Innovation and knowledge accumulation– an intellectual property rights perspective

Kira Lopperi, [a]
Aura Soininen [a]

[a] Department of Business Administration,
Lappeenranta University of Technology, Finland
kira.lopperi@lut.fi
aura.soininen@lut.fi

Abstract

In the recent years, a good deal of attention devoted to the emergence of the "knowledge economy". The rapid pace of development in today's technology-driven economic environment has resulted in specialized knowledge becoming a very short-term resource. Companies cannot alone master the development and commercialization of complex and evolving technologies. The different forms of enabling knowledge creation within the firm without sacrificing the collective effort will be discussed. This knowledge accumulation is especially important for radical technologies. We will analyze the distribution of knowledge and discuss how legal tools, patents in particular, can be utilized in the context of the different innovation types in the ICT sector.

Keywords: Innovation, knowledge accumulation, patents

Suggested track: A Managing organizational knowledge and competence

1. Introduction

Knowledge does not want to be free or owned- instead, it is people and institutions that want knowledge and the property rights around it to be structured in a particular way. From idea generation to commercializing new technology knowledge accumulates and fluctuates from tacit to explicit. Early economists of innovation and technological change (see e.g. Nelson (1959) and Nordhaus (1969) identified three locations where innovation takes place: in non-profit institutions, in profit-seeking firms, and in the mind of individual inventors. Allen (1983) proposed a fourth location, namely the collection of firms whose interactions would produce "collective inventions" that arise from the exchange and free circulation of knowledge within groups rather than in the inventive efforts of particular firms or individuals. Innovation can be seen as strategic e.g. Dewar (1986), Dosi (1982) or as a social learning process e.g Grant (1996), Huber (1991), Powell (1996). The open innovation process offers a framework for integrating the imperfect mix of informal coordination mechanism, implicit and explicit knowledge, along with some formal governance structures. (Chesbrough Henry W. 2003) Technology, much like knowledge is cumulative in nature – accumulation of technological capabilities based on the existing knowledge rather than clear-cut destruction and displacement. The type of technology and the knowledge embedded influence how companies can best benefit from protecting their inventions from imitation. Patents, for instance, provide them with a right to prevent others from utilizing the patented, new and non-obvious, invention. Of course, knowledge as such cannot be protected by legislative means, not even by patents, and in general, preventing others from making use of inventions is difficult: If one learns about an invention, he is able to manufacture and use it and his use does not diminish others' ability to utilize the same invention (Teece David J. 1986). The traditional view of basing a company's competitive advantage on those resources controlled by that company applied to patents is no longer regarded as the only viable option. The long-established way has been to capture all the rights and use them in order to exclude others. The new trend is toward transactional purposes meaning revenue and resources via cross licensing, joint ventures, collaborative R&D and strategic alliances. Intellectual property rights can facilitate knowledge and technology transfer and diffusion. This study will look at companies both in Finland and in the US in the ICT sector.

The originality of this research paper lies in the combination of three perspectives: the nature of technology and knowledge, innovation and knowledge accumulation, and patents. The paper is founded on academic literature as well as empirical research data.

The empirical research data consists of material collected by interviewing representatives of 27 ICT companies. The interviews were conducted in two sets. The interview data consisting of 19 Finnish ICT companies was collected by Aura Soininen in Spring 2003. The summary of the interview results has been published in 2003. The interviews of 8 ICT companies residing in the Bay Area, US, were conducted in cooperation with Pia Hurmelinna in Autumn 2004. These interview results have not been previously reported.

The first set of interviews focused on Finnish ICT companies' patent strategies, but the second set of interviews was broader and it related to ICT companies' (US) innovation models, patent and licensing practices. The questions asked from companies' representatives during the interviews were open-ended. Quantitative results were not a desired goal. The Finnish companies interviewed differed in size as well as in the particular field they competed within the ICT sector. In total, the interviewed companies offered software products and related services, equipment and/or communications and logistic services to a wide range of clients. The amount of patents and pending patent applications varied from 0 to over 7000. Five of the U.S. companies interviewed were global ICT companies that provided software and hardware products as well as services to a variety of clients in order to make communication and networking easier. Two of the companies provided digital entertainment products, and one of them delivered secure access and managed network solutions to its clients. Unlike the other seven companies this company had no patents and it did not operate globally but its main operation area was in North America. All the other companies had large or medium sized patent portfolios.

2. The nature of technology and knowledge

Technology can refer to processes that transform labor, capital, materials, and information in to products or services, sets of operations, skills and activities, and tools, techniques, products or processes, or methods (Kelley Donna J. et al. 2002). We equate technology with knowledge that is applied. We maintain that by analyzing the different types of technologies and relating this to the innovation patterns it is possible to find the most appropriate ways to distribute and share knowledge. It can be argued that technological opportunities are generated in a fundamentally important and inexhaustible way through the combination and recombination of various technologies, new as well as old. (Granstrand O. 1998) Tushman and Andersen (1986) add by making a distinction between competence-destroying and competence-enhancing technological innovations. This leads us to conclude that the innovation process is highly dependent on the knowledge accumulation and learning processes in the organization. The terms invention and innovation should be distinguished. Invention is the first occurrence of an idea; while innovation has also a market orientation (the invention will be developed further and brought to the market). Inventions are traditionally associated with R&D carried out in universities while innovations occur mostly in firms. (Fagerberg Jan, 04)

