Knowledge sharing in the open innovation process — Case: Grid computing

Mika Lankila[a],
Jukka-Pekka Bergman[a],
Ari Jantunen[b], and
Juha-Matti Saksa[b]

[a] Technology Business Research Center
Lappeenranta University of Technology, Finland
{mika.lankila, bergman}@lut.fi
[b] Department of Business Administration
Lappeenranta University of Technology, Finland
{ari.jantunen, juha-matti.saksa}@lut.fi

Abstract

The emerging challenges in the operational environment for the companies also demand new approaches to their innovation processes. When adopting the open innovation paradigm, companies can take advantage of technological and market discontinuities by sharing knowledge with other development communities. Grid computing is a real-life example of emerging and potentially disruptive technology, which can change the way we see and use IC technologies today. Technological development and learning take place in a number of collaborative open source initiatives. In order to create new markets for Grid computing and current leading vendors to overcome "the Innovator's dilemma" (Christensen, 1998), substantial knowledge sharing is needed from the development parties in the form of collaboration between research and business communities. This paper tries to bring forth the above mentioned issues through the case example.

Keywords: knowledge sharing; open innovation; grid computing.

Suggested track:

A. Managing organizational knowledge and competence
B. <u>Knowledge creation and innovation, e.g., in R & D</u>
C. Knowledge sharing within and across organizations and cultures e.g., in off-shoring arrangements
D. Micro, meso and macro institutional factors affecting knowledge and learning
E. The relationship between knowledge and power
F. Communities of practice, knowledge networks and networking

G. Practice-based perspectives on knowledge and learning
H. Dynamic capabilities
I. Intangible assets and social, intellectual and cultural capital
J. The relationship between individual, team and organizational learning
K. Leadership and Human Resource Management in knowledge-based organizations
L. The nature of knowledge work and knowledge workers
M. The role of information technology in knowledge management and collaboration
N. The importance of knowledge management in IT design, implementation and use
O. Knowledge and learning issues in the context of global, virtual teams
P. Public service sector approaches to Knowledge Management and Organizational Learning and comparisons with the private sector
Q. Practitioner's Track

1 Introduction

Innovation is always formed in a social system. It is about knowledge sharing and creation in a social context where creative individuals share their knowledge within a group (Leonard & Sensiper, 1998). Innovation is also 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 transfer of knowledge from diverse perspectives. This makes organizations to explore new approaches for creating knowledge and assimilating it into business processes. The source of competitive advantage is related to the capabilities to share, create and utilize new knowledge in a diverged business environment.

Due to the fact that innovations become more knowledge intensive, organizations have recognized the key advantage of collaborative learning, co-operation, and synergy that come from utilizing inter-organizational networks. The challenge of these networks is to manage and develop interpretation of the internal and external environments of firms to capture the future-oriented knowledge (Kulkki & Kosonen, 2001; Scharmer, 2001) that will shape the future business development. In these inter-organizational networks, individuals are able to transcend the traditional organizational as well as individual boundaries to transfer their personal knowledge through social interaction (e.g., Miller et al., 2002; Miller & Morris, 1999; Nonaka & Toyama, 2003).

In the recent innovation and knowledge management literature, the importance of external knowledge sources and utilization of networks in the innovation process have been strongly emphasized (e.g., Caloghirou et al., 2004; Nonaka & Toyama, 2003; Spencer, 2003; von Hippel, 1988). According to Chesbrough (2003), the innovation paradigm has changed fundamentally from a closed innovation system to a more open one. The changing innovation paradigm forces firms to reconfigure their structures and processes. Thus, innovation management also means orchestrating complex social processes as a game (Dougherty & Takacs, 2004) in which interaction between different actors creates new knowledge, and reveals new business opportunities. In their recent study, Grand et al. (2004) argue that the emergence of a new innovation paradigm, e.g., in the software industry, and the involvement in it betoken new philosophy in general towards innovations and innovation processes.

Hence, the core question is: how are organizations able to have access to and to benefit from the collaborative search of knowledge in innovation processes? In our paper, we will review the state of the art of the open innovation paradigm and clarify the dynamics of knowledge sharing in the open innovation process. We explore incentives to share the organizational as well as personal knowledge within an open innovation process. Also, coordination mechanisms that are needed to maintain coherence and continuity of the process are considered. The paper introduces an emerging technology called *Grid computing* as a real-life open innovation process through the inter-organizational “NetGest” research project.

