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Legal fights for patent rights

Are the judicial concerns of small companies justified?

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Abstract— Patents and patenting have been extensively studied in recent years. Large firms are considered more advanced in their management of technology and prosecution of patents, while small firms possess a limited capacity to operate the legal quality of patents. This article deals with concerns expressed by small companies about the legal uncertainties of patents and patenting. We present results from our interviews and subsequently focus on studying patent litigations, in Finland. We present the types of parties, court actions, and industries with high litigation activity. Speed and cost of litigation is compared with selected other countries. Data are retrieved from multiple sources, including the Darts-IP database with a global coverage of IPR related litigation cases.

We find that an opposition action is the most frequent type of litigation, followed by infringement and invalidity actions. Combinations of infringement and invalidation actions are not as common in Finland, as seen in other countries. Most litigations are fought by and between large companies. Recommendations are given for technology management in small companies. **Introduction.**

I. INTRODUCTION

It is often argued that small companies are disadvantaged in their use of patents and patenting to protect their intellectual assets [26]. We know from literature that small companies' patents are of lower quality and value than those applied by and granted to seasoned applicants [6,16,17]. We also know that small companies are unwilling to disclose their inventions and do not trust the ability of patents to deter imitation [20]. Sichelman and Graham [38] list five reasons for inventors and startup companies to forgo patent protection on their inventions, including high cost of patenting and patent litigation.

Many small companies are aware of their lack of resources and capabilities in patent litigations, and fearing the unknown, they are reluctant to enter into the uncertain and risky business of patents, at all [40]. Such fears are not baseless, while the risk of litigation is much higher for patents owned by individuals and firms with small patent portfolios [27]. As a result, small companies' representation in patent applications and grants is far lower than their share of firm-demographics [14, 23, 24].

While small companies are aware of the risk related to patent litigations, they have a hard time trying to evaluate the size of the risk and the possible outcome scenarios and

consequences thereof. From our earlier interviews with small companies we have learned that entrepreneurs and small company managers pay attention mainly to the technological and business aspects of their inventions, neglecting most, if not all, legal aspects of their portfolio management. Their readiness to face judicial challenges remains low until an adverse event forces a shift of focus. This is in part due to poor understanding about how patents litigations work and the overall functioning of the judicial system. [41, 42]

While current research focuses mainly on infringement and invalidation prosecutions [1,10,15], we argue that a more fine-grained analysis of patent litigations is needed to enable small company managers and entrepreneurs to better evaluate the risks and requirements of legal prosecutions. We will show how small companies reflect the thought of patent litigations and their main concerns and misconceptions on the judicial system. Our research builds on this challenge and examines patent litigation cases processed in the Finnish courts of law to provide a detailed view of their different types, durations and costs with a lens of technology management in small companies.

This article contributes to the existing literature on technology management and judicial research on managing patent enforcement and prosecution. We offer, to our knowledge for the first time, evidence from the Finnish patent courts on the quantity and quality of patent litigations. Our research aims to support formulating IP strategies and enhancing technology management in small companies.

As small companies understand poorly patent related litigations, and while this low level of awareness is an important factor affecting their patenting propensity, we need to ask a rather broad question:

RQ 1: What are the types of patent litigations fought in the courts of law?

Small companies are ill prepared for legal challenges and their interest to initiate or preparedness to get dragged into judicial processes is generally low. Not understanding the factors behind litigations limits their chances of knowing the likelihood of getting sued, rendering them inefficient in their technology management. This leads us to our second Research Question:

RQ 2: What is the risk for small companies to get dragged into patent disputes?

Prior research has indicated that fear of high costs and financial obligations deter entrepreneurs from patenting. The higher the potential cost, the lower are the chances that they are able to survive, less alone thrive through legal disputes. This now leads us to our third Research Question:

RQ 3: How much does a patent litigation cost?

In summary, the objective of this paper is to enhance understanding of patent disputes, technology management and functionality of the patent system from an small company's point of view.

The remainder of this paper is organized as follows: The next chapter presents some prior research in relation to our research and the judicial environment of patent litigations. Chapter 3 presents the research setting and data, and in chapter 4 we present our empirical findings. Chapter 5 discusses these findings and presents our suggestions and chapter 6 is a conclusion of our research.

II. THE SETTING – PATENT DISPUTE ENVIRONMENT

A. Initial Interviews

We conducted a series of semistructured interviews during 2015-2016 among SME and large companies, private inventors, patent agents and policy makers [40-42]. For this research, we revisited the synopsis made from the interviews and focused on the patent prosecution and litigation related considerations and challenges of the interviewees. We also report the findings from interviews with IPR agencies and policy setting organizations, here, for the first time.

The details and demographics of the interviews with small and large companies and private inventors are given in [40]. Table 1 presents details for the interviewed organizations, not reported before.

We conducted semistructured interviews with experts in the IPR agencies and policy setting organizations. The focus of the interviews was to make sense of the functioning of the patent system for small companies, to understand the need for improved education in the field and to consider what type of actions public support organizations should take to

TABLE V. DETAILS OF THE EARLIER INTERVIEWS

Organization type	Count	Minutes	Interviewee positions
IPR Agency	6	991	CEO, patent agents, IPR consultant
Policy setting organization	12	1368	Civil servants in government agency, ministry, administration, public financing organization; managers in policy research, industry organizations, business development units

enhance the capabilities of businesses, in this respect. We made audio recordings of the interviews and prepared a comprehensive synopsis detailing the discussed topics and the main points of interest.

The interviews provide a wealth of detailed information on various aspects on SME patenting, awareness of IPR, sources of information, public support for inventions, functioning of the patent system, etc. The interviewees shared with us their thoughts, experiences and concerns about legal disputes, or uncertainties, challenges and fears thereof. The findings from the interviews form the basis of our study and lead us to our initial research problem.

The interviews reveal four main topics of concern to small companies. These are:

- Patents Are A Risky Game

The interviewees were influenced by news articles on patent trolls and high-profile litigations with extensive costs and damages imposed. Legal battles between well-known companies, like Nokia, Apple, Samsung and Qualcomm attract attention with their gargantuan costs and damages [13,36]. Small companies following these developments consider it a real risk that they might, even if unintentionally, infringe someone's patent and have to pay the harsh consequences. Even if they seek others' patents to ensure their freedom to operate, the possibility of infringement and costly compensations always exists. Court rulings are thought to be arbitrary and getting sued might mean an end to one's business.

- Patent System Is Too Difficult

Most small companies have a basic understanding of the functioning of the patent system. However, they also have many false ideas and excessive expectations about the system, clearly not quite understanding it's features and working. Some are confused by the perception of country by country differences in patent requirements. This is illustrated by differences in acceptance of multiple dependent a in the US and Europe. Small companies have a profound suspicion that the patent system exists to serve large companies, and is unmanageable by and does not provide real protection for smaller entities.

- Patents Are Not For Us

The high cost and eventual legal proceedings defers many small companies from patenting. They consider it difficult to notice if someone infringes their patent(s), and even if they found out, they would most likely not go enforce their rights, due to cost, time, required managerial attention and lack of know-how to prosecute. Employee inventions are not encouraged due to fear of a need to pay compensation to employees – this is a statutory requirement in Finland for employee inventions. Small companies lack the skills to manage the patent application and patent protection processes.

