

How Individual Inventors and SMEs Exploit Intellectual Property Rights: The Case of Finland

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Abstract—Inventions have long been recognized as key driver for wealth creation of nations. As intellectual property (IP) rights are costly and difficult to acquire and enforce, it is often argued that SMEs are disadvantaged in their ability to utilize IP rights. Against the background of the patent upsurge, we first conduct a literature review of the role of patenting and alternative instruments to protect intellectual property. Secondly, the patent frequencies are analyzed based on statistics, and thirdly semi-structured interviews are used to provide an understanding of private inventors and SMEs IP rights utilization. The results of the study show that actions to support patenting in Finland and registering of other types IPR remains low. As propensity to patent using different routes, national first filings are declining for small countries like Finland as companies increasingly use PCT, and other alternative routes. Interviews with private inventors and SMEs show, that the general knowledge of the global patent system, and capabilities to operate with IPRs, are quite modest. This leads to unjustified high expectations of economic benefits of patenting, and eventually, disappointment with IPRs. Reasons for this development, and challenges to the Finnish national patenting support environment are discussed. We derive some possible challenges for future patent policies from these insights.

I. INTRODUCTION

The importance of innovations is widely recognized as a means to generate wealth, in modern market economies. Technological innovations are often based on research and development (R&D), carried out in companies of different sizes, aiming to improve and/or renew their product and service portfolio, company processes or markets.

Inventions are at the heart of technological innovations. An invention is a profoundly new, and creative way to solve a real-world problem in a manner that has industrial applicability. Inventions emerge from the creative work and genuine ideas of one or more inventors. Inventions and other intangible assets play an increasing role in today's society. Patents in particular have taken center stage, as witnessed by fast rising numbers of patent filings. However, the implementation of a change in Intellectual Property (IP) utilization represents a challenging task for SMEs, because the resources and capabilities that are required may be lacking.

Inventions are the blooms growing from the investments in R&D. For a company to appropriate the investment, inventions need protection against malicious competitor or market actions. If not protected, others could try to make use of one's invention without a need for any comparable

investment in R&D. The use of formal intellectual property rights (IPR) tools to protect inventions is less common with individual inventors and small or medium sized companies than with large companies. Of the 10.000, or so, patent applications, that Finnish inventors and companies annually produce, private inventors and SME companies represent but a mere fraction. Large companies dominate patent application statistics and even more so, when comparing the granted patents statistics. It is thought, that this is due to the lack of knowledge and understanding about patents and other IPR tools among private inventors, and SME companies.

This research focuses through a qualitative approach on documenting the reasoning and thoughts of individual inventors and SMEs while considering how to protect their invention. The research is carried out by conducting semi-structured interviews among private inventors, large companies and SME companies. Interviews are expected to clarify the viewpoints, pros and cons of patenting and other IPR protection, as well as the non-formal IP protection methods. A literature review of past research is presented and a comparison is made of the interview results with findings from earlier studies. The growing literature and discussion about the importance of intellectual property, and scarcity of knowledge about how IP works for small companies and private inventors leads to the following research goals:

- To gain understanding about the dynamics of IP generation and protection within SMEs and among individual inventors
- To understand how SME companies, individual inventors, and large companies differ in using patents as means of IP protection
- To identify “best practices” that SME companies and individual inventors should adopt when considering and using IP protection methods.

The scientific contribution of this research adds empirical, qualitative data to the patenting motives and practices among Finnish SME companies and private inventors. The rest of the paper is structured as follows: Section 2 reviews literature of managing innovation activities and protecting inventions. In section 3, we present our methods and empirical results by illustrating the challenges to intellectual property generation and management. The 4th section concludes and provides areas for future research.

II. INTELLECTUAL PROPERTY AND THE ROLE OF PATENTING

A. From inventions to innovations

Innovations are widely considered important and necessary factors for competitiveness, prosperity and wealth of nations, in modern economies. Innovations are encouraged in Finland, as in other industrialized countries, on national levels by pro-innovation legislation, education system, tax benefits, and public financing and support services. Societies promote innovative activities in all kinds of organizations, whether they be technological, social, management, process, or other innovations, by nature. The term “Innovation” has many definitions. We will use, here, the following definition: “*Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.*” [1]

Companies renew their products, services and processes through innovations, thus improving their competitiveness and attractiveness. Other types of innovations, often social, by nature, are generated by NGO’s and public organizations, to improve public services and social practices. Research institutes and universities provide basic nutrients for all innovations, by carrying out fundamental, and applied research and generating knowledge and know-how for public consumption.

Invention, on the other hand, is not a synonym for innovation. Inventions serve as an important source for innovations, but most inventions never lead to innovations, thus failing to generate any wealth or prosperity. Ballard [2] argues that the reason invention defies satisfactory classification, either as fact or law, is because it is a question of pure judgment. A man in the street, a patent officer examining the claimed invention, and a technical expert in a patent litigation process all have different views.

One definition of invention is: “A unique or novel device, method, composition or process”, and the process of inventing: “A process within an overall engineering and product development process” [23]. Another says that an invention is a device, contrivance, or process originated after study and experiment, and discovered by the inventor [16]. Also, “Invention is creative thought, embodied in physical form” [18]. In the U.S. Patent Law a patentable invention is defined as: “any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof”. Additionally, the invention shall not have been discovered before, and the differences between the invention and prior art are such, that the invention as a whole would not have been obvious to a person having ordinary skill in the art that the invention pertains. In general, inventions are technical or scientific discoveries, which are both useful and applicable.

The road from inventions to innovations is often uneasy. The number of thoughts and bright ideas that people have well exceeds the number of real inventions, fulfilling the requirements of novelty and inventiveness. Such findings and ideas could still be turned into innovations to serve the finder’s business endeavors, as long as they don’t infringe someone else’s patent or IP rights. An invention with novelty and inventiveness might or might not lead to an innovation, depending on the capabilities of the inventors and their employers. Large companies are best positioned to make use of their inventions. Smaller companies are typically less capable to benefit from inventions. And private inventors are in most disadvantageous position, when it comes to appropriating the investment into creating the invention and turning IP right into innovation and real business value.

