

David and Goliath

- Patent litigation and its challenges for SMEs

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Abstract

The current patent system is by many scholars considered flawed regarding the intended positive effects on innovation, especially for small and medium-sized enterprises (SMEs). However, an effective patent system requires possibilities for firms to enforce their patent rights to fulfil the basic premise of inspiring innovation. The purpose of this study is to examine the challenges that SMEs face in patent litigation and how it affects them and their innovation. 14 semi-structured interviews were conducted with Chief executive officers or research and development managers of Swedish SMEs to gain insights into the process of patent litigation and its effects on the interviewed firms. Results showed that R&D investments decreased after patent infringement in many cases and that firms had a tendency to change the way new patents are written to create stronger patents. The main finding is that patent litigation had a negative effect on SMEs, due to the high direct and indirect costs resulting from a patent case. This adds to previous research which highlights the disproportionate effects of patent litigation on small firms compared to larger firms.

Keywords: patents, patent litigation, patent enforcement, patent system, patent infringement, SMEs, innovation

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Table of contents

1. Introduction	1
2. Theoretical framework	4
2.1 Patents and patent litigation	4
2.1.1 NPEs	5
2.2 Patent litigation strategies	6
2.3 The patent litigation-innovation relationship	7
2.4 SMEs and patent litigation	9
2.5 Differences in patent litigation across countries	11
3. Data and methodology	12
3.1 Data collection and sampling	12
3.1.1 Interviews	13
3.2 Data analysis	15
4. Empirical findings	16
4.1 Swedish firms and patent litigation	16
4.1.1 NPEs	18
4.2 SMEs' experiences in patent litigation	19
4.2.1 Patent litigation strategies	19
4.2.2 The patent litigation-innovation relationship	20
4.2.3 Consequences for the firms	22
4.2.4 SMEs and the patent system	25
5. Analysis and discussion	28
5.1 Patent litigation strategies	28
5.2 The patent litigation-innovation relationship	29
5.3 Consequences for the firms	30
5.4 SMEs and the patent system	32
6. Conclusion	34
6.1 Managerial implications	35
6.2 Limitations and avenues for future research	35
References	37
Appendix	43
Appendix 1	43
Appendix 2	44
Appendix 3	45
Appendix 4	46

1. Introduction

In 2018, NuCurrent filed a lawsuit against Samsung for misappropriation of trade secrets and patent infringement (Casetext, 2019). NuCurrent, a small firm in Illinois, USA, that developed a wireless charging technology had invited the tech giant to present the technology with the hopes of reaching a license agreement. Prior to the meeting, Samsung had signed a non-disclosure agreement but then still implemented NuCurrent's technology in new Samsung Galaxy S7 and S8 phones (Brown, 2018). Samsung, with a history of stealing from smaller firms, knows it can rely on its legal department to strong-arm smaller firms that have few resources for a legal battle at their disposal (ibid.). With the help of Paul Hastings LLP, one of the top law firms for the Fortune 500 companies, Samsung managed to invalidate all of NuCurrent's claims and deny the small firm's motion for a preliminary injunction (Bellini, 2021).

On the one hand, this case illustrates how firms often perceive patents to be an important facilitator for innovation by granting exclusive rights over an invention which helps firms to protect their interests (Crane, 2013). On the other hand, it also shows some of the flaws of the patent system and how vulnerable many firms are when it comes to IP protection through patenting. Enforceability of patent rights is perceived to be the backbone of the patent system (Helmets, 2018), a system made to inspire innovation (Krasteva, 2014). Yet, enforcement of patent rights can become rather expensive, especially for SMEs that have limited financial resources (Cohen, Nelson and Walsh, 2000). Due to the costs that result from a patent case, other activities, i.e. innovation, might suffer.

In light of these costs associated with patent litigation, research on the patent system, patent litigation and the impacts on innovation has increased over the years. This development can also be credited to the fact that patent holders' rights have increased over the last decades (Jaffe, Lerner and Jaffe, 2007). This should, in theory, lead to increased innovation. However, in the case of cumulative innovation, where every inventive step depends and builds on the previous one, patenting does not always spur innovation and might even decrease it. According to Bessen and Maskin (2009) the reason for this is that, without patent protection, new ideas by imitators can be beneficial for innovation and social welfare. Furthermore, they might lead to follow-on

innovations by the inventor, resulting in more profits in the future. The costs of protecting the invention can often outweigh the profits. Simultaneously, stronger patent rights “may actually increase the cost that frivolous patent litigation can impose on innovative firms, which in turn may curb innovation and growth” (Mezzanotti, 2020, p. 1). Patent litigation is therefore closely intertwined with innovation and can have a negative impact on firms and innovation. Yet, it is still unclear exactly how and why firms are affected by patent litigation. We apply a qualitative approach by conducting interviews to investigate SMEs’ experiences in patent litigation. This gives us the opportunity to look at how and why firms behave the way they do in patent cases and to examine the various challenges SMEs often face in this context. Consequently, our research question is: *How do firms behave in patent litigation and how does it affect SMEs and their innovation?*