- Patent System Is Flawed

A pending patent application is troublesome since no one knows for sure which, if any, of the claims thereof will

eventually come into force. Small companies find it difficult to operate on a market where they cannot find certainty of their freedom to operate. In addition, reading patent documents and understanding what they actually protect and where the limits to the protection are is though excessively difficult. When applying for own patents, the small companies have a hard time drafting an application and understanding the judicial wording or claims making the whole system seem repugnant. There is also a common understanding that some countries do not respect patent rights, and thus the system is not worth the while for small companies.

From these findings we deduct that among small companies there is a low level of know-how and understanding about the functioning of the patent system, and especially it's judicial extension of enforcement, prosecution and litigation.

B. SMEs and patent litigations

Patent litigation is considered one of the most complex forms of civil litigation resulting in patent lawsuits being complicated and costly [18,44]. While patents and patenting are studied immensely in the last decades, we have found the intersection between research in technology management and judicial research less covered. Researchers in technology management, strategic management, business management and judicial scholars cover many fields of inventions, innovations, patents, patenting, and the patent system. They accumulate our knowledge and understanding of the numerous features and viewpoints thereof.

A number of judicial scholars have published works that lay the basic foundation to our topic. Most of their research focuses on the litigations in and functioning of the US patent system. We do not present a conclusive literature review but rather refer to some key documents as a base for our study.

In the US, patent litigation is concentrated. Almost half of the more than six thousand new patent litigation cases filed every year are filed in either Delaware or Eastern Texas [3]. Allison, Lemley and Schwartz [1,2] report that in US infringement litigations patentees win only 25 % of decided cases. Of all patents whose validity was decided, 43 % were held invalid. Lanjouw and Schankerman [27] have studied the standing of small companies in US patent litigations in their landmark research. They report that litigation risk is much higher for patents owned by individuals and firms with small patent portfolios. These findings are of interest to our research validating the necessity of our research questions.

A special edition chapter in [44] presents an overview and comparison of patent litigation systems across jurisdictions and lists following challenges:

1. Patent litigation is considered one of the most complex forms of civil litigation,
2. Litigation settled before reaching the court system is not publicly documented,

3. Private information exchanged between parties is not revealed to the court or, even if revealed, it is not recorded,

4. Information on cases is not centrally collated in many jurisdictions (i.e., information has to be accessed from individual courts), and

5. There are also substantial differences between jurisdictions that affect the interpretation of observed litigation data and make any direct comparison of litigation across jurisdictions challenging.

Moneywise, the United States is considered the most expensive country for patent litigation. Bader [5] reports that the average cost of a US litigation case grew from \$400,000 in 1999 to \$499,000 in 2001 per single case; a jump of 25 %. Menell et al. [34] report the median of patent litigation costs range from \$530,000 to \$5,9 million, case depending. Companies that launch or get dragged into litigations need to have a big war chest. The urge towards settlements is high, due to insufficient financial resources. The average cost to challenge a patent in the US is \$4-5 million [7]. The longer the litigation lasts, the higher the costs. Graham and van Zeebroeck [15, table 1] provide litigation costs, damages policies and other details in several European countries and the US. In Europe, patent litigation costs tend to be in the range of 50-400,000 €, while in the UK this figure is tripled and more than twenty times higher, in the US.

In Europe, Cremers et al. [10] compares patent litigation systems in Germany, the UK, Netherlands and France. She presents differences by jurisdictions and provides detailed information on the process structures, costs and durations. Her research reveals that the number of cases heard by German regional courts is significantly higher than the number of cases heard in the other three jurisdictions. She shows that a considerable number of patents are litigated across multiple European jurisdictions, and that there are substantial differences across jurisdictions in the outcomes of cases, judged on the merits of the case. Zingg and Elsner [45] introduced a patent quality term, a function of both broadness and definiteness of the patent and tested it in three largest patent-granting European countries – Germany, France and the United Kingdom – between 2008 and 2012. They find significant differences in patent litigation outcomes by technology, industry and jurisdiction, and a positive correlation between the patent quality proxy and the litigation outcome.

Researchers in technology management cover many aspects of patenting, such as motives to patent, appropriation strategies, behavior of various industries and technology domains, state of patenting in entrepreneurial and SME companies [20]. Marco [31] and Henry [19] discuss how patent litigations affects company market valuation, finding that the resolution of uncertainty decided by adjudication is as valuable to the firm as the initial patent grant. So, when a patent is granted its value to the company is limited because of the uncertainty of the patent's validity. When the uncertainty is removed, the patent's value is topped.

Bjuggren, Domeij and Horn [8] interviewed nine Swedish SMEs with experience of Swedish patent litigation. They reported that companies considered the proceedings too slow and costly. Small companies found involvement in litigation a difficult and disruptive experience.

The impact of patent litigation to small companies is studied in [21]. They report that the number of patent applications by the plaintiff SMEs decreases after patent litigation and argue that this could result from high costs of patent litigation adversely affecting their regular R&D activities. They also argue that patent litigation is a good learning event for SMEs, leading them to improve the quality of their future patent applications. Somaya, Williamson and Chang [39] find that in-house patent law expertise is a significant predictor of a firm's patenting performance.

Leiponen and Byma [28] researched alternatives between different IP strategy approaches in small firms. They raise policy questions regarding the functionality of the existing system of IP rights.

C. JUDICIAL STRUCTURES

Patent disputes are divided into administrative and civil litigation. Administrative litigation is a proceeding to overturn an adverse decision by the PTO, such as rejection of a patent application or a denial of an extension to a deadline. The agency examines and decides the case based on the law, evidence and arguments. Decisions by the PTO may be appealed against through the judicial transaction routes, described below.

Civil litigation cases are disputes between two private parties. In rare cases, civil litigations may be brought between a private party and a government agency over decisions that involve application of statute or law.

In September 2013, a specialized intellectual property court was established in Finland. The Market Court is the exclusive first instance for basically all IPR cases. It also processes appeals related to the registration issues and other administrative decisions of the Finnish PTO. In the Market Court, cases are handled by specialist judges who have significant experience and background in IPR matters. Appeals against the litigation-related decisions by the Market Court are registered with the Supreme Court and on administrative matters with the Supreme Administrative Court. Both of them require a leave to appeal [35].

The patent litigations deal with eight types of actions as shown in Fig. 1. Administrative litigations are initiated with the PTO, which serves as the first instance. The Market Court is the appellate level court and the Supreme Administrative Court delivers judicial review decisions. Civil litigation cases start at the Market Court, as the first instance. It's decision may be appealed against with the Supreme Court. Both the Supreme Court and the Supreme Administrative Court require a leave to appeal.