While figuring out how to fully appropriate the value of an invention, consideration should be given to its protection. Scientific and technological inventions with utility, novelty, inventiveness, and industrial applicability are eligible for patent protection, which is perceived the most important means of formal protection of an invention. There are many ways to protect inventions. Patents and utility models offer almost global protection for technological inventions. Other IP rights include design rights and copyrights which protect artistic results of creative processes, and trademarks and other business identifiers used to protect business activities and brands. The inventor might also choose not to seek formal protection for his/her invention. Alternative routes of protection include secrecy, making the invention public, complexity, and first mover advantage on the market.

Innovations are a driving force behind productivity raise and increase of the wealth of nations. Unfettered innovation markets provide a suboptimal level of innovative services to the economy as described in [9] by saying that as innovative products and processes have a high fixed cost and low marginal cost of production, the investment in innovation will not be profitable, if the fixed costs cannot be recouped through maintaining a market price above marginal cost. As innovations are socially beneficial, this would lead to low level of innovation activities, in a society.

B. Protecting intellectual property (SME perspective)

To understand how innovations in modern developed societies could be enhanced by improving the inventiveness within the society, we will research the roots and blooms of the interplay of inventions and innovations. The focus is on inventive processes within SMEs and the conceived paths to optimal value creation. We use the official EU definition for SME [5] categorizing micro, small and medium sized companies as seen in Table 1.

TABLE 1: EUROPEAN COMMISSION'S SME DEFINITION

Category	Headcount	Turnover or	Balance sheet total
Medium-size	< 250	≤ € 50 m	≤ € 43 m
Small	< 50	≤ € 10 m	≤ € 10 m
Micro	< 10	≤ € 2 m	≤ € 2 m

Micro-enterprises are defined as enterprises that employ fewer than 10 persons and whose annual turnover or annual balance sheet total does not exceed 2 million euro;

Small enterprises are defined as enterprises that employ fewer than 50 persons and whose annual turnover or annual balance sheet total does not exceed 10 million euro;

Medium-sized enterprises are defined as enterprises that employ fewer than 250 persons and whose annual turnover or annual balance sheet total does not exceed 50 million euro.

Large enterprises are those that exceed staff figure OR both of the two other figures in the definition of a medium-sized company.

The company size is but one of the differentiating variables, that are thought to affect the company's management of IP strategy and conduction of innovation and IPR practices. Ownership is another topic that could be worth considering. The EU definition [5] of SME also categorizes SMEs into three categories:

- Autonomous firms, meaning that the company is either completely independent or has one or more minority partnerships (each less than 25%) with other companies.
- Partner firms, meaning that the company's holdings with other companies rise to at least 25% but no more than 50%.
- Linked firms, meaning that the company's holdings with other enterprises exceed the 50% threshold.

The term "holdings" stand for the SME in question being partly (or wholly) owned by one or more companies, or the SME in question partly (or wholly) owning other companies. This differentiation is plausible, since it might be argued that two SME companies, where one is owned and managed by a technology oriented entrepreneur, and the other partly owned by a large company or a venture capital company, and managed by a professional manager, would have different networking resources, different goals, a different mindset, and probably different ways to cope with IP and its protection.

An interesting inset into the categorization of "SME" is to consider what kind of "holding" types exist, and what they mean, in practice. It would seem reasonable to think that ownership of a company affects the goal setting and relevance of IP protection in the company. For example,

firms where professional investors are shareholders and possess the decision making power either through major shareholding or agreements are known to pursue strong growth and exit within a conceivable future. Whereas firms owned by large companies might be focused on integrating within the business processes of the larger company as efficiently and seamlessly as possible. In such firms, business goals, growth, and IP generation and protection are handled in larger context, and combined with such efforts of the larger partner/owner company. The type of the owner or "holder" clearly has an effect on the firm, and should be taken into account.

Also, a differentiating factor might be the company orientation, in regard with market and technology. Companies that are technologically oriented are thought to be more active in R&D, and subsequently, in creating inventions. They are the prime candidates for research concerning IP protection. Even these companies could be divided into invention based and market need based firms, where invention based companies are established for the reason of commercializing an invention, and market need based companies are fulfilling a function on an existing market, while possibly generating inventions based on their market experience and technological capabilities.

Purely market oriented companies approach business from another angle, putting the customer deal first. They concentrate on business and could not care less about R&D and inventions, unless they are stumbled upon while working with a customer case. Even in such cases these companies would rather not enter the world of inventions, as the whole business is tuned and oriented towards efficient marketing and customer service process.

Understanding the large variety of what the term "SME" really means, is important. It is obvious, that all these differences will have an effect on the very core questions that this research is aiming to solve.

In the review of prior literature research on inventions, innovations and patenting among SMEs has been studied. Various aspects along the process from an idea via invention to innovation and commercial viability have been considered interesting for our research. In Table 2 we present a non-comprehensive list of prior research which is relevant to our work. The objective and/or the research question(s) are presented along with information on the data used or generated. Key findings give but a glimpse of the results and are presented solely to provide understanding to the reader about the various approach angles that the topics in question may have.