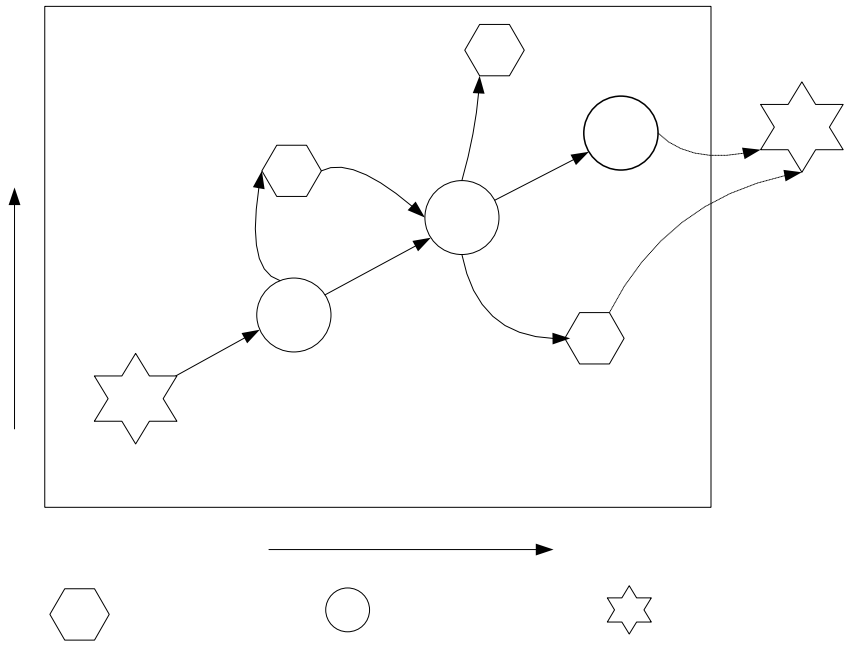

Figure 1. Technology trajectories

Figure 1 illustrates how innovations evolve in time. Kash and Rycroft (2001) state that innovations of complex technologies arise from the context that conditions them. Therefore precise boundaries between the patterns are frequently difficult to draw. There is a continuum of innovations that range from incremental to radical. An innovations placement on this continuum depends upon perceptions of those familiar with the degree of departure of the innovation from the state of knowledge prior to its introduction. (Dewar Robert D. et al. 1986) In time the performance and utility of the incremental technology increase. However rarely the technology trajectory follows a straight line. New trajectories with a series of feedback and feed forward loops arise (a). The new technology may be developed but it may not be applicable to the company or the knowledge embedded is tacit and may inhibit transfer to an outside party (b). Also the turbulence of the industry may also prompt the company to prepare for future developments. In the case of a new technology evolving to a radical technology the best possible way to exploit the technology is not evident as radical innovations produce fundamental changes in the activities of an organization and produce clear departures from existing practices (c). However returns from exploration are systematically less certain, more remote in time, and organizationally more distant from the locus of action and adoption (March James G. 1991). Few of these ideas will be adopted unless the organization has the internal knowledge resources (complexity and knowledge depth) to interpret and absorb them (Dewar Robert D. & Dutton Jane E.1986), (Cohen Wesley M. et al. 1990)

Technological knowledge involves various degrees of specifity, tacitness, complexity, and interdependence. The more specific, tacit, complex, and interdependent the knowledge is, the harder it is to share and transfer. (Chang Yuan-Chieh et al. 2004b) A *radical innovation* is a product or a service that requires substantially different technology and marketing skills compared with existing products in the industry. The emphasis is on technology that results in a new market infrastructure (Hamel (2000), Garcia et al. (2002), O´Connor et al. (2001). Christensen (1997) has defined technologies in relation to customer needs. *Sustaining technologies* foster improved performance of existing products or services. *Disruptive technologies* may lead to worse product performance for mainstream customers, even though the radical innovation often embodies a new and improved value

proposition for rapidly growing segments of non-mainstream customers. There is also a distinction between systematic and autonomous innovation. Chesbrough et al. (1996) argue that *autonomous* innovations may be pursued independently from other innovations whereas *systemic* innovations require information sharing and coordinated adjustment throughout the entire product system. To commercialize an innovation profitably, a tremendous amount of information from different industry players and customers must be gathered and understood. This task is easier when information is explicit. Tacit knowledge on the other hand is implicitly grasped and used but has not been fully articulated. Part of the tacit as well as codified knowledge can be captured so that only a limited amount of people is able to find out and/or apply that knowledge. Patents, copyrights, trade secrets and contracts can be mentioned as such means. They make it possible that knowledge created and applied within a company stays proprietary. This is particularly important in fields where R&D costs are high but the end-results are easy and inexpensive to copy.

3. Innovation and knowledge accumulation

According to Powell et al. (1996) two rather different strands of thinking about collaboration and learning can be identified. One approach is largely strategic (e.g. Teece (1986), Williamson (1991). In this case to pool resources with another organization depends on calculations involving risk versus return. According to an alternative argument, learning is a social construction process. (Brown John Seely et al. 1991). According to Mody (1993) learning is a key motive for cooperation. It can be argued that individual learning is inseparable from collective learning. The insight accumulated is not a private substance, but socially constructed and distributed. This emphasizes knowledge sharing and fostering learning at different levels of dissemination, going from individuals to groups to the whole organization or even the inter-organizational system.

Collective invention relies on the exchange and free circulation of knowledge within groups rather in the inventive efforts of particular firms or individuals. (Cowan R. et al. 2003) The capability to identify, expand, and exploit business opportunities are crucial in order to transform an industrial network into an open innovation network. (Chang Yuan-Chieh et al. 2004a, p.21) The key is widespread socialization of knowledge via collective investments.