There are three actions concerning patent validity. Administrative hearings are de facto negative decisions by the PTO, such as rejection of a patent application or an application for a Supplementary Protection Certificate for prolongment of the term of a pharmaceutical patent. While such decisions are listed in the Darts-IP database, we note

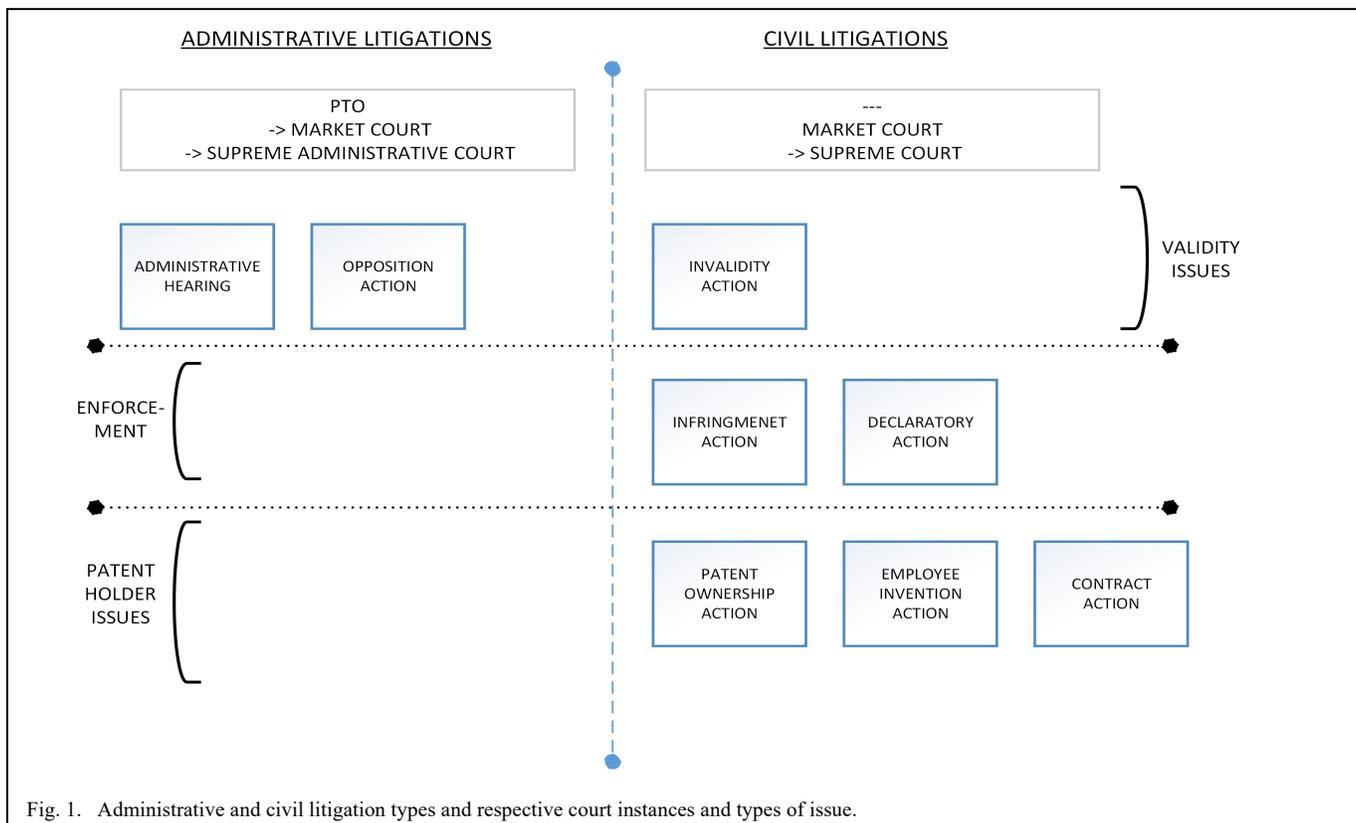


Fig. 1. Administrative and civil litigation types and respective court instances and types of issue.

that the database excludes all positive administration decisions, such as a patent grant. Thus, we should understand that ‘Administrative hearing’ cases differ from actual patent litigations. A nine months opposition period starts once the PTO grants a patent. During the opposition period, any third party may oppose the patent grant by registering a written opposition with the PTO. Typically, companies oppose patents close to their business. In addition, invalidation claims against a utility model may be put either to the PTO as an administrative case or to the Market Court as a civil case.

An infringement action the first of the two enforcement case types. A patent holder initiates it against a suspected infringer. If the suspected infringing party fails to setup a license deal with the patent holder or convince the latter that there is no infringement, the patent holder may file a petition with the Market Court, and a trial will start. Declaratory actions establishing non-infringement means petitions where a party ask the court to conclude that the party is not in infringement of a specific patent.

Patent holder case types include actions related to patent ownership, a contract or employee inventions. Finnish employee inventions are governed by the Act on the Right in Employee Inventions and the Act on the Right in Inventions made at Higher Education Institutions. They lay the terms for the employees and an employer to agree upon the rights to inventions made under an employment contract or in the university research. Disputes concerning employee inventions are civil litigation cases with the Market Court as a first instance. There is a statutory rule that an employer claiming the invention made by an employee shall pay the latter fair compensation for the invention. Litigated cases most often relate to disagreement between employee and the employer upon what is considered a fair compensation. Ownership disputes arise when, for example, the business is sold or consolidated with another company, and the ownership of the patent(s) is obscure. Both parties may claim a better right to the invention, and its respective patent. Disputes on patent related contracts actually deal with patent ownership, and whether or not a contract exists for transfer of the rights. Occasionally, licensing agreements are a source of disputes, in this group of actions.

III. DATA AND RESEARCH SETTING

This research is rooted in our earlier interviews having shown the small company managers’ need for a clearer picture of legal prosecution of patents. We have consequently identified sources of data on patent litigations and experts in the field to interview. This research is qualitative by nature, and uses a mixed-method approach. We conduct analysis of litigation cases and sense making interviews to generate an understanding of the judicial processes in patent courts from the viewpoint of technology management. Our research setting and steps follows the structure in Fig. 2.

A. Data

The patent system in general provides a wealth of information freely available for anyone to search and find. The same is not true for patent enforcement. Only a fraction of all patent disputes ever enters into litigation. Lemley, Richardson and Oliver [30] suggest that probably as much as 90% of all patent enforcement remains unlitigated, and thus, unobserved. This main body of patent enforcement remains outside of the scope of this study. Even when prosecuted, the litigation occurs primarily out of sight, in the privacy of the court system. Comprehensive information about the cases, their backgrounds, prosecution and results are hard to find.