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TABLE 2: REVIEWED LITERATURE AND KEY FINDINGS

Study and its Research question(s) / Objective	Data and Technology area	Key findings
Brant & Lohse [4] A briefing paper for policy-makers towards innovative SMEs, and effective IP management	Interviews with business leaders from innovative SMEs in high technology sectors in different countries	SMEs should make use of a variety of IP protection methods. Lack of knowledge and, particularly, financial resources puts SMEs in a less advantageous position in utilizing formal IPR. Governments should act to make the IP system more accessible and beneficial for SMEs.
Rassenfosse [19] Motivations to patent and particularly monetary motivations	Data from an EPO (2006) survey on patent filing intentions, motivations, and patent usage	SMEs are more active in using their IPR for monetary motivations, than large companies. US is way ahead of Europe in this sense, indicating problems with the European market of technology.
Grandstrand & Holgersson [6] Patenting frequency and propensity via diverse routes decreases patenting via national PTOs in small countries	Statistical analysis of various patenting routes, survey with 138 Swedish companies and pilot interviews	Patent applications from small countries take increasingly the PCT and EP routes and use less the national PTO services. This is explained in the light of changes in the balance of economies over the global patent era
Holgersson [8] Entrepreneurial SMEs motives and use of patenting	Interviews with 57 Swedish SMEs	Entrepreneurial SMEs with limited resources have low interest to patenting, although the motive to attract clients and VC's was found high. Internal competence in patenting is necessary for SMEs entering IPR scheme.
Jensen & Webster [9] Firm size and usage of patents, trademarks and industrial designs	Data from IP Australia, Australian Bureau of Statistics, and IBISWorld Australia	No evidence that SMEs would be disadvantaged to use IPR as they are more innovative and benefit from using IPR to access strategic alliances.
Kingston [12] A policy paper on the patent system from European SMEs and individual inventors point of view	The contents are based on the author's experience of directing an EU-commission study "Enforcing Small Firms' Patent Rights"	Several action points listed for consideration to policy makers. SMEs and large companies are rudely unbalanced in resolving IPR disputes. Lessons to learn from the US legal system and a need to consider changing the Paris Convention agreement in favor of SMEs.
Kitching & Blackburn [13] Formal and informal IP protection methods within SMEs	Interviews with 400 SME owner-managers in the UK.	IP is valued as the most significant asset of a company. Managers are aware of the broad range of formal and informal protection practices. Non-registrable legal rights was common whereas registrable rights was a difficult step to take.
Lanjouw & Schankerman [14] Which patents are prone into litigation suits and are small companies handicapped in protecting their IP rights	9345 US patent litigation cases drawn from the LitAlert database, the Federal Justice Center (FJC) database, and the USPTO database	Litigation of patents remains low in the US. Probability of litigation increases with the number of claims and forward citations per claim. Most patent suits are settled outside the court. A large portfolio reduces the probability of a suit.
Leiponen & Byma [15] IP strategies of small Finnish manufacturing and service firms.	A dataset of 504 Finnish SMEs are surveyed	Patents are not a very important to most SMEs. Only 12% of them have patents. There is a lack of resources to obtain and defend patents. Speed to market is the most important protection mechanism among all firms IPR policies should be re-evaluated from the small firm perspective.
Olander et al. [17] Does the small size of a firm relate to innovation protection possibilities and incentives to innovate	Qualitative interviews with eight small Finnish companies from different industries	Lead time is among the most useful protection mechanisms, but SMEs are restricted in using it. HR management is essential to SMEs in keeping the innovation related knowledge within the firm. SMEs most valuable innovative assets are the existing knowledge assets. Protecting them is vital to SMEs innovative capabilities.

III. METHODS AND RESULTS

A. Analysis of patent statistics

The purpose of utilizing patent statistics in this study is mostly to give context of the recent patenting trends worldwide and in Finland. Patents focus on how to make inventions work and as all patent applications are published 18 months after the priority date, patent data contain new information on a company's new product development activities not found elsewhere. Patent data offer a valuable data source as individuals and companies worldwide in 2014 applied for patents on about 2.7 million inventions (patent families) and almost 1.2 million granted patents in 2014 [24]. A uniform structure throughout the world and the long time series available makes the patent data a unique source of

information. The large number of patent applications is not a completely new phenomenon: even in 1980 protection was being sought for more than 600,000 inventions per year worldwide and, since then, countries such as China and Korea have joined the race for technological innovation. Patent applications of top 5 offices (SIPO, USPTO, JPO, KIPO, EPO¹) accounted for 82% of the world total in 2014, which is considerable higher than their 2000 share, 70% [24]. Figure 1 demonstrates the huge increase of patent filings for the top five offices in the last decades.

¹ State Intellectual Property Office of the People's Republic of China (SIPO), United States Patent and Trademark Office (USPTO), Japan Patent Office (JPO), Korean Intellectual Property Office (KIPO), European Patent Office (EPO).

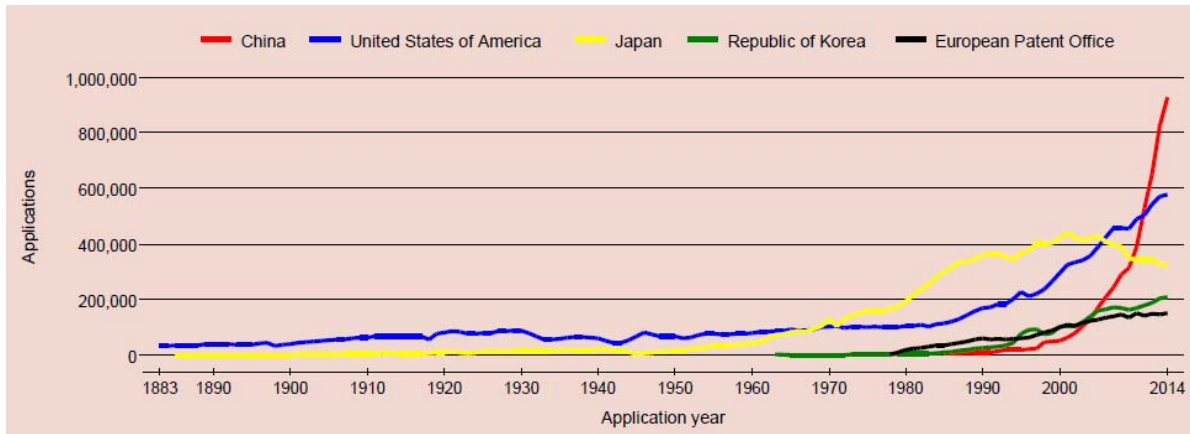


Figure 1: Trend in patent applications for the top five offices [24]

A worldwide increase in patent filings has also been characterized by marginal inventions with broad and/or overlapping claims. Building patent fences and blocking competitors are some of the new strategic motives of patenting [7].

The globalization and harmonization of the patent systems (e.g. Patent Cooperation Treaty, PCT system and the ongoing European Union unitary patent scheme) has meant big changes both to national patent offices (PTOs) and SMEs' operating environment. Vervenne et al. [21] study focuses on the contribution of SMEs in patenting in the European Union. Their study shows considerable country differences in the SMEs contribution to national patent portfolios (Figure 2). Established knowledge economies, such as Germany, Finland, France, Netherland, Belgium and Sweden are known to host the headquarters of some of the large multinational companies that might lead to lower share of their SME sector in patenting. On the other hand, in other knowledge economies, such as the UK, Denmark, Italy and Spain the share of the SME sector in patenting is much higher, suggesting that the matter is more complicated.

Finnish applicants filed altogether 137.826 patent applications in years 2000-2014. The statistics shows a

declining share of domestic applications and growing share of international applications (Figure 3). The increasing role of international filing routes means less residential applications and less work for the Finnish PTO (National Board of Patents and Registration). The Finnish PTO started services as a receiving office for international applications when becoming a member of the Patent Cooperation Treaty (the PCT) in 1980, and as an International PCT Authority in 2005.