Linux may well become the emblem of this type of knowledge economy. Here the market is not the dominant form of coordination- instead co-operation is. (Boyer Robert 2001)

The following figure 2 merges the different viewpoints and makes it easier for companies to identify the key aspects of their knowledge accumulation process. The term complexity is used to describe the factors affected by the nature of technology and knowledge. The essence of exploitation is the refinement and extension of existing competences, technologies, and paradigms. Its returns are positive, proximate, and predictable. The essence of exploration on the other hand is experimentation with new alternatives. Its returns are uncertain, distant, and often negative. (March James G.1991, p.85) Knowledge extraction and capture are related to exploitation whereas knowledge integration and creation are more uncertain and may not seem profitable in the short term. The openness describes the degree of cooperation and learning from outside parties. Interaction has two aspects: one to jointly produce knowledge among partners, the other to cooperate and/or compete for knowledge exploitation (Powell W. 1998)

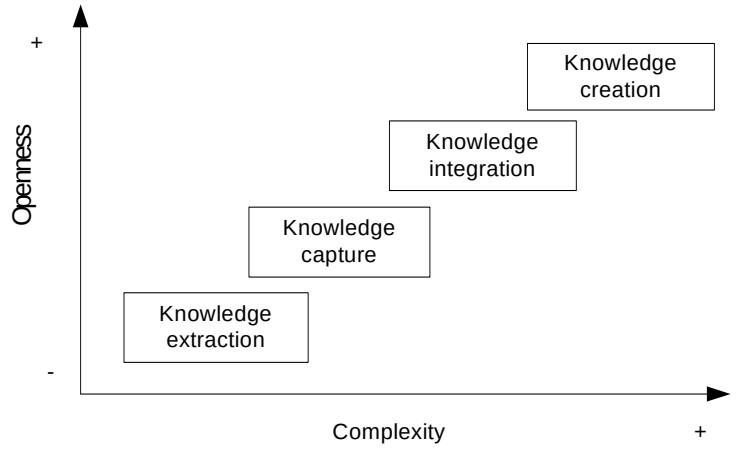

Figure 2. Focus of innovation

Knowledge extraction involves pushing the performance of current technologies further. The focus is on the internal capabilities of the company and on the incremental value the technologies can bring. The focus is on research on need to know basis, where questions

are to be answered according to the existing knowledge. The innovation does not requite complementary assets to enable to functionality of innovation. Individuals and groups within the organization prioritize improvement and may transfer knowledge among different product innovation processes/projects. People make knowledge explicit and communicate experience between different innovation processes and projects. In *knowledge capture* the research scope has extended to include a few trusted external sources, but the cooperation is focused on problem solving rather than looking for new solutions. Employees consider experimentation and learning to develop the knowledge base. Individuals abstract knowledge from experience and generalize for the application for new processes. There is a need to pay attention at balancing short-term objectives with the need for developing and diffusing knowledge for the overall organization. Individuals need to start making knowledge available to others by incorporating it to vehicles such as databases, technology standards that can be widely disseminated and retained over time.
In *knowledge integration* when outside knowledge is integrated within the company new learning occurs. The learning shifts to a more extended role throughout the organization. This may be due to new technologies that arise to compliment the incremental technologies. The company may also act as a complementor to someone's radical technology. People have spare resources that can be devoted to activities that are explicitly aimed at developing knowledge or testing new solutions. Company needs to have managerial and cultural awareness of knowledge transfer and integration to enable transformation of innovation into the best commercial opportunities. More complex and uncertain technologies require knowledge sharing and cooperation with outside parties. In *knowledge creation* risks are higher as radical innovations do not have established markets and present huge risks for the organization involved. The weak customer hold makes it difficult to establish market position as marketing activities tend to revolve around the characteristics of innovation. The explicit knowledge (for example patents) may help in bridging the gap from R&D to commercialisation.

4. Patent strategies in the ICT sector in the US and Europe

Legal issues go hand in hand with business decisions and they must be taken into consideration as early as possible in the innovation processes. In this chapter, we will discuss how the nature of technology and knowledge as well as the knowledge

accumulation process is and should be reflected in patent strategies. We will begin our glimpse to ICT companies' patent strategies by presenting the division of patent strategies into offensive, defensive, and transactional patent strategies as well as to "no patents" strategy. We have not, however, regarded this often used distinction sufficient for the purposes of this paper as it discusses mainly how companies utilize patents in their businesses and how they react to patent infringements, while the patent application process is largely left aside. This is natural taken into account that patenting strategies are not necessarily closely tied to the intended use of patents: Whatever the use of a patent is, in the end, good and valid patents that read on someone's revenue stream are the desirable goal. Also, the function of patents may be different at different times. Consequently, after presenting the strategy division that is largely based on the use of patents, we will focus on the patenting process and discuss how the division e.g. into radical, new and incremental technologies explained in Chapter 2 is reflected in the patent landscape. In addition, we will take a look at the knowledge accumulation process and patents from the viewpoint of an R&D intensive company.