1) Darts-IP

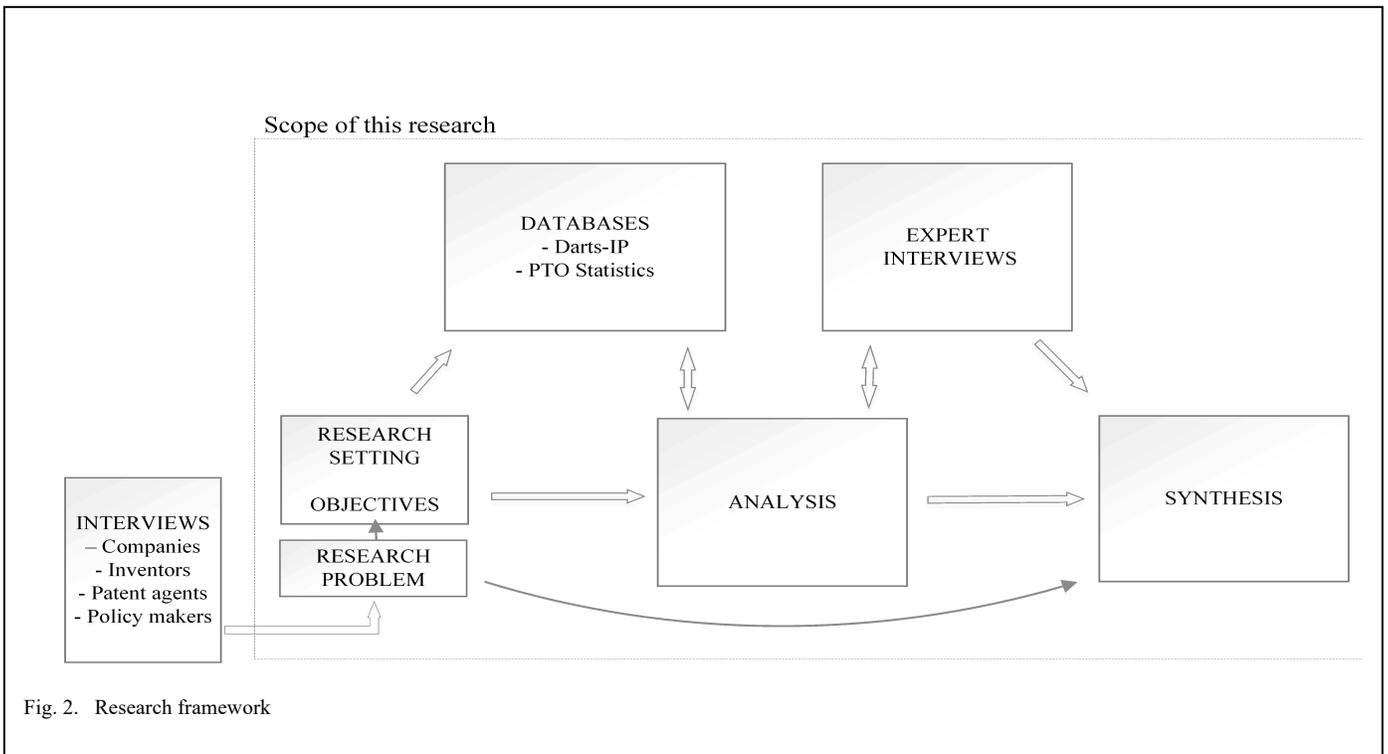
In various jurisdictions, court documents are, in principle, public and may be retrieved by requesting them from the court. In practice, this requires prior knowledge about what to ask for, and renders this route for information retrieval difficult and unwieldy. In our research, we make use of the commercial Darts-IP database¹. For years 2000-2017 the database contains 1,055,008 patent cases distributed geographically as shown in Table 2.

We downloaded, with gratitude of the Darts-IP company, patent litigation cases for Finland. This dataset includes 1025 litigation processes with 2074 separate adjudications. We then limited the scope to cases which have been initiated between January 1st 2000 and December 31st 2017, discarding any appeal or judicial review level records, where the case had been initiated prior to year 2000.

TABLE VI. DARTS-IP PATENT CASES BY COUNTRY/REGION

Country/Region	% of all cases
Japan	23.2
Europe (incl. the UK)	16.9
The United States	16.2
China	16.1
Commonwealth (incl. Hong Kong)	12.2
Brazil	8.8
South Korea	4.6
Other countries	2.1

¹Darts-IP is a commercial database service brought to market by a Belgian company Darts-IP. The company, founded in 2006 by an IPR lawyer, Mr. Jean-Jo Evrard, has compiled legal databases containing information on millions of Intellectual Property legal cases, worldwide. At present, four domains of intellectual property - patents, trademarks, design rights, and domain names are covered.



As the court processes easily drag on for many years, we cannot with certainty know which of these cases have made it to the final conclusion, and which remain yet to reappear at a higher-level court. It is likely, that some of the first instance cases will proceed to the Appeal level, and some even to the judicial review level. To minimize the number of open cases, we searched the database in January 2019 and added all appeal and judicial review cases that were connected to our dataset and were concluded in 2018. The final dataset used in this research includes 910 court cases with 1808 documents.

2) Patent data

We make use of the patent statistics from the Finnish PTO to perceive how litigation activity relates to changes in patenting and the number of patents in force. The data have been retrieved from the Finnish PTO web site [37]. During the course of research, we have made frequent explorations to patent databases Espacenet and the Finnish PTO's Patinfo, to control for the details of patents in the litigations. Information, such as ownership, validity and registered opposition has been checked to improve our interpretation of the litigation data.

3) Interviews

We have reported the findings from our initial interviews with small and large companies, private inventors, policy makers and patent agents in our previous publications. For this research, we have revisited our synopsis of these interviews focusing on the motives to forgo patenting and reflections of the interviewees on patent litigations. These provide the basis and background for our research.

We conducted a second set of interviews during the research, while analyzing data from the litigations. We

contacted eight experts affiliated with patent prosecution and carried out one or more telephone interviews and further email exchanges with them, in order to clarify and make sense of the findings.

4) Literature

We make reflections to relevant findings from literature, such as comparisons to other countries. Taking up such findings where they add value to our findings, we present them and discuss them in the results section.

B. Research setting

The basis for our research setting and objectives are the interviews with a number of small and large companies, private inventors, patent agents and policy makers. We have reported findings from these interviews earlier. In this research, we have furthered the analysis of those interviews with a focus on patent prosecution. We are set to provide a depth of understanding into the patent litigation cases through studying and analyzing a large dataset of patent litigation cases and analyzing the characteristics of different types of cases.

We follow a hermeneutic research strategy with a goal for an in-depth understanding of the researched phenomenon of patent related judicial prosecutions from the perspective of technology management in small companies. The research approach is descriptive-analytical, as we seek to make a systematic classification of the empirical dataset and draw conclusions from the findings. The research is empirical-descriptive as we elaborate our analysis through further interviews with experts in the field.

To answer our research questions, we conduct the research, as follows:

1) Identifying the types of patent litigations fought in the Finnish courts of law, we analyze the cases in our dataset from the Darts-IP database to present the frequencies of different case types. We classify the cases to reflect the concerns revealed through our analysis of prior interviews.

2) We consider the probability of entering into patent litigations through evaluating the number of cases in comparison with the number of patent data, from the PTO statistics. We further refine our results through interviews with experts in the field.

3) We base our evaluation of the cost of patent litigations on expert interviews and on checking the Darts-IP database for any court decisions on costs and compensations.

Finally, we synthesize our findings into results and recommendations based on the analysis of data and findings from expert interviews, reflecting our initial research problem and the respective research questions. We make comparisons with findings from the literature, where relevant and valuable.

IV. ASPECTS OF PATENT LITIGATIONS

Now we are ready to institute our fact-finding mission into patent litigations. First, we will discuss how the prosecution of patent applications unfolds, at the Finnish

PTO.

A. Prosecution of patent applications

Table 3 shows the status of all patent applications, as of February 2019, that have been filed between years 2000 and 2017. The number of applications stands for national first filings, as well as PCT national phase applications received by the PTO. Prosecution of the applications from the first four years, in the table, has been accomplished, resulting in either the application being dropped, canceled/rejected, or granted a patent. Some of the applications from 2004 onwards are still active applications, without a PTO conclusion.

We find the share of patent applications that were granted a patent ca. 45%. For the latter years, the percentage is lower due to a number of applications still in the process.

We also notice that the main reason for applications to cease is abandonment by the applicant. Mostly such an event occurs after an office action that requires the applicant to respond, but about a fifth of abandonments result from neglecting the payment of patent maintenance fees.