Figure 2: SME contribution (%) to national patent portfolio's [21]

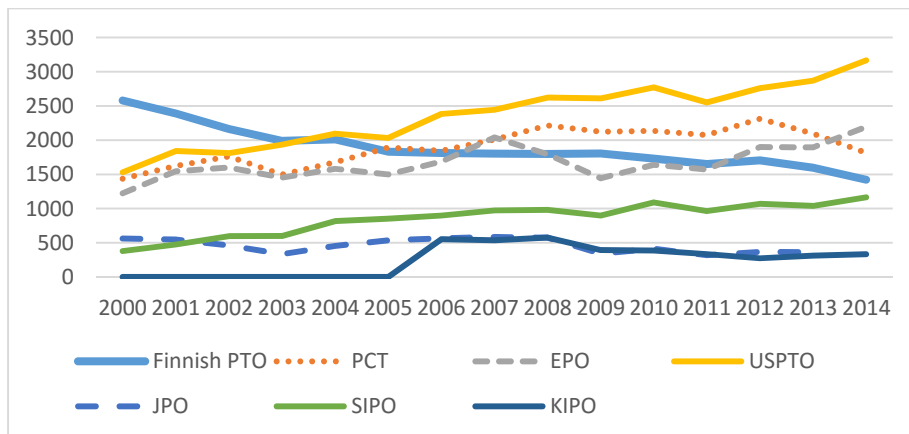


Figure 3: Major patenting routes for Finnish inventions 2000-2014

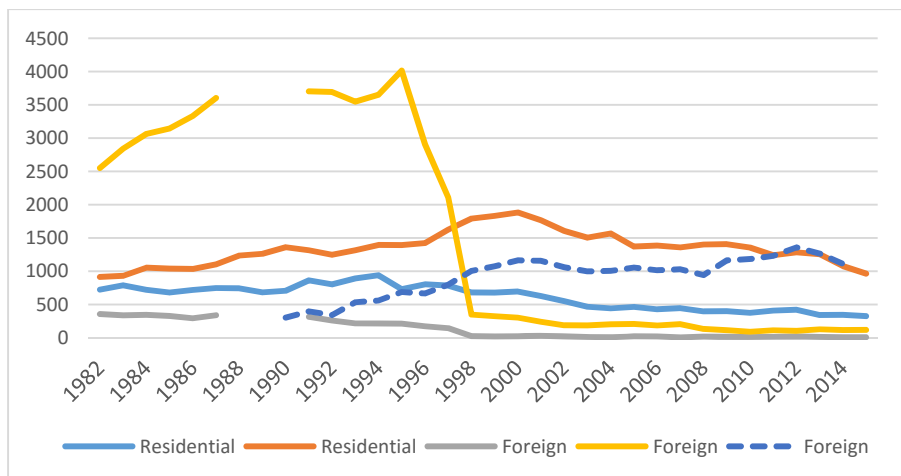


Figure 4 Sources of patent applications to the Finnish PTO 1982 - 2014

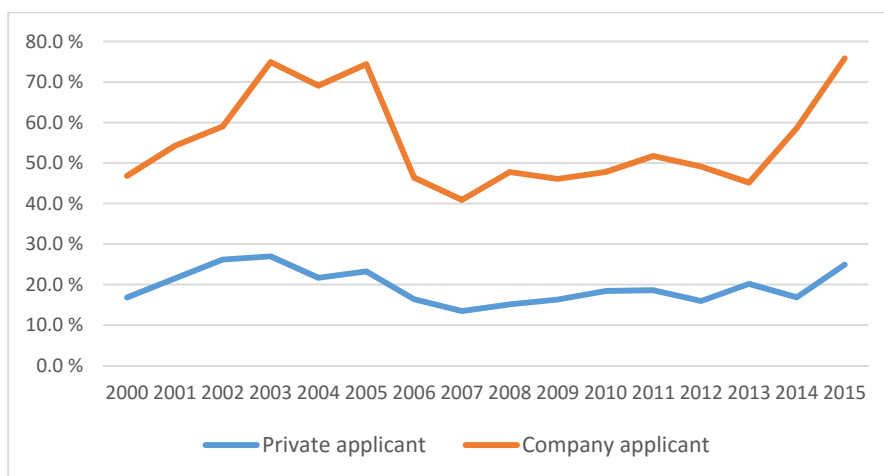


Figure 5 Estimated share of successful patent applications at the Finnish PTO in 2000-2014

In (Figure 4) a dramatic reduction is shown of applications from foreign firms to the Finnish PTO between 1995 and 1998. This is thought to have resulted from Finland joining the European Patent Convention (EPC), in 1996. The increase of PCT applications after 1990 does not match the drop, thus reducing the application turnover of the Finnish PTO.

From 2000 to 2014 Finnish applicants filed over 28.000 patent applications to the Finnish PTO. Altogether 12.975 patents were granted during the same period. Even though the applications and grants are not matched, the trend shown in Figure 5 is clear – applications by companies are more successful than applications by private applicants.

The purpose of the EPC is to centralize the prosecution of European patent applications. After Finland joined to the EPC in 1996 there has been an increase of EP validation patents. Finnish applicants make about 1600 European Patent (EP) applications a year. The long process of European Unitary patent is still in process. The objective of a European unitary patent protection is to limit formalities and lower

costs and it have been argued that it should benefit SMEs, universities as well as private, individual inventors.

B. Semi-structured interviews

A set of semi-structured interviews has been conducted to gain understanding about motivations and methods of generating, protecting and appropriating the value of IP among SME companies and private inventors in order to pave the way to answering the questions set forth in the introduction chapter. Interviewees were selected from different interest and experience groups to gather all necessary aspects of the field of study. In this research a qualitative approach is chosen to collect data on the research topic and to perform an analysis of the data.

All interviews were semi-structured in a way that certain topics were brought into discussion either naturally, in conversation, or by the researcher asking necessary questions. Altogether 16 such interviews have been conducted, 11 of them face to face with an average duration of 127 minutes, each. Five interviews are conducted over the telephone or by email.