4.1 Overview of patent strategies

The term "patent strategy" refers to those long-term goals companies have set for their patent activities and the implementation of these goals. Hence, patent strategy includes rewarding employees for patent disclosures, and thus, encouraging their inventiveness. It includes filing and acquiring patents, making use of them in business *e.g.* blocking others from using a technology, licensing technology and patents, as well as enhancing company's reputation. Enforcing patent rights and giving up those patents, which are no longer useful is part of patent strategy too. (see e.g. Somaya (2002)) Naturally, patent strategy goes hand in hand especially with company's IPR and technology strategies, and it should, at least in theory, be in line with company's business strategy. (Knight 2001) In practice, though, based on the interviews, patent strategy is not necessarily very closely tied to company's business strategy. How tight the relationship is depends on the importance of patents in company's operations. (Soininen (2003)

In academic literature patent strategies are often divided into two categories: offensive, and defensive patent strategies (e.g. Rahnasto (2001), Granstrand 1999), and some have

added a transactional patent strategy as a separate category (e.g. Showalter & Baxter, (1999). Offensive patent strategy refers to utilization of patents in order to generate direct revenues to a company. The offensive patent strategy includes active utilization of patents in order to prevent other companies from imitating company's products and processes, and thus protecting its competitive advantage based typically on differentiation. In addition, offensive use of patents includes using patents for generating licensing revenues. The latter has become rather common in the ICT industry, particularly among US-based companies. Therefore the enforcer does not necessarily require that the alleged infringer stops using the patented invention but offers a license. It is not, however, only companies that seek extra revenues in addition to those revenues that accrue from their products that are interested in improving their licensing programs. Companies that base their operations entirely on technology/patent licensing have emerged. Some of these companies actually have their own R&D department, but some, so called patent trolls, merely acquire interesting patents, typically from bankrupt firms, and claim infringement. (Soininen (2005)

Defensive patent strategy refers to the utilization of patents for guaranteeing company's freedom to operate and innovate in certain markets. Patents are acquired and used for achieving more leverage against potential infringement claims. The hope is that a strong patent position would influence other companies not to claim patent infringement. Then again if it is claimed that a company infringes on someone's patents, a large patent portfolio may give that company an opportunity to offer something in return. Defensive patent strategy has become essential particularly in the US where the amount of granted and applied patents is constantly rising, and many companies use patents offensively. In addition, in the ICT sector, companies are often dependent on other companies' patents due to the fact that products typically involve multiple patented inventions. (Soininen 2005, Rivette & Kline (1999) According to the interviewed US companies, in the ICT sector, it is impossible to be aware of all the filed and granted patents so that a company could be sure that it does not infringe on anyone's patents. Defensive patent strategy is not, however, vital against pure patent licensing companies. They do not manufacture any products themselves and do not therefore infringe on anyone's patents. (Rice (2003) The scene is somewhat different in Finland where software companies in particular do not file for patents and most ICT companies do not utilize patents offensively. Therefore acquiring patents for defensive purposes appears to many as a waste of company's resources. (Soininen 2003)

Transactional patent strategy refers to the utilization of patents in order to attract financing. It is namely important for investors and potential buyers so that a company they invest in or acquire has a defendable position in the market place. (Showalter & Baxter, 1999, Miele (2000) A patent portfolio may also be needed for partnering and thus acquiring resources to the firm. In addition, patents, which are public documents, affect the ways companies are able to negotiate: Patent holders' are able to discuss their technology more openly than companies that rely merely on trade secrets. The possibility for open discussion is an advantage because many companies are not willing to write non-disclosure agreements (NDA) early on in the negotiation process. This is because NDA's could restrict their ability to utilize their own inventions. (Miele 2000, Soininen 2003) Typically, transactional patent strategy is considered as a strategy for small, start-up firms. However, also large companies may use patents to enhance their image as an innovative company.

In practice patent strategy is company-specific and fits seldom in only one category. Nevertheless, companies' patent strategies can be characterized as being more offensive, more defensive, more active, more passive, more adaptive or more static than other companies' patent strategies. The goal is to use patents so that company's competitive advantage is enhanced. Patents may be a part of company's risk management too. In essence, patent strategy is about getting more money or saving money. It is not required that a company has patents for it to have a patent strategy. A company may, for example, decide not to file for patents, but rather publish its inventions or protect them in other ways and save money compared to a strategy where money is sunk in unutilized patents (Soininen, 2005, Miele, 2000). These resources may rather be invested in R&D. Companies may rely e.g. on trade secrecy or, in case of software, on copyright protection to protect their innovations. Especially European IT companies appear to be accustomed to dealing with copyright protection, which forms the basis for their contracts and other practices. (Soininen 2003, Blind et al. (2001) In addition, instead of building a patent portfolio, a company may need a strategy for diminishing the risk of infringing on others' patents and avoiding the costs involved. This may include paying attention to contract and insurance practices, and potentially publishing company's inventions. The approach can be called "no patents" strategy. In a way, "no patents" strategy is part of all the other patent strategies. Companies make negative decisions *e.g.* about applying for patents, licensing

and asserting them. In fact, the success and popularity of the open source model may very well diminish the attractiveness of proprietary strategies in the future. (Soininen 2005)