It is also interesting that some of the earlier applications are still in the process, and yet not decided, even after 15 years from the first filing. We interviewed a PTO representative to gain understanding about this phenomenon, and found out that a small number of patent applicants seem to be satisfied having a pending application, for as long as

TABLE V. STATUS OF PATENT APPLICATIONS FILED 2000-2017, AS OF FEBRUARY, 2019
BASED ON [22]

Finnish PTO Patent statistics							
	Applications	Processing	Rejected	Abandoned	Cancelled	Granted	% of appl.
2000	2,915	0	27	1,465	104	1,319	45.2 %
2001	2,663	0	18	1,324	121	1,200	45.1 %
2002	2,377	0	19	1,224	82	1,052	44.3 %
2003	2,193	0	11	1,102	94	986	45.0 %
2004	2,228	1	21	1,209	72	925	41.5 %
2005	2,068	5	7	1,171	82	803	38.8 %
2006	2,021	0	14	1,099	88	820	40.6 %
2007	2,020	3	18	1,098	90	811	40.1 %
2008	1,952	4	15	1,089	102	742	38.0 %
2009	1,943	5	6	1,093	85	754	38.8 %
2010	1,835	12	9	1,058	65	691	37.7 %
2011	1,779	20	10	1,000	76	673	37.8 %
2012	1,830	38	17	960	52	763	41.7 %
2013	1,744	77	9	930	61	667	38.2 %
2014	1,551	111	9	826	48	557	35.9 %
2015	1,421	225	1	734	62	399	28.1 %
2016	1,373	385	4	606	49	329	24.0 %
2017	1,530	692	2	615	61	160	10.5 %
TOTAL	35,443	1,578	217	18,603	1,394	13,651	

possible. Thus, we identify and observe a patent strategy where a pending status of a patent application is preferred over a decision, either a grant or rejection, by the PTO.

The PTO decisions rejecting a patent application may be appealed against at an appellate level court. During 2000-2017, there were 158 such administrative litigation cases, of which the applicants won 30 and lost 121. The supreme administrative court granted leave to appeal in 65 cases, of which the applicants won 6 and lost 56. Thus, the win-rate of patent applicants was 19% at the appellate level and 9.2% at the judicial review level. The overall applicant win-rate where the PTO's adverse decision was overturned was 22,8%.

B. Disputing patent's validity

After the application is prosecuted and if a patent is granted, its validity may be challenged through opposition and invalidation actions. In Finland, opposition action seems mainly a business of a small number of companies. The top-10 companies, seen in Table 4, filed 128 opposition actions comprising some 47 % of all opposition actions. The companies whose patents are opposed, are also few, with 10 companies in defense of 45 % of all cases. Metso Group and Andritz are the two most active companies in opposition actions both ways.

Once the opposition period has expired, the patent may still be revoked by the Finnish Market Court by filing a petition to invalidate the patent (Invalidity action). The list of 98 cases initiated in the Finnish courts 2000 -2017 consists of 84 plaintiffs and 84 defendants. Thus, attacking others' patents through invalidity actions is less concentrated than actions of opposition. The top 10% of companies active in petitioned ca. 22% of all invalidation actions.

C. Enforcing patent rights

Allegations of infringement of a patent accounts for the second most frequent litigation type. Here, large companies prevail and the pharmaceutical industry is leading the path petitioning over 30 % of all infringement cases. Around half of the top-20 plaintiffs and defendants in infringement cases are pharmaceutical companies. Other industries actively pursuing or defending infringement cases are machinery, chemical industries, technology and forest industries.

It is often thought that infringement petitions are tied to actions seeking to invalidate the disputed patent. This does not seem to be the case in the Finnish patent courts. Matching all 161 infringement cases with the 304 opposition cases and 98 invalidity cases in our dataset, we identified all infringement cases which are preceded or followed by an opposition or invalidity claim and referring to the same patent number. Checking for the plaintiff and defendant names is sometimes tricky as company name and ownership changes become visible in plaintiff/defendant names, in due course. We have tried to account for these changes using

internet searches and information from the Finnish company registry database².

TABLE IV. COMPANIES FILING AND RECEIVING MOST OPPOSITION WITH THE NUMBER OF CLAIMS.

Companies in Opposition Actions	
Opposing	Opposed
Metso Group 46	Andritz 42
Andritz 37	Metso Group 27
Kvaerner 18	Valmet 11
ABB Asea Brown Boveri 13	Kvaerner Group 10
Valmet 8	UPM-Kymmene 9
Foster Wheeler 8	Vacon 9
John Deere Forestry 6	Ponsse 7
UPM-Kymmene 6	Foster Wheeler 5
Stora Enso 6	Kemira 4
Ab Enzyme GmbH 6	Stora Enso 4

In addition, the patent number given in the litigation data is sometimes obscure. The court documents are sometimes not consistent with their managing of the IP right numbers. Occasionally, court documents have made note of a patent application number, which, at a later trial might be replaced with a number of a granted patent, either a Finnish (FI) or a European (EP) patent number. And if a patent application is divided, or turned into a utility model application, the new numbers will make their way to the court documents. While these numbers are all inherently related to the same invention and disputed IP right, the intrinsic variability in the numbering scheme makes it hard to make the connection

between different court stages. A fair effort has been made to search the patent databases and to secure these connections between the document numbers This research has brought us only 27 cases (16,7 % of all infringement actions) where the suspected infringer has initiated an invalidation action or opposition action against the disputed patent. Similarly, these 27 cases represent 6.7 % of all 402 opposition or invalidation actions.

D. Disputes of patent holders

The overall number of actions concerning employee inventions, contract or patent ownership remains low. This is, however, an important litigation action for smaller entities, and especially to private individual inventors. Out of the 77 litigations, here, private individuals acted as a plaintiff in 59 cases, and as a defendant in 15 cases. Most of the companies involved in patent holder disputes are large, well-known corporations, with a few exceptions of small companies, public organizations and NGOs.

E. Overall view of litigations

² ² Finnish company registry <http://www.ytj.fi> is searchable by company name or the registry number. The registry is used, here to check changes in company names, as necessary.

FIRST INSTANCE CASES - PLAIN

Fig. 3. First instance case types initiated in the Finnish pa

The total number of first instance cases covering our research period was 669. The frequency of the types of litigation actions, at the first instance courts is seen in Fig. 3. Opposition action (304 cases) is the most frequent – slightly below 50 % of all litigation cases. Next comes the infringement action (157 cases and 23.4 % of all) followed by invalidity actions (98 cases, 14.2 %). The remaining cases are actions relating to ownership of the patent (38 cases, 5.4 %), employee inventions (25 cases, 3.5 %), non-infringement declaratory actions (22 cases, 3.2 %), and other issues (25 cases, 3.3 %).

The total number of plaintiffs in the first instance litigations is 268. The top-30 companies accounted for 47 % of all the cases (Fig. 4). The IP strategy of the active plaintiffs is probably more aggressive than average. The list comprises mostly of public listed companies, other large companies and

companies owned by large companies. Lower in the list, Biobe, Vaahto and LMP Patents are small companies while Tamfelt, Teknoware and Langh Ship are medium-size companies. Leitzinger is a patent agent and most probably litigates on a clients' behalf.

The number of patent applications received and patents granted or validated by the PTO, as well as the number of patents in force at a specific year are shown in Table 5, in parallel with the litigation numbers for the same year. The numbers include first instance cases only, and exclude administrative hearings, which we do not consider representative of genuine patent litigation cases.