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TABLE 3. SUMMARY OF ALL INTERVIEWEES

Organization type	Count	Minutes	Position	Connection to IP matters
Large companies	3	454	IPR Manager	Responsible for organization's invention and IPR processes
SME companies	8	945	Entrepreneur	Director/inventor with or without patents and other IPR
None	5	-	Individual inventors	Applicant and/or owner of IP rights

The interviews have been categorized in three groups, as shown in Table 3. The 11 interviews were lengthy and thorough face-to-face meetings with wide fluctuations in topics covering different aspects of intellectual property, its significance and value, corporate and best practices, opportunities and challenges, sources and need of information, interplay and cooperation, and other, occasional topics. Individual inventors are approached by telephone/email.

During the face-to-face interviews, comprehensive notes were taken documenting the subject matters, key points and thoughts, responses and considerations. All except two interviews were recorded and the nine recordings were later used to revisit the interview notes. Amendments to the notes were made, where necessary. The revisiting process has confirmed, that notes made during the interviews are well representative. All major findings and key points were found in the interview notes, while only minor amendments were picked up from the recordings. This assures us that even those interviews that failed to record are adequate and usable in this study. Comprehensive memorandums were prepared from all face-to-face interview notes, organizing and presenting the discussion topics, thoughts, comments, ideas, problems, challenges, practices, etc. that came up during the interviews. These memorandums were then analyzed and used to formulate the results and key findings in this report.

Large company interviews were carried out with three major companies (Table 4). The selection of companies was based on the field of industry in technology or high-tech services, the inventive capacity of the company confirmed by checking that it has a patent portfolio, and a convenience factor meaning that an interview was possible and

uncomplicated to agree upon. Not all large companies are eager to participate in academic studies, especially if they feel that they might give away sensible information. Since we are working on qualitative, rather than quantitative research, the selection of the target groups has been based on accumulation of new knowledge, rather than statistically representative samplings. Thus, the convenience factor allows restricting the interviews to companies that lie within the scope of the research and fulfill the other two criteria.

The summed duration of the interviews with large companies was 454 minutes, averaging 151 minutes per interview. Interviewees were in manager positions and they all participated and/or directed the companies' processes for IP generation and protection. They all have an engineering background and two have been working with R&D projects, before this current position.

SME company interviews were carried out with eight firms (Table 5). Seven entrepreneurial owner-managers were interviewed for 826 minutes, averaging 118 minutes each and one non-owner manager of a company just thresholding below a medium-sized company was interviewed for 119 minutes.

Inventors are also found in research institutes and universities, where scientific or technological research is conducted. Members of research teams might make a new and unique discovery, which would be patented by the institute, or the inventor himself. In SME companies the inventing activities vary greatly by company. Technology startups are the best bet to find inventors, when looking at SME companies. There, inventions and patents are common, although not as abundant as in large companies.

TABLE 4: INTERVIEWED LARGE COMPANIES

Company	Industry	R&D	Patents
A subsidiary of a large, foreign corporation	Technology provider delivering electricity and machinery products, turn-key projects, and services to global industrial customers	Several business units, each having R&D functions. IPR process unified on the corporate level.	669 applications and 599 granted patents (Patinfo)
A company within an international group of companies	Technology provider delivering mechanical engineering and electronics products, services, and projects to industrial customers and to end-users through distributors.	Independent business units having own R&D functions. IPR partly handled within the business unit, and partly supported from the corporate level.	157 applications and 124 granted patents (Patinfo)
A Finland based company operating in several countries	ICT services to corporate and private customers on the Finnish market	R&D tightly organized within the company.	202 applications and 167 granted patents (Patinfo)

TABLE 5: SME INTERVIEWS

Company		Ownership	Industry	Patents
Sales, million €	Staff			Sources: Patinfo, Patentscope, Espacenet
10 arctic	50	Several, large industrial owners	Technology development, machinery design and construction, project consulting	11 applications, 10 granted patents
2 base	20	Entre-preneurial	ICT/IoT solution provider and operator	5 patents granted
The two interviewees are connected to more than one company		Entre-preneurial	Cleantech and ICT product design and production	Over 30 patents in total
2 saris	10	Entre-preneurial	Chemistry products for industrial use	24 patents
< 1 maja	<10	Entre-preneurial	software design and production & hardware integration for energy technology IoT solutions and services	No patent applications, trademarks in use
< 1 mathias	1	Entre-preneurial	software design and production & hardware integration for ICT solutions and services	1 patent application, transformed into 1 granted utility model
< 1 corento	1	Entre-preneurial	Health and well-being technology solution design and services	No patent applications, trademarks and copyrights in use
< 1 masu	1	Entre-preneurial	Product development of energy- and cleantech devices	2 patent applications, 2 granted patents

A. In-house IP generation and protection

The interviews reveal many differences between large companies and SMEs in how they comprehend, value and process inventions, intellectual property and IPR. A very clear difference is notices in IP generation and its protection, where the coherent strategies and lean processes of large companies contrast the poor awareness and almost non-existing processes of SMEs.

In Finland, the law on employee inventions defines the rules of conduct in companies, in case an employee makes an invention. The employee is then obliged to notify the employer about the invention and provide a detailed description of the said invention and its potential benefits. The employer shall within the next four months consider if the company will claim the invention. If it does, the inventor is eligible for fair compensation based on the value of the said invention.

Awareness about and processes to enforce the law were satisfactory in large companies with operational management processes, such as:

1. Raising awareness about inventions and the employee invention process among R&D personnel
2. Instructions and tools for employees to prepare and deliver an invention notification
3. Regular meetings of a IPR workgroup evaluating employee invention notifications
4. Necessary networks and expert connections to gather background information and prepare in-depth analysis of the invention under analysis
5. Top management authorization or involvement for deciding upon claiming the invention for the company
6. Processes to consider and decide upon patent applications and further commercialization or integration into business processes
7. Documented practices for compensating the inventor(s)

The awareness and capabilities to deal with employee inventions is much lower in SMEs as presented by Figure 5. Most SMEs are unaware of the legal premises of employee inventions and lack due processes to manage them.