Increased research in this field of business has also been motivated by higher numbers in many aspects associated with patent litigation. First of all, the number of patent applications has seen a steady increase from 1.703.200 in 2005 to 3.224.200 in 2019 (WIPO, 2020b). At the same time, the number of patent litigation cases has also been on the rise. In the US, patent cases have almost doubled from 2009 to 2015 (WIPO, 2018) and a similar development has been observed in some European countries between 2000 and 2008 (Cremers *et al.*, 2017). A phenomenon that has been gaining attention even more recently is the involvement of non-practicing entities (NPEs) in patent litigation, especially in the US. NPEs, also called patent assertion entities or “patent trolls”, do not engage in R&D or production themselves. Instead, they acquire patents from companies and inventors in order to file infringement suits and claim license and settlement fees (Cohen, Gurun and Kominers, 2014; Kiebzak, Rafert and Tucker, 2016; Helmers, 2018). Between the years 2004 and 2012 the litigation cases in which these entities were involved, increased from less than 500 to over 2000 (Kiebzak, Rafert and Tucker, 2016).

Just as the initial filing of patent applications can be a financial burden for firms, especially SMEs, patent litigation can become costly very quickly, as mentioned before (Somaya, 2003). Above all, the United States and the UK exhibit the highest average litigation costs, ranging up to \$6 million and \$2 million, respectively (Helmers, 2018). Patent litigation in other European countries is significantly cheaper in comparison, with costs ranging from \$60.000 to \$250.000

(ibid.). In 2008, patent litigation costs in the US, UK, China, Japan, Germany, and France alone added up to over \$9bn (Bjuggren, Domeij and Horn, 2015; Helmers, 2018). Financial consequences of patent cases can therefore be detrimental for firms, particularly SMEs, that have limited resources at their disposal. Due to this and the fact that little research has been done on Swedish firms, we decided to focus our research on Swedish SMEs.

In this paper, we combined quantitative and qualitative data collection. In the first step, a database of Swedish firms involved in patent litigation was created with Darts-IP¹, a global database for IP cases. Information on infringement cases, patent specifics, plaintiffs and defendants, damages, trial lengths, industries, and outcomes was collected. The database created consists of 1427 different infringement cases worldwide containing at least one Swedish firm. The dataset was further reduced to 53 SMEs. These firms were contacted for an interview, resulting in 14 firms interviewed. Questions referred to patent litigation, the legal process and its effects on the firm and innovation. We found that patent litigation strategies during the legal process differ markedly between the firms, that patent litigation has negative effects on SMEs mainly due to the costs involved in infringement cases, and that most firms now have a negative attitude towards the patent system after their involvement in a patent case.

The remainder of the study is structured as follows: Section 2 covers the theoretical framework, which discusses patent litigation and its relationships to innovation, strategies, and SMEs. Section 3 describes the methodology, including data collection. In Section 4, the empirical findings are presented. Section 5 contains the analysis and discussion. Lastly, Section 6 contains our conclusions.

¹ Darts-ip is a private company that provides access to data and analytics to over 6 million global IP cases. It is most commonly used by law firms, attorneys, corporate legal departments, IP managers, paralegals or law librarians (Darts-IP, 2021)

2. Theoretical framework

2.1 Patents and patent litigation

The purpose of patents is to inspire innovation. The exemplary patent is something only granted to an invention representing obvious advancement on present ideas, rewarding its creators through exclusive rights, and opening up new markets (Weatherall and Webster, 2014). The Swedish Intellectual Property Office (PRV, 2019) defines a patent as an intangible asset that can help a firm obtain a better market position, avoid price competition, and force competitors to establish their own technical solutions. In order to get a patent approved, it needs to meet three different conditions: it has to be *new*, *inventive* and *industrially applicable* (PRV, 2020). A patent only needs to lack one of these conditions in order to be invalidated, a risk that has proven to be significant for patents involved in patent litigation (Allison and Lemley, 1998). In fact, plaintiffs just win marginally more than 50 percent of patent litigation cases in the US (Jean O. Lanjouw and Schankerman, 2004).