The total number of validity disputes is more than twice higher than that of enforcement disputes. We find the

TOP-30 COMPANIES IN CIVIL LITIGATIONS

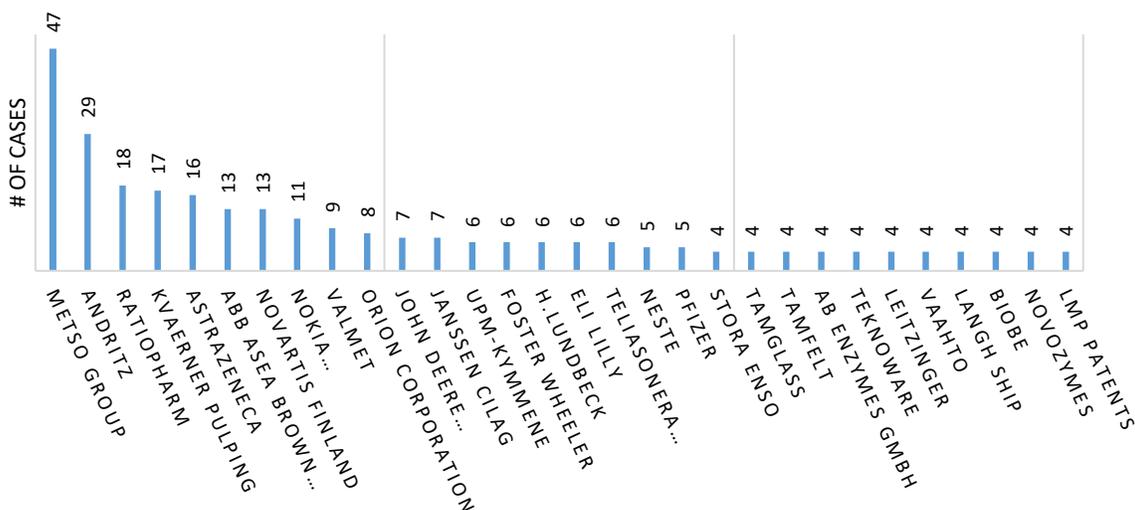


Fig. 4. First instance civil litigation actions initiated by companies in the Finnish courts, 2000-2017.

TABLE VI. FIRST INSTANCE PATENT LITIGATIONS AND PATENT STATISTICS FOR 2000-2017

	Darts-IP database			Finnish PTO			
	Actions related to:			Patent statistics			
	Validity	Enforcement	Patent holder	Applications	Granted	Validated	In force
2000	23	5	2	2,915	N/A	N/A	N/A
2001	23	7	11	2,663	N/A	N/A	N/A
2002	33	1	12	2,377	N/A	N/A	N/A
2003	29	7	1	2,193	2,402	6,266	31,963
2004	60	6	2	2,228	2,075	5,759	36,059
2005	16	3	1	2,068	1,757	5,639	39,471
2006	18	3	15	2,021	1,059	6,469	43,345
2007	20	9	2	2,020	921	5,478	44,522
2008	17	6	0	1,952	998	5,245	47,027
2009	15	29	4	1,943	1,055	4,556	47,294
2010	11	28	8	1,835	923	4,644	46,622
2011	15	30	4	1,779	841	4,764	47,055
2012	27	16	0	1,830	835	5,249	47,943
2013	31	4	8	1,744	711	5,164	47,791
2014	29	2	3	1,551	786	4,724	48,190
2015	33	8	3	1,421	931	5,121	48,485
2016	0	10	1	1,373	815	5,956	48,978
2017	2	9	0	1,530	704	7,065	50,315
TOTAL	402	183	77	35,443	16,813	82,099	

number of validity disputes dependent on the number of patent applications and patent grants, which is logical, as validity disputes consist of opposition and invalidity actions. Table 6 presents the comparison of litigation numbers with that of patent applications and grants (including EPO patents validated in Finland). Enforcement actions and a sum of all action types compared to patent grants and the number of patents in force, at the specified year. Comparing these figures with other researchers' findings, we can deduct that, in general, patents are litigated less in Finland, than in the US, where the number of patent litigation cases to the number of in-force patents is ca. 1,7 ‰ [9, 32].

F. Time and money

The overall duration of litigation varies by country and by litigation type. While Infringement litigations are typically the hardest, cases for employee inventions are the slowest to prosecute. Table 7 presents average infringement litigation durations in some countries, measured from the petition filing date to the date of adjudication. In the US some district courts offer a fast ('rocket docket') resolution of civil cases, where adjudication may be reached in less

than a year. In the US districts with the most patent litigations, the time to a trial is typically two to three years, median at 2.4 years.

TABLE V. NUMBER OF VALIDITY ACTIONS, ENFORCEMENT ACTIONS AND ALL LITIGATIONS COMPARED WITH PATENT STATISTICS FOR YEARS 2000-2017.

	Mean	Median	SD
Validity vs. Applications	1.13 %	0.88 %	0.0070
Validity vs Grants	0.33 %	0.27 %	0.0020
Enforcement vs Grants	0.19 %	0.12 %	0.0018
Enforcement vs In force	0.02 %	0.02 %	0.0002
All actions vs Grants	0.57 %	0.62 %	0.0026
All actions vs In force	0.08 %	0.09 %	0.0004

TABLE VII. AVERAGE DURATION OF INFRINGEMENT CASES IN THE FIRST INSTANCE COURTS

Country	Months in first instance	Source
Finland	11	This study
Sweden	35.5	[8]
Netherlands	12	[44]
France	18-24	[10]
Germany	14	[44]
UK	24-36	[44]
	12-14	[10]
US	18-42	[44]
	28	[4]
Japan	12-15	[44]
China	6-18	[44]

In Finland, the Market Court pursues to conclude within one year of the commencement of the litigation proceedings. This target has been rather well achieved, as the average duration of a patent dispute in the Market Court is 10.7 months [26]. Larger patent litigation suits, such as combinations of infringement and revocation proceedings, seem to last longer. From our discussions with practitioners in patent litigation we find that a typical patent litigation suit in the Market Court takes anything from about 3 months to 3 years, case depending. Opposition suits are judged in the Market Court in about 14 months, while employee invention disputes are slowest, taking in average 22.6 months to conclude. An estimated average time of litigation in the Market Court is 11 months. It should be noted that these figures are based on a one-year statistics with rather modest amounts of cases, and they should be interpreted with caution.

If the court conclusion is challenged to a higher-level court, the total duration of the process may take many years. In average, it takes 19 months from the first instance adjudication to a court conclusion at the appellate level, and 25 months from the appellate court adjudication to the court conclusion at the judicial review level. Sometimes, the adjudication at a higher level refers the case back to a lower level court, which means that the litigation process will start again, from the beginning. Long duration of the court proceedings means higher legal costs and the longer time in a state of uncertainty for the parties.