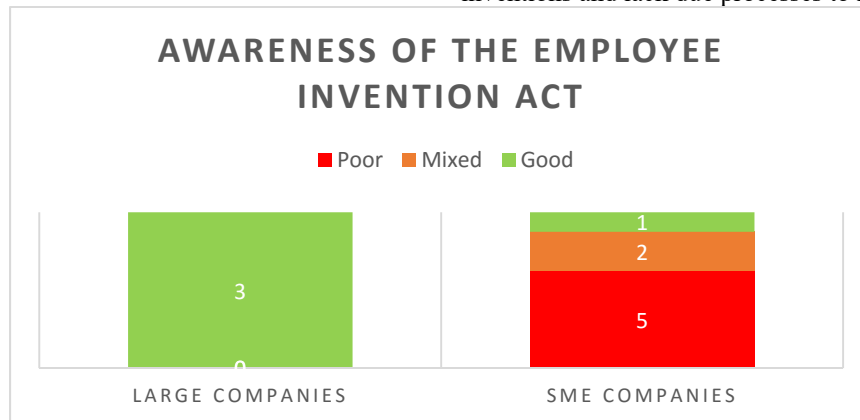


Figure 6 Level of awareness of large and SME companies of the legal basis for employee inventions

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TABLE 6 BEST PRACTICES FOR SMES FOR MANAGING INTERNAL INVENTION PROCESSES

1. Awareness of and process for employee inventions	
SMEs should understand that the law on employee inventions is a useful. Setup proper actions to process them	
Opportunity:	Improved personnel commitment and motivation. More inventions are recognized and reported. Well-organized image enhances HR and recruiting
Threat:	Inventions pass unrecognized or walk out the door. Bad-will from mishandling inventions. Discrepancies or legal disputes over 'fair compensation' matters
2. Compensation policy for employee inventions	
Setup a guideline and communicate it to the personnel for calculating a fair compensation for employee inventions	
Opportunity:	Motivate inventors to produce and report inventions. Control the expenditure set aside for invention compensations.
Threat:	Possible disagreement between the inventors and the company over the invention value and compensation levels.
3. Top Management commitment	
Top management should show commitment to invention practices. Defining invention process responsibilities and launching reporting practices along other communication and participation creates a growth environment for inventions	
Opportunity:	Leadership example has a strong motivation effect and enhances invention generation and company R&D performance
Threat:	Lack of interest will flow all the way through the company
4. Understand the cost of IP protection	
Management should clearly understand the cost of acquiring, maintaining and enforcing intellectual property rights before entering into IPR processes	
Opportunity:	Establish a balanced, profitable and secure IPR portfolio, supporting the business
Threat:	Waste money on weak applications and patents unable to enforce the acquired rights. No money to pay patent maintenance fees leading to expired patents.

Large companies often encourage employee inventions and readily compensate inventors. This is considered a threefold issue in fields of management of a) human resources (HR), b) R&D and c) intellectual property (IP). The inventions claimed for the company are typically dealt with in one of three possible ways:

- Some inventions are considered commercially uninteresting and dropped
- Invention is considered valuable and a patent is applied for
- Invention is taken into use by the company but no protection is sought (mostly process inventions fall into this category)

Dealing with employee inventions in SMEs is more vague. Entrepreneurs typically are quite unaware of their obligations towards their employees' creating inventions and sometimes unwilling to even consider the issue.

Interviews with large companies and SMEs reveal a number of issues where SMEs would need to improve, in order to fully appropriate their R&D expenditure through patenting. Main findings are presented in Table 6 as best practices for SMEs

In SMEs, the lack of awareness and due processes goes hand in hand with low knowledgeability of the patent system, in general. Even where inventions are generated, it might not be clear if they could be protected. SMEs in most cases don't fully grasp the idea of patentability requirements; subject matter, utility, novelty, inventiveness and industrial applicability.

B. Motives for patenting

The differences between large companies and SMEs in patenting motives are less frequent. Common motives include following:

- Freedom to operate (FTO)
- Preventing imitation
- Hindering competitors' FTO

Other motives to patent from large and SME companies are presented in Table 7. It is obvious that with larger financial resources, the large companies have a wider variety of IPR tools, including patenting inventions "just in case" without any idea how to appropriate the investment. SMEs with limited funds must often satisfy with a modest number of patents. Not all inventions are patented and secrecy is often the choice of protection, especially in SMEs.

Table 7 Motives to patent in large companies and SMEs

Large companies	SMEs
Competition motives	
<ul style="list-style-type: none"> - Setting up entry barriers for newcomers entering our business field - Even weak patents are useful tools for scaring off competition in large projects 	<ul style="list-style-type: none"> - Differentiate the company from competition
Business & business development motives	
<ul style="list-style-type: none"> - Patents are useful to secure future FTO even if not utilized in current business activities 	<ul style="list-style-type: none"> - Generate revenue via licensing - Winning time to consider breadth of patent family - Strengthen own R&D functions
Reputation motives	
<ul style="list-style-type: none"> - Acquiring a "high-tech" company image - Customers require patented solutions 	<ul style="list-style-type: none"> - Patents are a marketing tool to make the company look interesting - Convince financiers, clients and employees of the company's trustworthiness - Innovative image of the company
Risk management motives	
<ul style="list-style-type: none"> - Stopping anyone from monopolizing an invention - Patents as a currency to trade with competitors - Patents are necessary for working with partners 	<ul style="list-style-type: none"> - Reduce threat of litigation

Reputation motives were found higher among SMEs than large companies. This supports the findings from Blind, [3] (in Figure 5) and Jell [10] (on page 138). Since patenting is considered very expensive, SMEs readily consider other means of protection, before deciding on a patent application.

C. Infringements and threat of litigations

The experiences of large companies and SMEs about infringement issues and litigations are very different. Large companies are typically well prepared and relaxed about such issues. Monitoring potential infringements, as well as reacting to infringement claims from others, have organizational procedures in place and are stripped from mythology. Large companies monitor competition over several channels and where potential infringement is found, actions are considered and decided upon with company lawyers and relevant managerial level. In most cases approaching the potential infringer is enough to stop the infringing activity.

Large companies have experienced that the infringer takes such notification seriously, and either stops the infringement or negotiates a license. This means the IPR regime works just like it should, minimizing the unauthorized use of someone else’s IPR. This result supports the finding of [14] that in the US the threat of court action (suits) is the primary mechanism through which ‘sorting’ among disputes occurs. In other words, the value of a patent system lies mainly in the fact that patent disputes are settled rather than processed in courts. The fear of litigation deferring the infringer seems to work for European companies, as well.

SMEs’ position on infringements is quite different. In general, they lack confidence and tools to identify infringements of their patented inventions, or to stop the infringing activity, if recognized. This belief of SMEs is supported by the interviews, while cases of unsuccessful stopping of infringements were presented. It is obvious that SMEs lack know-how, tools, and resources to enforce their IPR against someone infringing their patents.