The development process in Grid computing can be seen as an appropriate example of the open innovation process, which combines external knowledge sharing with companies’ internal R&D capabilities and processes. A wide array of the leading ICT companies (e.g., IBM, HP, Sun) along with scientific research institutes are working together in a global scale in order to create a robust technology platform for research use, and also for exploiting new emerging business opportunities. The fundamental question is why the firms would share their knowledge with their competitors in this development process.

The data collection has been conducted during the international research project NetGest (Network Identity, Grid Enabled Services and Trust Networks). The main purpose of the project was to examine Grid computing and its network identity and trust issues for the Finnish computing industry. During the research project, the participants formed an open and collaborate knowledge sharing network to explore the Grid environment, and to create new innovative solutions for computing problems. The research process revealed some problems in the open knowledge sharing process, and found evidence of the need for mutual incentives between the participants to share their knowledge with other members. The research project started in August 2003, and lasted for ten months. It was coordinated by the National Technology Agency of Finland, Helsinki Institute of Physics (Finland/Switzerland), and two university research centers called Technology Business Research Center (Finland), and Wirlab (Finland). The participating companies in the project were an international ICT company, two international data network security companies, and two local telecom operator companies. The research focus is illustrated in Figure 1.

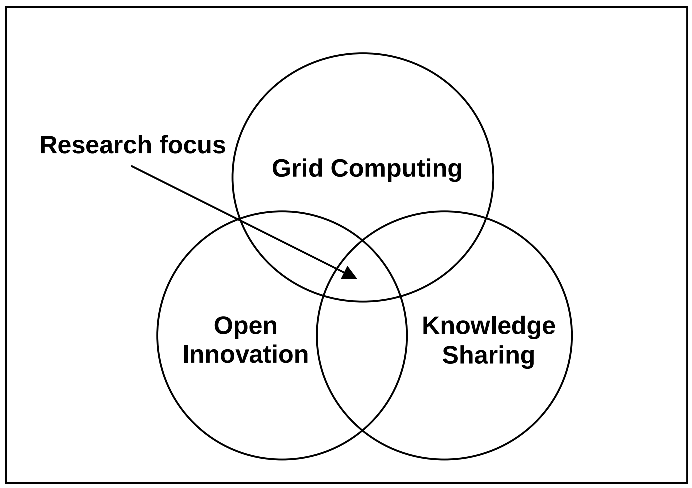

Fig. 1. Research focus.

Due to the fact that the emerging open innovation paradigm will have major effects on organizations, the issues of knowledge creation and sharing as well as coordination mechanisms in collaborative innovation management become increasingly important in the organizational studies. This paper examines these important issues, and discusses future challenges related to the innovation activities.

2 Open innovation paradigm

The 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). According to Chesbrough (2003), the innovation paradigm has changed to an open innovation mode in which utilizing external knowledge sources has a central role and internal R&D is the administration of meta-knowledge about externally available knowledge (Feller, 2004), which objective is to complement and combine internal knowledge with external knowledge. In the open innovation paradigm, firms also use external channels to generate value from their internal ideas and capabilities, and configure their business models to profit from innovations (Chesbrough, 2003). Thus, according to Feller (2004), open innovation can be considered as the least formal way to conduct collaborative R&D. However, successful innovation requires control in the open innovation paradigm, even more than in the closed innovation paradigm, as firms have to reconfigure structures and processes continuously to match with the changing business environment. Thus, innovation management also means orchestrating complex social processes in which interaction between different actors creates new knowledge and reveals new business opportunities.

The importance of connections with external actors is of great concern especially when innovations are systemic. As the divergent technological development will have a strong impact on the whole structure of the computing industry, the new situation opens up opportunities for new types of innovations. When practices and approaches in technological development change, the institutional transformation offers possibilities to develop new ways to operate. As a consequence of behavioral change in organizations, the nature of the products and services provided in the computing business may change. Divergent development stimulates growth in 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. Essential to the success of the open innovation process is that collective activities during the knowledge creation process 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 communities, such as epistemic communities in the sense of Cowan et al. (2000, p. 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.