We have approached practitioners to estimate legal costs of patent litigation. We find that on each court level the cost is in the range of 50-200.000 euros, depending heavily on the case complexity and the amount of evidence brought to the court, witness and specialist hearings and possible changes in the parties' approach, during the process. In principle, the losing party shall pay all legal costs of the winner. In practice, it is not quite as straightforward, as the court may rule otherwise. Sometimes both parties are ruled to cover their own costs. On other occasions the losing party is ruled

to pay the winner's costs in part, only. Typical events where the judge might not award a losing party to pay the full amount of the winning party's legal costs include situations where:

- The case brought to the court by the plaintiff has not been obvious, justifying the judicial processing and court ruling on the issue.
- There exists a disparity in the measures that the parties have exercised to present and defend their case. Especially if the winning party has demonstrated excessive action measures, as compared to the loser, and the loser has not neglected defending his standing, the court may cap the winner's cost demands to a reasonable level.
- The legal costs of the winning party are considered excessive and oversized as compared to typical rates of lawyers in the industry.

The cost of stating opposition against a patent is around 10.000 euros, according to interviews. If the case proceeds over several stages, each stage will cost approx. that amount.

V. RESULTS

While the findings of our research are presented in the previous chapters, we will highlight those, which we consider the most interesting.

A. Findings from the interviews

First, we have revisited the data from our earlier interviews and deducted four important topics why small companies, in general, prefer to remain outside the patent regime. These topics are:

1. Patents Are A Risky Game
2. Patent System Is Too Difficult
3. Patents Are Not For Us
4. Patent System Is Flawed

Small companies perceive that the patent system carries a risk to those involved. It is much harder for them to actually know what the risk is, how to measure it and what to do to minimize it. In addition, only few small company managers are fully aware that patents are negative rights, which must be proactively enforced. It is common to think that possessing a patent will inhibit others from entering your market, or, at minimum, using your technology. This is, of course, not the case, as patents must be considered rather a sword, than a shield. Many small companies assume as well, that patents are well-defined tools for protection inventions and businesses against imitation. It is unpleasant and difficult for them to accept patents as probabilistic property rights [11, 29], where uncertainty is built into the system and almost every patent is breakable [43].

Another point of interest is the conceived poor functioning of the patent system. One manifestation of which is the well known but not quite so often stated fact, that reading and understanding a patent document might actually

require much more than a 'person having ordinary skill in the art'. The ability to read and understand a patent's scope and width of protection is far from trivial. We consider this an important problem, which the policy makers and patent offices should focus on.

B. Prosecution of patent applications

We have shown that some 45% of all patent applications are allowed, and a patent is granted to the applicant. Those not granted are either rejected (ca. 1%), abandoned (ca. 51%) or cancelled (ca. 3%). There is a large variation of these percentages by examining office [44]. Germany, for one, is close to Finnish figures with 42,5% of applications allowed, 22,7% rejected and 34,8% withdrawn or abandoned. Norway has a low rejection rate, like Finland, allowing 52,7%, rejecting 0,3% and having 46,9% of applications abandoned or withdrawn.

We have not researched the reasons for abandoning patent applications, but assuming that small companies are over represented in abandonments this line of research would be of great interest for our research topic.

We showed that fighting in the court to overturn a PTO rejection of a patent application results in a favorable decision ca. 22% of the time.

The overly long pending time of a patent application raises many questions, too. As we know, in some countries the examination process can be postponed for several years, before the applicant needs to either pay the examination fee, or drop/cancel the application. This is not the case in Finland, and there is little information, so far, on why and how such prolonged applications exist.

C. Answering the research questions

We will now focus on formulating answers to our research questions, based on what we have reported in the previous chapters.

RQ 1: What are the types of patent litigations fought in the courts of law?

We have recognized three types of patent litigations:

- a) Issues related to patent's validity
- b) Issues related to enforcing IP rights
- c) Issues that focus on the patent holder's business

We presented the distribution of the 669 litigation cases and discussed their features, in detail. Issues related to patent's validity (i.e. opposition and invalidation actions) are the most frequent, followed by issues related to enforcement (i.e. infringement action and declaration of non-infringement). Patent holder issues, such as employee invention, contract and patent ownership actions are less frequent.

Opposition action is a playing ground for a small number of large companies, while invalidation action is much more evenly distributed among a large number of companies. Infringement action is dominated by pharmaceutical

companies and individual inventors are most active in patent holder issues.

We have constructed a picture of patent litigation field and showed the types of actions, within. Thus, we conclude to have answered our first research question.

RQ 2: What is the risk for small companies to get dragged into patent disputes?

Bjuggren [8] reported that in Sweden 123 patent cases were filed between years 2000 and 2008. Cremers and Schliessler [12] report 4587 cases in Germany, 1002 cases in France, 326 cases in the Netherlands and 256 cases in the UK for the same time period. Our study shows that in Finland there were 332 first instance cases. It certainly looks like Finland is getting patent litigations over its fair share. Despite some uncertainties in the figures, described below in the Limitations chapter, we can postulate that in Finland patents are litigated actively.

We have shown that ca. the ratio between patent litigations and patents-in-force is ca. 0,8%. This is less than in the US (1,7%). Cremers et al. [10-11] have shown that a considerable number of patents are litigated across multiple European jurisdictions and that Germany is the most important country for patent litigation. As the majority of patents in force, in Finland, are European EP patents, it is likely that disputes concerning these patents are not fought in the Finnish courts. Plaintiffs might rather select bigger battlefields, such as Germany, where a positive adjudication's impact is considered bigger.

Bjuggren [8] reports that ca. 27% of defendants in patent cases are small companies. Lacking data on company size we are unable to conclude the share of small companies in Finnish litigations. The risk of litigation is higher for small companies with less patents in their portfolio [27].

We conclude that due to lack of detailed information on the company size in litigations, we are unable to answer our second research question, in full. We can say that patent litigations are an active field, in Finland, and that according to research, small companies face an increased risk, thereof. Further research is needed to allow for a more detailed picture of the situation.

RQ 3: How much does a patent litigation cost?

We have carried out expert interviews to identify and evaluate litigation costs in our previous chapter. We have then reflected these findings to the numbers from other countries, available in literature. We conclude that while the cost of patent litigation depends heavily on the type of the case, an average estimate that any small company manager should bear in mind while considering legal actions, is in the range of 50-200.000 euros, per court level.

Additionally, we have shown the prosecution times in the court for different types of actions. As the legal proceedings might drag on for years and extend to multiple court levels, there is not a simple answer to the duration issue. We conclude, however, that the estimated times and comparisons with other countries provides a sufficient insight into the duration of court proceedings.

Thus, we have answered our third research question with this conclusion.

D. SME perspective

We find that by far, the most litigations are fought by and among large companies, or their subsidiaries. Pharmaceutical and (bio)chemical industries prevail in lawsuits, although a forestry engineering company, Metso Group, is the clear "winner" as per the number of litigations, in the Finnish patent courts. Nokia is, in general, known as an active IPR enforcer. It's appearance in the Finnish courts is rather scarce, which might indicate that the company has selected other battlefields for their litigations.

Infringement and opposition actions are clearly a game of big companies. No small players are found on their top-20 lists. Invalidation actions are more evenly distributed, and no company-size bias is visible, there. Administrative litigations are also quite evenly distributed, although only few companies ever work through administrative litigation processes more than once.

Infringement litigations are the ones most feared by small companies. A threat of large legal costs appended with damage compensations and even punitive damages brushes many smaller entities away from patent business. It is comforting to see that infringement litigations are in practice fought between large players, and small companies are not seen on the top-lists of these actions.

It is notable that the legal costs for patent litigation run very high, for a small company. Not very many of them can arrange and carry the financial burden of patent litigations. This observation remains a major obstacle for small companies in their efforts to make use of patenting and patents, efficiently.