4.2 Different types of innovations, knowledge accumulation and patents

On the one hand patents can be utilized in order to maintain the control over the use of company's technology, but on the other hand, patents can be used for acquiring resources to a company. Both of these functions are of essence when considering how patents and different types of innovations relate and how patents can be a part of the knowledge accumulation process. When a company is considering whether it should apply for patent protection, it weights its costs and benefits. The benefits include the right to exclude others from using the novel and non-obvious invention described in the patent claims for a limited period of time, and the costs include e.g. the patent application, preparation and maintenance costs as well as the lost benefit of keeping an invention in secret. The invention has to be described in the patent application in such a manner that the man in the art would able to make the invention based on the description. (Granstrand (1999) Based on the interview data the main considerations for deciding whether a company should patent an invention consist typically of the invention's patentability, its technological and commercial potential, and its significance and usability in relation to other technologies available. If it is a question of an autonomous innovation, the possibility that a company would actually benefit from patent protection so that patents would provide the company with a monopoly position is greater than in the case of systemic innovations. This is because systemic innovations are not usable by themselves but require changes in the underlying system. Thus, the use of these innovations may require licensing of other companies' patents. Similarly, it is possible to make a difference between complex and simple technologies. In simple technologies one patent may cover the entire product, while in the case of complex technologies, one product may very well contain hundreds of patented inventions. (Bessen (2003), Soininen 2005) In fact, particularly in the ICT sector, patents do not usually provide their holders with a monopoly position and the right to actually use the patented invention is often dependable on other companies' patents.

In addition to the complexity and interdependence of technology, the visibility of the invention is, according to the interviewees, assessed when considering its patentability.

This is because the patent holder should have the opportunity to prevent others from using his patented invention also in practice: If the invention is used in companies' internal operations, for instance, it is difficult to detect unauthorized utilization of an invention. If the invention is not easily detectable, it may also be better for the company to keep the invention as a trade secret. It should be noted, though, that although a patent would be applied and granted, not everything becomes known. For instance know-how related to the implementation of the patented invention can be maintained as a trade secret. The pace of technological development, and thus the estimated lifespan of an invention affects also the consideration whether a patent should be filed. According to the interviewees there is no point in patenting technologies that become outdated in couple of years. In fact, the patent application phase may last several years.

Patents should be filed to technologically and commercially feasible invention. Patented inventions should not become outdated soon, and they should be visible so that trade secrecy is not a viable option and infringements are easy to detect. This is not, however, enough. A good technology does not equal a good patent. The applicant wishes typically to obtain broad, valuable patents which are both valid and enforceable. Therefore, ideally, the patent claims define a broad range of technology which must be included in any competing products thereby making the patent very valuable. Patents on radical innovations as well as patents on interfaces are such patents. In fact, radical innovations have, for instance, in Nordic legal regimes been thought to deserve broader patent protection than mere improvement and combination patents. (Godenhielm (1990), Westlander (1996) When it comes to the enforceability and validity of patents, it is to the applicant's advantage to address all questions regarding patentability, particularly novelty and inventive step, during prosecution, rather than later, after the patent is granted, in litigation or in negotiations with a potential licensee. (Miele 2000) Let us now assume that a company has come up with a groundbreaking, radical innovation, which is patentable and the company has decided to patent it maximum protection in mind. The maximum level of protection can be achieved by filing wide patents covering product's key elements or by filing some wide and some narrower patent applications and thus developing a portfolio around a product or a process. Alternative ways to achieve the same result are often included in one patent application or patented separately. This makes designing around more complicated and costly. In fact, opportunities for designing around the claims

should typically be considered at the application phase and included in the patent application if possible. (Miele 2000, Knight (2001) Improvements developed later may also be patented, and thus the life of exclusivity can be prolonged. In addition to improvements, continuous patenting is applicable to systemic innovations that incorporate many technologies advancing in many fronts. The final product may in these cases represent a radical step *e.g.* in increased technical performance. (Granstrand 1999)

Although the company that came up with a radical innovation had protected its markets by patents, the patent landscape does not remain the same through times, and neither do the technology and knowledge accumulation patterns. Even in a case of radical technologies, the first firm to capture a strong patent position may loose it as other companies start to pay attention to the technology. Another company may patent all the potential improvements. The various patenting tactics are illustrated in the following figure.