2.1 Motives to inter-organizational knowledge sharing

Chesbrough (2003) argues that because a set of certain erosion factors, closed innovation model is not applicable in many industries anymore. These erosion factors include the availability and the mobility of highly educated work force, the emergence of venture capital, external options for ideas sitting on the shelf, and the increasing capability of external suppliers. These factors eventually cause the failure of the closed innovation model. In the media, some special cases of open innovation, namely, open source software development projects have sometimes been seen as idealistic endeavors aiming to oppose commercial, private benefit seeking proprietary software developing firms. However, alternative or at least complementary explanations also exist. Is the adoption of open innovation approach driven by benevolence or benefits?

Innovation studies have examined the motives that conduct the behavior of participants in collaborative innovation projects (Bergquist & Ljungberg, 2001; Lerner & Tirole, 2002; Hertel et al., 2003; Lakhani & von Hippel, 2003). The participants attain compensation from their contribution to the development, and these returns can be, for example, learning and experience. Many of these benefits depend on belonging to the developing community (von Krogh, 2003). The issue of incentives to participate in an open innovation process should not be ignored. Feller (2004) claims that collaboration of organizations in R&D processes involves both endogenous and exogenous motives. Hagedoorn and Schakenraad (1989, ref. Pyka, 2002) list the incentive-based and knowledge-based motives of firms participating in innovation networks:

- high costs and risks of R&D in high tech industries;
- quick pre-emption strategies on a world-scale despite a ‘loss’ of potential monopoly profit;
- shortening of time-to-market;
- exploration of new markets and market niches;
- technology transfer and complementary technological assets; and
- screening the evolution of technologies and opportunities.

Kogut and Metiu (2002) explain the existence of certain open innovation solutions by proposing that in some situations the open innovation model offers more benefits at less cost and risk than the closed innovation model. Furthermore, without openness some useful knowledge may never be created. Thus, in the economic sense, openness is often just the most effective way to operate when developing large-scale, systemic and radical innovation (Feller, 2004). Thus, co-opetition, i.e. co-operation while competing, has increased widely in high-tech industries (Nalebuff & Brandenburger, 1997).

In accordance with Spencer (2003), we propose that by sharing their knowledge within the open innovation process, companies can learn and influence other organizations' research as well. By sharing knowledge and being a member of such a knowledge sharing process, the firm can influence both technological and evaluation standards in an emerging industry, which in turn will lead to development that favors the firm. In addition, the active participation of companies increases when having a critical mass of competitors on the same technological trajectory.

2.2 Knowledge sharing and management

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). As Leonard and Sensiper (1998) argue, 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 the emerging contradictions facing the organization. Organizational as well as individual boundaries can be seen as catalysts on one hand, and constraints on the other hand in this dynamic interaction. Grand et al. (2004) point out that bypassing these boundaries, new knowledge and innovations can be created.

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), when 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.

Dougherty and Takacs (2004) have noticed that the innovation activities in such a context also need to be organized wilfully and purposefully to meet the goal. Such communities should act as a shared context where participants, i.e. individuals and organizations, can work in an open as well as open-minded 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. Despite the freedom of participants, such open innovation communities are also very often controlled by someone. Several studies (see, e.g., Bergquist & Ljungberg, 2001; von Krogh et al., 2003) agree with the importance of the process control arguing that open innovation communities are working under a shared and often very loose idea or vision. Due to the fact that the creative processes, as innovation processes, are very fragile and sensitive to interruptions, such processes bring more and better value for the participants if they are facilitated and controlled (Osborn, 1963). The fragmentation of knowledge increases the need for control and coordination in divergent innovation process.

To establish an open knowledge sharing innovation process requires appropriate methods and practices, in other words, a medium to support innovative activities. Chesbrough and Teece (1996) argue that open and networked innovation processes need to be controlled and carefully 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. Due to that, a successful innovation can be created through heedful collective activities (Dougherty & Takacs, 2004). To make an open innovation process work and to exploit the advantages of such conditions, managerial intervention 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 process, and to utilize them in their own business processes, e.g., in the form of new products, services, and new knowledge, or through intellectual property right (Pisano, 1990; Shapiro & Varian, 1999; Hurmelinna et al., 2004).

According to Judge et al. (1997), the increasing demand for openness in innovation processes leads us to a dilemma: 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 deadend, and the continuity of the process might be lost. The balance between control and freedom as well as between openness and closeness is needed. A successful innovation process rises 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). The open innovation phenomenon can also be seen to address the managerial problems of exploitative and explorative innovations presented by Benner and Tushman (2003) by providing an explanation for better responsiveness to new requirements in a changing business environment. 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). Dougherty and Takacs (2004) argue that the central idea of the innovation process is to manage it as a game, and allow the participants heedfully interrelate through team play, i.e., through the open innovation process with a shared goal. When creating new knowledge, the balance between the exploration and exploitation is essential (Boisot & MacMillan, 2004; Benner & Tushman, 2003). Acquiring knowledge from divergent sources decreases the ability to respond to new knowledge, and the acquired knowledge becomes useless, even if it would be valuable and exploitable for the development of the innovation.