E. Limitations

Our research does not come without limitations. First, we recognize a significant probability that the Darts-IP dataset is lacking case information and case documents. We have amended our dataset, on the run, when finding new court decisions. We believe, however, that this shortage does not distort the overall picture, and the data that we have used is reliable. In order to have faith in our data, we have made occasional sanity checks double checking the Market Court decisions directly from their site for any discrepancies [33]. None were found.

On the other hand, the downloaded dataset occasionally mixes the process numbers untangling court documents, that should be connected. We have worked vehemently to correct such flaws, to the best of our skills.

There is also a challenge with the patent numbers used for case reference. The practice of courts in listing the patent identification number is vague. Sometimes a patent application is listed, another time there is a patent number. We have also found respective European EP patent numbers and utility model numbers, when a patent application has been converted to a utility model application. And then there is also different version numbering of patent applications.

The obscurity in the numbering scheme makes it sometimes very difficult to know, which patent (or IP right) related disputes the court is processing. We do not see an easy way to solve this issue, as it is up to the court practices to improve information management.

Having a correct number of litigation cases is crucial for the reliability our research. We realize that while each case is listed on a new line, in our dataset, there are occasions where more than one patent is disputed within the same case. There are as many lines in our dataset, as there are disputed patents within a case. If this is not accounted for, the number of cases will turn out too large. We have reported such cases for as many times as there are patents involved.

And finally, reference to company names in the court documents is variable. No company identification numbers are used, but companies are rather just named in the documents. The naming might contain typing errors, different versions of the name, different combinations of names, when there are more than one party, on one side, etc. It is therefore important to run a cleaning operation to unify the naming of the companies. We have carried out such operation and estimate that in about 15 % of the cases we have had to correct the writing of the company name.

Apart from challenges with the database content, our research covers a long period from 2000 to 2017. Many companies have disappeared during this time because of a name change, sale or consolidation of the company, or the company going out of business. Name changes can be challenging, especially when we wish to identify cases where a company sues another for infringement, and then we would like to find if there is an invalidation action brought by the other company. We have identified a few of such cases but cannot be quite sure that all are found.

VI. RECOMMENDATIONS

A. Research recommendations

Studying patent litigation from the perspective of technology management is both challenging and interesting. While judicial scholars cover many aspects of the patent system's functionality and systemic performance, and researchers in technology management bring forth evidence of patents and patenting from the corporate viewpoint, very few researchers tackle the interplay between these two fields. As a result, there are lots of possibilities for research and creation of new knowledge. From our study, we would like to point out few possible fields of interest, that would need additional attention.

Legal databases and other data sources are now available to provide detailed and high-level information on patent litigations. The plaintiffs and defendants are found in the databases, as well as the patents and other IP rights, subject of dispute. It is rather easy to identify companies who are pro-active in litigations, and thus, display an aggressive approach to IPR enforcement. It is not as easy, however, to find out and identify the companies who have no active role in patenting (thus, who do not possess patents or patent applications), but who are dragged into legal disputes,

anyway. We know from literature on NPE litigations, that these patent "trolls" eagerly sue small companies or even private persons, who know nothing about patents, have no experience on IPR, and are unable to respond to legal threats, made by the NPEs. But beyond this scope of patent litigations, we suggest that it would be beneficial, especially for small companies and entrepreneurs to gain a better understanding of who could possibly sue them and for what reasons, and eventually if that happens, how they should operate to manage the situation and to survive and prevail the experience.

A lot of research has been carried out on patenting performance, motives to patent, IP strategies and technology management in small and medium sized companies and entrepreneurial companies. These companies are an important for countries and regions, because of their potential to create work places. Innovative small companies are also seen as a driver for technological development, as they are often a source of inventions and innovations. Researching patent litigation from the perspective of small companies is challenging. No information about the company size is available in the court documents, nor in patent databases. Business databases are found that contain firm turnover, balance sheet and occasionally number of employees. It would be very interesting and beneficial to combine such information with information on patenting and patent litigation. Such data would extend the research field from current case-study type qualitative approaches, seen in technology management research, or the statistical analysis type studies, found in econometric and business research, and provide in-depth analysis of the performance of small companies in patenting and patent litigation, and an enhanced view of the functioning of the patent system and patent judicial system, from an SMEs point of view.

B. Policy recommendations

The functioning of the patent litigation system has been under scrutiny, in this research. Some findings are valuable for consideration in public policy making, in order to further enhance the system, and especially enable small companies to better manage judicial risks within the patent system.

Small companies have reported that they find the patent system flawed in ways described in this article. The one flaw, which we wish to highlight and consider utterly important, is the difficulty of reading and interpreting patent documents. Small companies argue, with good reason, that a person 'skilled in the art' should be able to understand the invention described in the document, which is not the case, currently. We encourage policy makers and patent and trademark offices to focus on this challenge and seek ways to improve the readability and comprehension of patent documents.

We find that provision of case data by the courts is unstructured. The contents of court conclusion documents follow an overall structure, but there is a large variance of information content given. Sometimes the date of petitioning is noted in the document, but most often it only the docket number is present. The docket number typically does not

reveal when the petition has been filed. Thus, we recommend that courts work to harmonize the structure of the conclusion documents, at least on each court level, and at least to include the date when the petition was filed.

Likewise, names of the parties and patent (or other IPR) numbers published are sometimes indefinite or conflicting. We recommend the courts to request the plaintiffs to report company identification numbers for all involved parties. We would like the courts to recognize the problem that we have encountered, that while progressing through the court levels, the disputed patent application might turn into a granted patent, or other change in the numbering scheme could take place. We recommend to the courts that when a different numbering of the IP protection has been used in a prior court proceeding, the courts request the parties to include both numbers in their petitions and other documentation, and that all those relevant identifications are included in the court conclusions, too.

VII. CONCLUSIONS

We have researched patent litigations in Finland between 2000 and 2017 using data from a commercial IPR litigation database, the Darts-IP. The case information downloaded from the database was our principal dataset, which was further supplemented with court documents browsed to gain an improved understanding of the case, patent related information from patent databases (Espacenet and Patinfo), and with corporate information retrieved from internet searches.

The judicial processes for patent litigations in Finland are presented. Both administrative litigations and civil litigations are described, and their relevant courts and case types introduced. The Market Court is a specialized court dealing with most IPR related litigations. Speed of the court processes is discussed and compared from different literature sources. The Market Court performs rather well in comparison, with 11 months mean time for delivering adjudication.

In reference to patenting in Finland, only a fraction of granted patents enter into litigations of any type. It is found that the top-30 companies account for just shy of half of all patent litigations. The other half is rather evenly distributed among 238 other parties. Types of litigation cases are presented where opposition cases are most frequent, followed by invalidation and infringement cases. Employee invention, ownership, and contractual cases follow. The Metso Group is found to be the most active company in all litigation suits, and especially in opposition actions and infringement actions.

Duration of the court proceedings are studied. While individual courts will serve rulings in a rather short time, the overall process could easily drag on for many years. The legal costs accumulate, accordingly and amount to 50-200.000 euros, for a single court action. As the case proceeds to higher court levels, the costs mount to even higher values. The loser, in most cases, is required to pay the costs of the winner, a significant share of them, if not all.

In the discussion part we present the results and give some recommendation for further research.

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