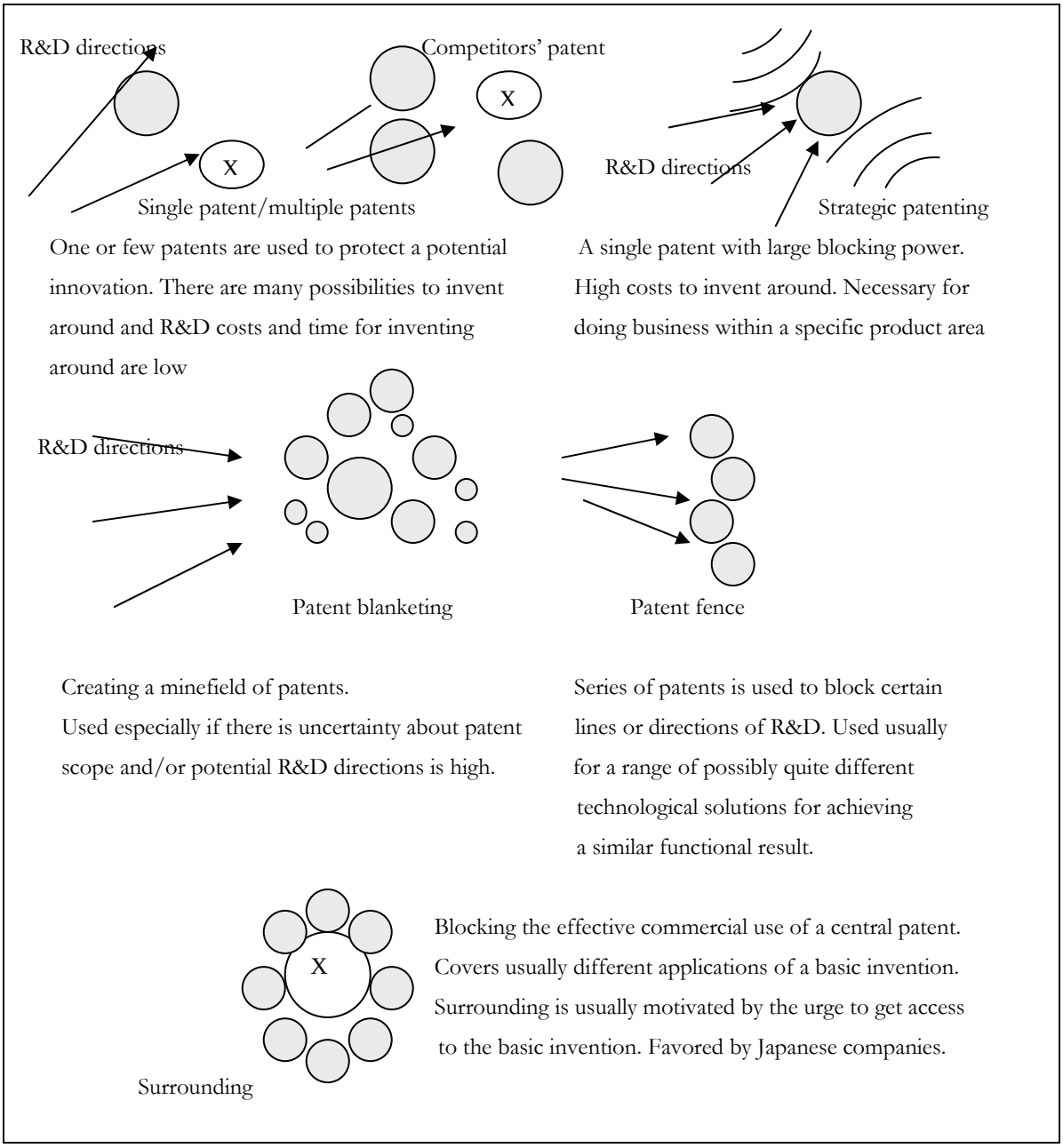

Figure 3. Various patenting tactics (Granstrand 1999)

When it comes to radical technologies, the patent landscape is undetermined. The inventor can by applying patent protection obtain a strong patent position and maintain that position by continuing to innovate and improve its technology and by patenting those

improvements. However, as other companies enter the landscape, changes occur and the company holding the basic patents may be forced e.g. to cross license in order to develop his technology further. Eventually, a complex web of patents, licenses, cross-licenses and patent pools emerges, particularly is technology is complex and cumulative in nature, it develops fast and innovations are systemic rather than autonomous. Indeed, this is the case with the current patent landscape in many parts of the ICT sector where companies are patenting in order to maintaining their freedom to innovate irrespective of other companies' patents. Actually, many companies contribute to the web of patents by attempting to "reserve" as extensive parts of certain business sectors or technology domains as possible in order to maintain their freedom of operation. In fact, according to Cohen, Nelson and Walsh's (2000) study 81.8 % of U.S. manufacturing companies file product patents for blocking purposes (Cohen et al 2000). These patents may never be utilized or they may be licensed or cross licensed. In this setting, also narrower patents may be of value. (Knight 2001)

5. Discussion

We have described the knowledge accumulation process in Chapter 3 where we have divided the process into four categories: knowledge extraction, knowledge capture, knowledge integration and knowledge creation. The process describes the ways companies innovate, whether they rely strictly only on their internal resources and focus on developing and improving only their core technologies, or whether they rely on both external and internal resources in order to develop new, even radical, innovations.When looking at the ways companies today operate it appears that they are well aware of the innovator's dilemma of managing the leap from incremental to new and disruptive technologies. Nonetheless, based on the interview data, companies' internal R&D is often fairly focused and licensing in external technologies as well as licensing out technologies to other companies is rising but nonetheless limited. Consequently, also companies' patenting efforts are primarily focused on their core technologies and related improvements. The US firms interviewed did, however, more than the Finnish companies, take also business considerations, e.g. leverage, into account when patenting was thought about. In general, the patenting process was more active in the US than it was in Finland: In the US it was not merely waited that engineers presented their invention disclosures,

but patent managers participated actively e.g. in the R&D processes, and thus detected patentable inventions as well as those inventions which might have strategic value early on. It should also be noticed that not all patentable inventions are born in the R&D lab. Particularly the business method inventions are often invented by the marketing people.

When companies come up with radical inventions, they often times do not see the benefit in patenting such inventions, unless of course, there is clear licensing potential. (Knight 2001) In fact, many times, these inventions are not even assigned to the company, as they do not fit to the established research area. Establishing a research lab for designing technologies that are not directly in the company's core operation area is one attempt to keep a company in the innovative loop, and secure its future in case radical innovations replace its current markets. Other typical way is to acquire small innovative firms, and cooperate with universities and other research institutes. In addition, particularly in the ICT sector, cooperation between companies is basically mandatory, and this cooperation is not merely limited to suppliers, distributors, end-users and complementors. In the context of standard setting a company may for instance agree to license all its essential patents for free. Another characteristic that is, according to the interviewees, typical in the current network economy is so called coopetition, the same companies may be partners at one field and competitors at the other. This makes keeping knowledge within a firm and away from the competitors increasingly difficult. However, although one could assume that cooperation increases knowledge exchange and thus learning, many of the interviewed companies mentioned that they do not want to know e.g. any trade secrets if it is not absolutely necessary. This was because companies do not want to limit their design freedom. Patents are, as mentioned earlier, beneficial in making communication easier.

