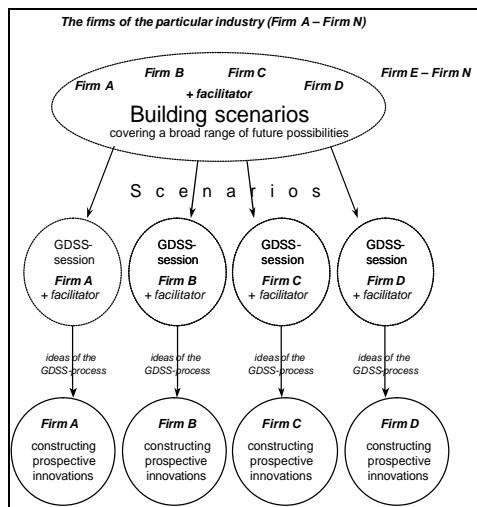


Figure 3. The controlled open innovation process (Firms A–D: members of controlled open innovation network; E–N: outsiders of the network)

The participants in the research project were the global electrical engineering company ABB, the international energy company Fortum, the international telecom company TeliaSonera, two local electrical distribution companies Koillis-Satakunnan Sähkö and Tampereen Sähkölaitos, seven SME software and electrical engineering companies: Eltel Networks, Empower, Enermet, MX Elextrix, Process Vision, Telewice and Wimotec; the National Technology Agency of Finland, Lappeenranta University of Technology and Tampere University of Technology. The research project started in January 2003 and will continue for three years.

#### 4.1. Scenario process and open knowledge sharing

The participants in the research project formed a collaborative knowledge network to share knowledge for the research project. The working group of the scenario process consisted of experts with different backgrounds (electrical engineering, production economics, information technology, business

administration) and enabled a continuous and open sharing of knowledge. Experts acted as facilitators controlling the progress of the innovation process. The company representatives contributed to the scenario process by sharing their knowledge and expertise in periodical project meetings, informal face-to-face meetings and in public seminars. Both parties of the research project – experts and company representatives – built up an open knowledge sharing context where they had access to all the knowledge gathered during the scenario process and affected the performance of the process and other partners through their own acts and contribution.

The scenario process resulted in four alternative future scenarios (Table 1), and on the basis of them the experts recognized the core capability development areas needed in future business environment (Table 2). The results and expertise were available for all the participants of the research project and exploitable for their own business processes. This future-oriented knowledge acted as a platform and prior knowledge for the idea generation process in the electronic GDSS laboratory and made it possible to extract value from the open knowledge sharing process.

Table 1. The basic elements of the future scenarios of the development in the electricity distribution business.

3. Positive regulation	4. Wild West
<ul style="list-style-type: none"> <li>-Integrated regulations in the EU</li> <li>-Local monopolies over networks</li> <li>-Competition legislation</li> <li>-Developing markets in service business</li> <li>-Quality control of electricity by authority</li> <li>-Decreasing prices due to regulative actions</li> </ul>	<ul style="list-style-type: none"> <li>-Unregulated electrical distribution and networks</li> <li>-Effective markets in service business</li> <li>-Investors are active in industry investments</li> <li>-Price and quality differentiation</li> <li>-Quality problems in outlying districts</li> </ul>
1. Basic infrastructure	2. Monopoly business
<ul style="list-style-type: none"> <li>-Undeveloped markets in service business</li> <li>-Local regulation</li> <li>-Decreasing rents</li> <li>-Low R&amp;D intensiveness</li> <li>-Stable and controlled prices</li> </ul>	<ul style="list-style-type: none"> <li>-Unregulated industry and market</li> <li>-Diffusion of companies into conglomerates</li> <li>-Vertical integration of companies</li> <li>-Emergence of local energy co-operatives</li> <li>-Customer segmentations</li> </ul>

Table 2. The key areas of core capability development in electrical engineering and the electricity distribution industry in Finland during the next ten years.