Threat of litigation is less of an issue among both large companies and SMEs. Some interviewees had occasional experiences with so called “Patent trolls”. Originally trolling has been a phenomenon in the US market, but presently such action is seen in Europe, as well. “Patent trolls” are here used in a meaning described by R  ther [20]. Typical characteristics of a Patent troll include:

- A company with only one single patent;
- None or negative turn-over;
- One employee and one member of board;
- The patent is vague and might fit into many different infringement claims with good imagination.

It is proposed that when SMEs meet potential infringement claims or threat of litigation, they should try to find a reliable peer-level person to discuss the matter with. Provision of such services would suit well to the chambers of commerce, or similar organizations.

D. Monitoring global patents

Following technological development and new patents within their industry comes with a lot of variation. Interest to follow others’ patents was lowest in the ICT sector, as its technologies are evolving rapidly. As granting a patent takes some 3 years in average, which is the same as the practical usability of the technology, searching patents from competitors provides little or no value.

In other industries, large companies tend to research patents prior to launching R&D projects. A comprehensive patent study is made to minimize the risk of infringing existing patents. Patent research is typically not carried out actively in SMEs. Sources of support and information in monitoring patents and accessing patent information are presented in Table 8.

Generally speaking, SMEs are not fully aware of the benefits of using on-line patent databases. They rather use the expert services from the Finnish PTO, or private sector consultant, than seek the databases themselves.

TABLE 8 SOURCES OF INFORMATION AND EXPERTICE ON PATENT MONITORING

Large companies	SME companies
Public support services	
	<ul style="list-style-type: none"> - Finnish PTO - ELY-keskus (regional offices of the ministry for labor and economy)
Private consulting services	
<ul style="list-style-type: none"> - Patent agency companies - Patent consultants - Patent attorneys 	<ul style="list-style-type: none"> - Patent agency companies - Patent consultants
On-line resources	
<ul style="list-style-type: none"> - Espacenet - Thomson Reuters Derwent World Patents Index - Questel Orbit - CPA Global Ipendo 	<ul style="list-style-type: none"> - Questel Orbit - Espacenet - Google patents - Patinfo

E. IP and IPR Education

Inventions and inventing is not taught in schools or universities, in Finland. Basic knowledge about intellectual property and IPR is scarce, in Finland. Sources of IPR information include:

- Finnish PTO organizes courses on a regular basis on patents, trademarks and industrial design rights. These one or half-day courses are designed to give elementary knowledge and skills to the relevant IPR topic
- Patent consulting agencies arrange eventual training courses for their clients. They are often tailor made and not open to public
- Two private training companies arrange occasional IPR courses
- IPR University Center is an alliance of seven Finnish universities focusing on IPR teaching. It organizes tailor made courses, conferences and need based courses on several IPR topics. The courses are mostly on IPR law, and cover less the engineering, business or management topics
- European patent law is taught on CEIPI courses. They are highly regarded educating Masters of IP Law and Management
- Companies organize internal courses for their R&D personnel and other employees
- Corporate IPR professionals have occasional in-house peer meetings and information exchange events
- Industry associations, chambers of commerce, or similar arrange irregular information days or short events open to public

Large companies tend to have a well structured education plan for their IPR experts, based on these information sources. SMEs, on the other hand miss most of these opportunities, not being able to allocate the necessary time resources for them. As the SMEs are found in a need of accurate and relevant information on IPR, it is proposed that to improve the know-how, universities and schools should more actively disseminate information about IP and IP rights to students. An engineering graduate should at least understand what an invention is let alone recognize it when it comes along. They should also have the skills to search the patent databases and read (and understand) the outcome.

F. National Finnish PTO services

There is a general conception that the quality and services of the Finnish PTO are good and sufficient. Whereas many large companies use other routes, most SMEs make their first filings with the Finnish PTO. National authority services the applicants in Finnish and Swedish, and allows applications to be drawn in English, as well. Since the numbers of applications to the Finnish PTO have reduced, there is a threat of reduction of its services. Such development would not be in the interest of SMEs, since they would then need to

approach other agencies, and not be able to use their mother tongue in the communications and application.

As the Finnish government is considered quite generous in helping SMEs, the functioning of the patent regime should be fixed to better serve SMEs.

G. Best practices for SMEs and individual inventors

The large companies were happy to provide some suggestions to SME companies and individual inventors concerning IP and IP rights.

- Employment contracts should include clauses transferring copyrights to the company as well as relevant non-disclosure commitments
- Employee invention process and policy is important and should be setup and communicated to personnel. SMEs not having these processes will lose inventions as they just are not spotted. Also, the process will reduce quarrels, which might arise if an employee is not informed properly about valuation methods and compensation policies
- Always use a professional patent agent to write the application. The value of a patent depends wholly on its quality, and its formulation should be left to an expert. The best patents are such that the inventor might not recognize that it's his invention, meaning that claims and description are generalized to an extent where it surpasses the inventor's imagination
- If financial resources allow, the patent application should be split into several applications, each containing one main claim and one view angle to the business case
- Be bold: The spirit in Europe is more risk evading. In the US a startup has no illusions and knows that it is almost certainly infringing someone's patent. But the attitude is more "wait and see what happens", rather than spending time and effort into planning and playing down the risk
- SMEs or individual inventors are not welcome to discuss their invention with large companies, before they have applied for patent. Large companies are vigorous in avoiding any communication that would impose the other party's business secrets on them thus severely limiting their freedom to choose their own standing
- An SME or individual inventor trying to sell a patented or patent pending idea to a large company typically overestimates the value of their patent. Large companies are willing to license from small players, but often the small players have a false conception about their invention's value and all the work that it needs to make it work for the large company
- Build your business case early and use trademarks and social media to do that. You should consider all these before applying patents
- The inventor quite often does not recognize when an invention is created. Someone should be looking at the process and help to recognize new discoveries. Checkpoints should be included in all R&D projects to do this