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 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 to 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). In our case study, the participating organizations engage in the process managed essentially by open innovation logic. Thus, our example of the innovation process contains collaborative open knowledge creation activities, and somewhat more closed internal knowledge exploitation activities.

3 Grid computing

Grid computing is one of the great promises of IC technologies in the future. Grid enables users to collaborate securely by sharing geographically remote processing, applications and data resources across the computing systems (Grimshaw et al., 2003). Berman et al. (2003, p. 9) describe Grid as "the computing and data management infrastructure that will provide the electronic underpinning for a global society in business, government, research, science and entertainment". This Grid infrastructure will provide "the ability to dynamically link together resources to support the execution of large-scale, resource-intensive and distributed applications" (Berman et al., 2003, p. 9). This resource sharing is done via a set of additional protocols and services that are built on the Internet protocols and services (Foster et al., 2003).

From the end-user perspective, research and business communities have different motivations and reasons for developing and using Grid computing. The development of the technological infrastructure can be seen to be in line with the laws of Moore (1965) in computing and Gilder (2002) in networks, but this is simply not enough to keep up with the demand. Science is becoming increasingly complex, and the need for computing power is today one of the biggest obstacles on the way to better results (Berman et al., 2003; Foster et al., 2003). In addition, research is conducted often in wide collaboration networks, because the scientific problems need larger resources. Due to these issues, researchers are waiting this new paradigm of computing to become reality. The Grid approach is seen as a new way to accelerate the technological progress by enhancing knowledge sharing, and to respond to this demand.

In business use, Grid computing is not only sheer computing power. Today's operating environments must be more resilient, flexible and integrated than ever before, and furthermore, end-user companies are interested more in enhancing their competitive advantage: improving productivity and achieving substantial cost reductions. The use of Grid-type networks is also attractive because of its inherent openness. It allows businesses, their suppliers, and consumers to interact freely. Distributed and flexible architecture also allows resources to be combined and used in novel ways, encouraging innovation and enhancing capabilities (McKnight et al., 2003).

Numerous Grid technologies are being developed concurrently all over the world in dynamic virtual organizations (Foster et al., 2003). Major players in the industry, such as IBM, HP and Sun, have been very active in the development process and participated in as well as contributed to many inter-organizational co-operation initiatives, for instance alliances, together with universities and other research communities (see, e.g., Berman et al., 2003). The development process relies strongly on the idea of *open source* approach (Weber, 2004), and, more broadly from the organizational perspective, on open innovation logic. Although the actual development of the Grid technologies is done in a number of different projects all over the world following open innovation principles, certain instances co-ordinate the development and especially the standardization process to avoid possible interoperability problems. The Global Grid Forum (GGF) is a “community-initiated forum of thousands of individuals from the industry and research leading the global standardization effort for Grid computing” (The Global Grid Forum, 2004, Overview section). The forum coordinates different development ambitions of firms and research, and steers the development process in the wanted direction to create reliable open source software. These achieved results can be utilized in the internal development by any participating member (The Global Grid Forum, 2004, Overview section).

Compared to the development of various other technologies, there is an exceptionally strong consensus both in the business and research communities on how the Grid technologies should be developed, and standardization process, among others, is well underway (see, e.g., Global Grid Forum, 2004). The idea of open innovation poses an interesting point of view to Grid computing as well. Engrossing questions can be formulated from this perspective:

- Why are the leading ICT service vendors willing to share openly their knowledge of Grid computing?
- Is it critical to organizations to adopt the open innovation paradigm in order to prosper in the emerging Grid computing industry?

3.1 Grid computing as a radical innovation

Tidd et al. (2001) state that ICT as a whole is a transformative innovation for the whole society and the environment. Grid computing has the potential to be part of that major transformation. Although Grid computing has analogies with extensively used technologies as the Internet or power-distribution network (Foster et al., 2003), it is still a long way from having an impact of the same extent on people’s lives. But in the long term, the potential is substantial, although from the “pure” technological point of view Grid computing can be seen as a natural part of technological evolution as an extension of distributed computing. Technologically, the impact will not manifest itself so much in new machines or devices, but in the way the current devices are managed and used.