The key areas of core capability development	Importance of capabilities in scenarios (1 = most important and 4 = least important)			
	Scen. 1.	Scen. 2.	Scen. 3.	Scen. 4.
1. Locality of business	1	4	2	3
2. Industry structure	1	2	3	4
3. Ownership of assets	4	1	3	2
4. Return of capital	4	3	2	1
5. Regulative knowledge in market	3	2	1	4
6. Regulative knowledge in rents	2	3	1	4
7. Knowledge in social policy	1	3	2	4
8. Changing customer demand	2	4	1	3
9. Competitiveness of electric energy	3	4	2	1
10. R&D management and automation	4	2	1	3
11. Human resource management	2	4	1	3
12. Environmental legislation	4	1	3	2

#### 4.2. Electronic GDSS and value creation

The open innovation process was continued with the idea generation process. The participants of the research project utilized the shared common knowledge from the scenario process when conducting the electronic GDSS sessions

among the lead users of two companies (an electrical engineering company and an electricity distribution company) as internal brainstorming sessions. During the GDSS session, the lead users generated new innovative product and service ideas for further innovation development in the companies. The generated ideas were discussed in detail and their advantages and disadvantages concerning the issue were evaluated. The evaluated ideas were categorized by grouping ideas with similar characteristics together to make it easier to prioritize them according to their significance to the company, shown in Table 3. The prioritized categories were then analyzed against alternative scenarios and core capability areas to reveal the most promising innovation ideas for future business environment.

Table 3. The prioritized idea categories to create and improve future business operations.

Company A	No. of ideas	Average importance of ideas*
1. Regulative knowledge	9	8,08
2. Human resource management	8	8,00
3. Management of the value chain	10	7,50
4. Innovative technological solutions	13	7,36
5. Service providing operations	16	7,18
6. Exploitation of external services	5	6,74

Company B	No. of ideas	Average importance of ideas*
1. Regulative knowledge	6	8,06
2. Investment and maintenance services	8	8,00
3. New technological solutions	8	7,40
4. Account management services	6	6,98
5. Electricity measurement services (EMS)	12	6,96
6. Internal business intelligence	12	6,70
7. Content development for EMS	12	6,64

\* Scale 1–10, 1=not important; 10=very important

## 5. Discussion and conclusion

In accordance with the overall focus of the research project, the future consequences of the deregulation of the electricity distribution market to the business environment and organizations related to the industry were evaluated and new innovation ideas for the companies were provided. The project also provided new methodological insights for existing innovation management theories and practices, especially into the management of the distributed innovation.

During the scenario process, the working group of experts and company representatives acted in an open knowledge sharing environment providing a plausible vision of the development of the industry for the next ten years based on the scenarios. The idea generation sessions in the GDSS laboratory were conducted by the lead users of the companies on the basis of the scenarios and their personal prior knowledge. Integrating the results of the scenario process and the idea generation sessions made it possible for the companies to benefit from the open innovation process, e.g. in their own R&D development and marketing operations.

The open source movement has shown its effectiveness organizing innovative networks around a common interest and benefiting from creativity and collaboration of a large number of participants (Sawhney & Prandelli, 2000). Despite the many advantages, openness has also potential risks and deficiencies (e.g. lack of coordination, dismissing of rewards and incentives systems) which have to be considered in open innovation processes. The challenge for the management in the open innovation process is to find out appropriate methods and practices for the utilization of external knowledge resources.

This study suggested guidelines for the management of the open innovation process in an inter-organizational context. The scenario approach has been traditionally used for anticipating future development and drawing alternative descriptions of the future. This study demonstrated the usability of the scenario approach as an effective method for establishing a structured and managed process to support the open knowledge sharing in innovation development. During the research project, it also became clear that the scenario process is a successful tool enabling the identification and examination of the industry-specific capabilities and the recognition of the forces behind environmental changes which are important for organizational renewal and the creation of appropriate core capabilities.

The idea generation process conducted in the electronic GDSS laboratory with the lead users was a very promising method for extracting value from the open innovation process. The electronic GDSS offered structured and effective tools for exploiting the results of the open innovation process and participants' prior knowledge and for integrating it with the companies' business processes. During the electronic GDSS sessions, the generated innovation ideas were evaluated against the recognized future requirements and then submitted to the next phase of the innovation process to the companies.

We found that combining two different qualitative approaches – the scenario process and the electronic GDSS process – made it possible to establish an open innovation process in an inter-organizational context during a research project aiming at exploring future innovations. However, more comparative research between the managerial methods and practices is required in order to reveal the optimal methods for the management of open innovation processes in distinctive contexts. In a changing environment, the ability to sense and seize new opportunities (Teece, 2000) and to build and reconfigure knowledge-based assets is crucial to the long-term competitiveness of firms.

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