2016 Proceedings of PICMET '16: Technology Management for Social Innovation

TABLE 9: TOPICS GIVEN TO INDIVIDUAL INVENTORS TO BE DISCUSSED OVER THE TELEPHONE OR EMAIL

Topic	
1. Description of one's experience in inventing and how it was started	10. What commercial steps have been taken to make use of the patent? Was there any steps taken before the patent was granted?
2. Why has the interviewee applied for a patent in his/her own name, instead of a company?	11. Was there some "customer need" behind the invention, or has it been based on one's technological know-how?
3. What were the reasons and motives for the patent application? Could one identify any reason for not having applied for a patent?	12. What obstacles might there be in appropriating the patent value? Why does it seem difficult to make money with a patent?
4. How did the application process go about. Were external services used?	13. How does one observe if someone infringes the patent? And what happens then, has this possibility been considered?
5. Was the patent granted and is it still in force? How has the annual patent fees been financed?	14. How easy would it be to circumvent this patented invention and find a competing solution? Is there only this one patent, or is there some patent fencing around the invention?
6. In which countries has the patent been registered, and what routes have been used to enforce the patent in other countries?	15. What other IP protection methods are known to the inventor? Have these been used or considered? What benefits or problems might there be with these?
7. How long did the application process take? Did it go through without delays? Did you meet any objection? How much did it cost, altogether?	16. What methods or tools are used to research patents and find information about existing patents?
8. How has the patent been utilized? Has it been worth the investment?	17. What best practices might one recommend for other inventors or entrepreneurs in utilizing patents or other IP protection methods?
9. What is the estimated value of the patent? Has someone been interested to buy or license it? And what would be the price, if it was for sale?	18. Is there some feedback to the public sector policy makers, or assisting organizations? Has one received any kind of support from the public sector in the process and how has it all worked out? What is the level of satisfaction with the support received?

- Patents of SMEs and individual inventors are basically rather poor quality. They tell almost everything about the business case but are able to get very limited protection and might be easy to circumvent. If the application is poor, it should not be pushed forward. It is wiser to stop the process before the 18 months have passed, and rework the idea. Sometimes one can see that the idea has been really good, but the application is bad and has ripped all value from the invention

Individual inventors that were not affiliated with any company were interviewed by telephone (3) or by email (2). Five interviews have been carried out (Table 9), where the interviewees have been presented with 18 topics and asked to resonate their feelings, experiences and understanding of them.

One interviewee has an engineering background and has been all his working-life in sales and product development. He became an inventor and applied for first patents while working in a company, and has continued patenting his inventions now after retirement, as a hobby.

Another interviewee is a serial entrepreneur. He considers patenting as a hobby besides his working life. Once he by chance happened to invent a working solution to a real-life problem, and got it patented, and has continued inventing and patenting since then. He now has three patent families and patents enforced in 20-30 countries.

The third interviewee is an entrepreneur in rehabilitation business. He keeps on inventing and has several patents in force.

The fourth interviewee is a technician and has been working in middle-sized companies. He has one patent on his

own name, and three patents co-invented with separate companies.

The fifth interviewee did not provide any background information.

For private inventors applying for a patent on his/her own name, motives to patent are similar to those of SMEs, except for one – to be respected as an inventor. Getting a patent and setting it on display is a non-business motive, but reality for some.

Other differences between private inventors and SMEs and large companies include:

- Patenting is initiated and carried out without connection to any business
- Sever lack of marketing and business skills

Individual inventors were in general disappointed with the patent system and public support that they received – or were promised but did not receive. They found that the IPR regime only works for big companies, patent lawyers, IP consultants and public administrators. For an inventor there are little benefits and mainly just costs remain. All interviewees hoped that there would be some financial support to cover the costs of patenting and its commercialization.

IV CONCLUSION

The main goal of the paper is to enhance understanding of SME and individual inventor intellectual property generation, protection and utilization. The framework of this study considers inventors, companies, support structures, and policy makers as actors whose interplay should promote a well-functioning machine generating inventions, innovations,

and successful businesses. The goal is a society where inventions are made, innovations are sought, and prosperity is pursued.

Prior literature studied has typically much narrower conception about SME. Here, we have presented a broader variability of SME and indicated differentiating functions that we consider important in evaluating SME behavior on IP generation, protection and utilization.

Statistics show the clear downward curve of filings to the Finnish PTO onward from the 1990s. Patenting routes have shifted and most applications by Finnish inventors now go to EPO and/or WIPO. The share of Finnish SMEs of new patent applications is low, below the EU-27 average. This is partly caused by the small number of SME employment in Finland, as compared to many other EU countries. Another cause is found through the interviews, as professional patent services are not readily available for many SMEs.

Interviews with private inventors, large companies and SMEs show, that as opposed to large companies the general knowledge of IP protection methods and the functioning of the patent system is low among SMEs and private inventors. Also they miss necessary tools to organize and manage employee inventions.

Both large companies and SMEs suffer from the lack of IP and IPR education for engineers and business people. Basic understanding of inventions, intellectual property, IPR, patenting and IP business conduct should be in place. Capability to use patent databases and utilize their information should be included. It is recommended that the government will process these suggestions into practical solutions to ensure the successful harvesting of the Finnish inventive resources.

Peer level support would help SMEs to handle sudden infringement claims from other patent holders. Such support would best be organized by the chamber of commerce, or similar actors dealing with the SMEs.

This study contributes to the previous literature in providing a qualitative analysis of IP generation protection and use among Finnish SMEs and private inventors, while enriching the picture with views from large companies. It further contributes to increase understanding about the functioning and effectiveness of the IP rights system in general, and to role of SME companies within that system.

These results do not come without limitations. The more detailed differentiation of SMEs presented is not made full use of, here. The concept was created on the basis of experiences from interviews, and will only be piloted in future research. Also, it should be noted that the literature review is not comprehensive. For the sake of this research a limited review was sufficient for setting the scope. Thirdly, the statistical analysis of patenting trends should not be used to compare elements between different countries. To do this, a deeper analysis of the economic structures is necessary which has not been the purpose of this study.

Based on our findings and experience some suggestions for future research is provided. Obviously testing the

differentiation between various SME types is of interest. How much effect do different holdings, orientations or management structures have on SMEs behavior might be quite important to know. Such knowledge, if differences are shown, would help recognize the types of SMEs that are most prone to invent and use IPR efficiently.

Another research topic is to expand the interviews to include other IP generation, protection and utilization stake holders in the society. These include research institutes, universities, public administrators and policy makers, patent agencies, and financing companies. Such research would give a higher-level image of the systemic interplay between various stake holders within the invention and innovation society Finland.

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2016 Proceedings of PICMET '16: Technology Management for Social Innovation

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