As Anderson and Tushman (1991) state, an industry evolves through a succession of technology cycles, which start with *technological discontinuity*. They can be competence-destroying, i.e., *disruptive*, or competence-enhancing. Disruptive technologies desolate existing know-how, which makes the mastery of the old technology useless. If this new paradigm, a vision of Grid computing becomes reality, it changes the way we see and use computers today. It will change the way the distributed computing resources are managed and transforms the conception of computing power from product to *service*. Companies do not need to buy a set of hardware to get required computing capacity; instead they can fulfil the same need with utility based service. Thus, it is a new way of understanding and managing already pervasive computing technologies (e.g. Internet and PCs). This would mean a marketing discontinuity in both macro and micro level fulfilling the criteria of radical innovation by Garcia and Calantone (2002).

Because of Grid computing ICT industry vendors may well see remarkable impact and a transformation in a way they serve their customers and how these services are produced. From the viewpoint of vendors and some end users (especially business users who can improve their own processes with Grid computing as well, such as finance companies) it is perceived as a radical innovation. When comparing to the definition of Day and Schoemaker (2000), Grid computing is definitely emerging technology with great uncertainty, complexity and paradigm shift relating inherently to it. In Figure 2 the change in computing is illustrated in the innovation space (Tidd et al., 2001).

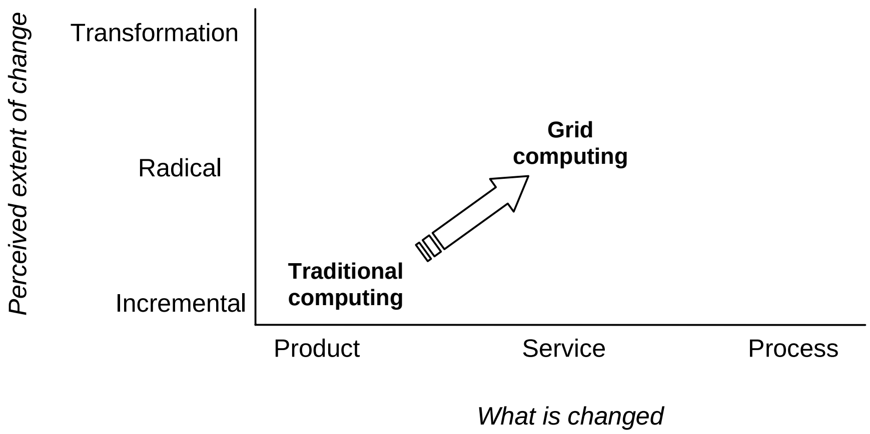

Fig. 2. The change of computing (Adapted from Tidd et al., 2001).

3.2 Motives and incentives to open innovation in Grid environment

Because of the inherent commercial potential and disruptive nature of Grid, ICT vendors want to be in the forefront of this emerging technology. We argue that the best way to achieve this goal is to adopt the open innovation approach and to share knowledge in collaboration projects, organizations, and even between individuals in order to acquire useful external knowledge. Many times in the emergence of radical and potentially disruptive innovation such as Grid computing now, established companies have suffered from “the innovator’s dilemma” when the rules of the game or the game itself have changed (Christensen, 1997). Several authors (e.g. Chesbrough, 2003; Miller & Morris 1999; Christensen & Raynor, 2003) have written about surviving these challenges by changing the innovation processes more open and collaborative, thus, adapting better to changes in the company’s operational environment.

One organization cannot develop all the needed complex and ambiguous Grid technologies alone. Without knowledge sharing and collaboration there would be no standardization process and not enough technological competence to create robust value adding services, i.e., there would be no Grid business at all! The possibility to shape the emerging industry and influence on both technological and evaluation standards increases knowledge sharing and learning as well. In addition, the active participation of companies increases when having a critical mass of competitors on the same technological trajectory (Spencer, 2003).