According to the US companies interviewed cooperative R&D takes place mainly if companies think that they are able to produce a better product together, combining both of their expertises, than separately. Cooperative R&D may occur e.g. in a form of a joint venture or a strategic alliance. From patent perspective the difference is remarkable: The joint venture is a separate entity to which the relevant IP can be assigned or licensed and that own the IP developed by the joint venture itself. In contrast, in an alliance, the parties own their own IP, but they may also have joint ownership to the IP developed during the cooperation. (Poltorak & Lerner 2004) From legal perspective, joint ownership has many

disadvantages. In fact, the control of the IP and other parties' rights (extent of licenses etc.) should be clearly agreed upon. Based on the interview data, many firms still operate on a rather closed innovation model varying from knowledge extraction to the knowledge integration phase. Nowadays, however, a firm has to be able to take advantage of useful ideas that are produced also outside the company in order to be successful. (Chesbrough 2003) In fact, collaboration between various companies has become increasingly essential as a result of technological complexity of products and processes, rapid technological change, more intense competition, and higher costs and risks of innovation. In addition, companies have become more specialized and are therefore often forced to acquire complementary technologies from other firms. (OECD (2004) Patents are and can be used as tools for cooperation and for acquiring the needed resources for a company. However, the existence of patents should not prevent companies from utilizing other than strictly proprietary models based on control. In fact, allowing e.g. a large amount of subsequent inventors to make improvements to the original work instead of limiting the access to a certain technology may add to its value.(Bessen & Maskin 1997, see also Shy & Thisse (1999), Lessig 2001)

6. Concluding remarks

In sum, the nature of innovations affects the way patents are used in a certain field. Patenting may not be worthwhile for preventing others from manufacturing the same or comparable product or using a process without investing the same amount of money in R&D if, for instance, early investments are low, the industry develops fast, and product cycles are short. Also the visibility of an invention as well as the opportunity to actually gain a monopoly position in relation to a certain product or a process affects on the determination of whether an invention should be patented. For example, lead-time, secrecy, copyright protection, advance on the learning curve, technological complexity and/or control of complementary assets may very well be enough for making profit. In fact, also according to Cohen, Nelson and Walsh's (2000) empirical research, patents have fairly minimal importance as protection measures especially in complex industries like semiconductors. In industries like drugs, chemicals, medical equipments and to some extent machinery, auto parts and computers, patents were, however, reported as being rather important. Distinction in this respect could be made between those industries where

one patent covers one product and industries where one product involves multiple patented inventions. (Cohen et al. 2000, Mansfield (1988) In addition patents role as protection measures seems to diminish as industries mature. Groundbreaking inventions are thought to deserve broader protection than improvements and combination inventions because they contribute to the technological development more than incremental improvements. Nonetheless, patents, even narrower ones, may be important for other reasons, such as maintaining the freedom to operate, and being able to acquire resources to a company.

This paper was an attempt to integrate the knowledge accumulation patterns and issues surrounding patents. Patents still focus strongly on the cost-benefit analysis whereas innovation and knowledge patterns are oriented towards more collaboration and learning. The framework developed will hopefully serve as a remainder of the work to be done in the field of intellectual property rights. Inventions and innovations need to be fully utilized; having rights to certain innovations still does not seem to mean that companies know what to do with these rights. More research needs to be conducted in the field of aligning the concepts to fit the current open innovation landscape.

References

Allen R. 1983, "Collective invention", *Journal of Economic Behavior and Organization*, vol. 4, pp. 1-24.

Bessen James 2003, *Patent Thickets: Strategic Patenting of Complex Technologies,* Research on innovation, available at http://www.researchoninnovation.org/thicket.pdf.

Blind Knut, Edler Jakob, Nack Ralph, & Straus Joseph 2001, "Mikro- und makroökonomische Implikationen der Patentierbarkeit von Softwareinnovationen: Geistige Eigentumsrechte in derIinformatinstechnologie im Spannungsfeld von Wettbewerb und Innovation", *Forschungsprojekt im Auftrag des Bundesministeriums für Wirtschaft und Technologie*, vol. Forcshungsauftrag 36/00.

Boyer Robert The diversity of institutions governing the "new economy", Knowledge: the new wealth of nations? SASE 2001 Meeting, June 28-July 1, 2001. 2001, University of Amsterdam.

Brown John Seely & Duguid Paul 1991, "Organizational learning and communities-of-practise: toward a unified view of working, learning, and innovation", *Organization Science*, vol. 2, no. 1, pp. 40-57.

Chang Yuan-Chieh & Chen Ming-Huei 2004, "Comparing approaches to systems of innovation: the knowledge perspective", *Technology in Society*, vol. 26, pp. 17-37.

Chesbrough Henry W & Teece David J. 1996, "Organizing for innovation: when is virtual virtuous?", *Harvard Business Review*, vol. jan-feb.

Chesbrough Henry W. 2003, *Open innovation: the new imperative for creating and profiting from technology,* Harvard Business School Press, Boston.

Christensen Clayton 1997, *Innovator´s dilemma,* Harvard Business School Press, Boston.

Cohen Wesley M. & Levinthal Daniel A. 1990, "Absorptive capacity: A new perspective on learning and innovation", *Administrative Science Quarterly*, vol. 35, pp. 128-152.

Cohen Wesley M., Nelson Richard R. , & Walsh John P. 2000, *Protecting their intellectual assets: appropriability conditions and shy U.S manufacturing fims patent (or not),* NBER Working Paper Series, Working Paper 7552.