The major Grid vendor IBM is a good example of company with the emphasis on open innovation. They state that they “have expanded their ground to include challenging ideas from their colleagues in academic and government research centers as well as from their clients” (IBM Research, 2004, Innovation section). In general in the development of Grid computing, big players are awake this time and open innovation paradigm is already adopted by many leading Grid vendors. They all are active participants in different development projects and alliances. Their innovation processes as well as structures are developed to enhance the knowledge sharing and learning. For example, IBM pledged open access to key innovations covered by 500 software patents to people and groups working on open source software and their Grid-relating research is publicly available (IBM, 2005). Sun also granted global open source community access to more than 1600 patents. In addition, Sun has developed External Research Office, which is responsible of administrating the metadata of external knowledge (Sun Microsystems, 2005, R&D section).

3.3 “NetGest” - a Grid project: the window to open innovation project

The main purpose of the international and inter-organizational NetGest (Network Identity, Grid Enabled Services and Trust Networks) -project was to examine the Grid computing and its network identity as well as trust issues for the Finnish computing industry. During the research project, the participants formed an open and collaborative knowledge sharing network to explore the Grid environment and create new innovative solutions for the computing problems. The research project was coordinated by three university research centres. The participating companies in the project were an international ICT company, two international data network security companies and two local telecom operator companies. The research project lasted for ten months.

The opportunity for open knowledge sharing with the other companies and research organizations in the industry was the strongest reason to participate in the project. If we compare the achieved benefits of the project to the list of the motives for firms to participate in innovation networks (Hagedoorn & Schakenraad, 1989, ref. Pyka, 2002), we can identify that gained benefits are clearly knowledge-based, while the incentive-based benefits were not experienced (Table 1).

Table 1. Comparing the motives for participation and the realized benefits of the participation.

Motives for companies to participate in innovation networks (Hagedoorn & Schakenraad, 1989, ref. Pyka, 2002)	**Realized benefits of the participation**
High costs and risks of R&D in high tech industries	National Technology Agency of Finland funded most of the project, thus, offering affordable way for participants to learn about Grid
Quick pre-emption strategies on a world-scale despite a ‘loss’ of potential monopoly profit	No clear/direct benefit
Shortening of time-to-market	No clear/direct benefit
Exploration of new markets and market niches	Scenario analysis revealed some interesting issues relating to the Grid markets in the future
Technology transfer and complementary technological assets	Inter-organizational teams shared actively knowledge across the organizational boundaries
Screening the evolution of technologies and opportunities.	The future vision of Grid computing and forecasts of the its future potential were studied with using the scenario analysis

The project consisted of three inter-organizational sub-projects which were oriented to technological development and one sub-project oriented to business implications through open and collaborative knowledge sharing. The business sub-project consisted of the analysis of the technological nature of Grid and scenario analysis of the future of Grid computing. The common vision of the development was achieved during the scenario process.

Project was coordinated by one research institute, although all the development work was done in inter-organizational project groups. To support knowledge sharing, NetGest-project organization exploited Wiki environment, which is a Web site that can be quickly edited by its users with simple formatting rules in order to provide collaborative discussions. All the documents and ideas of different parties were shared in Wiki to be freely accessed by anyone in the project.

4 Discussion and conclusion

The research project revealed several central issues in the open knowledge sharing process, and found evidence of the need for mutual incentives between the participants to share their knowledge with other members. In the NetGest project, on the basis of the scenario process, the working group of experts and company representatives acted in an open knowledge sharing environment providing a shared vision of the development of the industry for the next ten years. The project offered a good example and opportunity to examine and assess the Grid development project from an open innovation perspective. It also provided new insights for existing innovation management theories and practices, especially into the management of the distributed innovation. It strongly seems that in order to firms to innovate, to share knowledge and most of all, to compete successfully in the Grid environment, they have to adopt the open innovation approach to company's own R&D processes.

Establishing and organizing innovative networks according to open innovation principles around a common interest has shown its effectiveness in the collaboration of numerous participants (Sawhney & Prandelli, 2000; Weber, 2004). Despite the many advantages, openness also has potential risks and deficiencies (e.g., lack of adequate coordination, dismissing of rewards and incentives systems) which have to be considered in open innovation processes.

To summarize, this study made it possible to understand the phenomenon of the open innovation, and suggested guidelines for the analysis and management of the collaborative innovation process, although the theoretical basis of open innovation needs to be deepened. However, more comparative research between managerial methods and practices is required in order to find out the appropriate methods for the management of open innovation processes in different contexts. The Grid development has a number of characteristics of the open innovation phenomenon. Recognition of similar characteristics in other innovation projects helps to identify the central issues that have to be considered when managing systemic and distributed innovation processes.

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