Cowan R. & Jonard N. 2003, "The dynamics of collective invention", *Journal of Economic Behavior and Organization*, vol. 52, pp. 513-532.

Dewar Robert D. & Dutton Jane E. 1986, "The adoption of radical and incremental innovations: an empirical analysis", *Management Science*, vol. 32, no. 11, pp. 1422-1433.

Dosi G. 1982, "Technological paradigms and technological trajectories", *Research Policy*, vol. 11, pp. 146-162.

Fagerberg Jan 2004, "What we know about innovation: A guide to the literature," Oxford University Press, Oxford.

Garcia Rosanna & Calantone Roger 2002, "A critical look at technological innovation typology and innovativeness terminology: a literature review", *The Journal of Product Innovation Management*, vol. 19 , pp. 110-132.

Godenhielm Bengdt 1990, *Om ekvivalens och annat gott,* Ekenäs.

Granstrand O. 1998, "Towards a theory of the technology-based firm", *Research Policy*, vol. 27, no. 5, pp. 465-489.

Granstrand Ove 1999, *The Economics and Management of Intellectual Property; Towards Intellectual Capitalism,* Edward Legar Publishing Inc..

Grant Robert M. 1996, "Prospering in dynamically-competitive environments: Organizational capability as knowledge integration", *Organization Science*, vol. 7, no. 4, pp. 375-387.

Hamel Gary 2000, *Leading the revolution,* Harvard Business School Press, Boston.

Huber George P. 1991, "Organizational learning: The contributing processes and the literatures", *Organization Science*, vol. 2, no. 1, pp. 88-115.

Kash Don E. & Rycroft Robert 2001, "Emerging patterns of complex technological innovation", *Technological Forecasting & Social Change*, vol. 69, pp. 581-606.

Kelley Donna J. & Rice Mark P. 2002, "Leveraging the value of proprietary technologies", *Journal of Small Business Management*, vol. 40, no. 1.

Knight H.Jackson 2001, *Patent Strategy for Researchers and Research Managers,* John Wiley & Sons.

Mansfield Edwin 1988, *Intellectual Property Rights, technological Change, and Economic Growth in Charles Wlker & Mark A. Bloomfield, Intellectual Property Rights and Capital Formation in the Next Decade,* University Press of America, New York.

March James G. 1991, "Exploration and exploitation in organizational learning", *Organization Science*, vol. 2, no. 1, pp. 71-87.

Miele Anthony 2000, *Patent strategy: The manager's guide to profiting from patent portfolios,* John Wiley & Sons.

Mody A. 1993, "Learning through alliances", *Journal of Economic Behavior and Organization*, vol. 20, pp. 151-170.

Nelson R.R. 1959, "The simple economics of basic scientific research", *Journal of Political Economy*, vol. 67, pp. 297-306.

Nordhaus W.D. 1969, *Invention, growth and welfare: a theoretical treatment of technological change,* MIT Press, Cambridge, MA.

O´Connor Gina Colarelli & Rice Mark P. 2001, "Opportunity Recognition and Breakthrough Innovation in Large Established Firms", *California Management Review*, vol. 43, no. 2 , pp. 95-116.

OECD 2004, *Patents and Innovation: Trends and Policy Challenges,* OECD, available at www.oecd.org/dataoecd/48/12/24508541.pdf.

Powell W. 1998, "Learning from collaboration", *California Management Review*, vol. 40, pp. 228-240.

Powell W.W, Koput K.W., & Smith-Doerr L. 1996, "Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology", *Administrative Science Quarterly*, vol. 41, pp. 116-145.

Rahnasto Ilkka 2001, *How to Leverage Intellectual Property Rights, External Effects and Antitrust in the Communication Industry,* Academic Dissertation, Faculty of Law, University of Finland, Helsinki.

Rice Denis T. 2003, *Building a Strategic Internet IP Portfolio in a "down" Economy,* Practising Law Institute.

Rivette Kevin & Kline David 1999, *Unlocking the Hidden Value of Patents, Rembrandts in the Attic,* Harvard Business School Press.

Showalter Barton E. & Baxter Jeff D. 1999, "Strategic use of Software Patents", *Practising Law Institute, Patents, Copyrights, Trademarks, And Literary Property Course Handbook Series*, vol. February- March.

Shy Oz & Thiesse Jacques-Francois 1999, "A Strategic Approach to Software Protection", *Journal of Economics and Management Strategy*, vol. 8, no. 2, pp. 163-190.

Soininen Aura 2003, *Yhteenveto Suomen ICT-sektorin yritysten patenttistrategioita koskevista haastatteluista, De Core - project publications (in Finnish),* HIIT, WP2 seminar, Helsinki.

Soininen Aura 2005, *Patent Strategies in the ICT Industry,* Digital Economy project De Core: Structures of mobile digital economy, Helsinki.

Somaya Deepak. 2002, *Theoretical perspectives on patent strategy,* Robert H. Smith School of Business, Maryland.

Teece David J. 1986, "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy", *Research Policy*, vol. 15, pp. 785-805.

Tushman M. & Andersson P. 1986, "Technological discontinuities and organizational environments", *Administrative Science Quarterly*, vol. 31, pp. 439-465.

Westlander Olle 1996, *Patent allmänna domstolars praxis 1983-1991,* Stockholm.

Williamson Oliver E. 1991, "Comparative economic organization: The analysis of discrete structural alternatives", *Administrative Science Quarterly*, vol. 36, pp. 269-296.