To ensure the effectiveness of the patent system, patentees need to have options to enforce their rights. Especially in the case of infringement of a patent by another party, patent right holders need to be able to fight back so that they can maintain the value of their patents (WIPO, 2018). A patent loses value “if the patent holder cannot observe infringement, if he cannot identify the infringer, or if enforcement is too costly” (Crampes and Langinier, 2002, p. 258). Something that often is problematic for today's innovators is to anticipate what patents already exist and which ones they might be infringing, a problem that is exacerbated with the increasing number of patents (Ménière and Parlane, 2008). These preexisting patent barriers and what effect they have on society and innovators is something we lack empirical and qualitative data on nowadays (Boldrin and Levine, 2013). As mentioned previously, the patent system is meant to stimulate innovation. Some scholars argue though, that today's primary effect of the patent system is not increased innovation, rather it results in large dormant firms blocking innovation and constraining competition (ibid.).

2.1.1 NPEs

The emergence of NPEs marks a shift in how patent holders make use of the patent litigation system. Traditionally, it was intended to uphold patent owners' rights in case they were infringed upon. Yet in recent years, anticompetitive strategies have established themselves amongst firms and individuals to block competitors or merely for rent-seeking purposes (Ziedonis, 2003; Weatherall and Webster, 2014). Lowered costs and increased benefits of patent acquisition have contributed to this development (Mueller, Cockburn and MacGarvie, 2013). This resulted in NPEs, also called patent trolls or sharks, that buy up patents from firms, often ones that are struggling or which went bankrupt (Weatherall and Webster, 2014). Yet, NPEs have no intention of using those patents for anything else other than rent-seeking through royalty fees from licensees (Reitzig, Henkel and Heath, 2007). Hence, "trolls operate under a business model that seriously undermines the policy behind granting patents because they are currently allowed to extract all of the rights from a patent without conferring upon society any of the benefits" (Watkins Jr., 2014, p. 11). Moreover, NPEs differ from other licensors. Surprising manufacturers with an infringement suit is a key part of their strategy because it is more likely to lead to damages or royalty fees paid by the defendant (Reitzig, Henkel and Heath, 2007). SMEs are hereby more prone to be targeted for litigation by patent trolls than larger firms. As going to court over a patent is in many cases too costly for an SME, they become easy targets for NPEs that are only after settlement payments or royalty fees (Babin and Jarrell, 2018; UnifiedPatents, 2019).

According to Cohen, Gurun and Kominers (2016), the rise of patent trolls is consistent with the development of patent litigation cases. In 2005, about 200 lawsuits were filed by NPEs. That number increased tenfold by 2015. It is thus unsurprising that large corporations like Apple and Google "have spent more on patent litigation and acquisition than on research and development" (Watkins Jr., 2014, p. 13). As a result, practicing entities have called for reforms of the patent litigation system and policies limiting the leeway of NPEs.

2.2 Patent litigation strategies

Enforcement of IPR can occur in various ways and at different stages. Patent litigation strategies can hereby be defined as “a planned action that firms take, from threatening to sue, filing a lawsuit, to defending and/or countersuing opponent(s) in court to seek resolution for patent dispute(s)” (Yang, 2019, p. 429). The reason firms often take these actions is to generate some sort of strategic value such as taking out a competitor, building reputation, or generating royalties (Somaya, 2003). The first step, threatening to sue, is already seen as an effective strategy as it increases the value of the patent (Yang, 2019). In the case that these initial attempts to halt the infringement, which can also be informal, for example, through a cease-and-desist letter, are unsuccessful, owners can then file an infringement suit against the other party in order to resolve the dispute through an adjudication. Yet, many of these cases do not end in a final court decision. In fact, the majority of cases are settled before or during trial. A study done by Cremers (2009) showed a settlement rate of 56% in Germany for patent litigation cases. In the US, this number is considerably higher. Lanjouw and Schankerman (2003) found that approximately 95% of patent disputes are settled before a final court decision is reached.

Settlement, usually in the form of a patent license, can be seen as a way to negotiate with the infringer so that the patentee receives settlement money or royalty (Jeon, 2015). While expensive and lengthy trials are avoided this way, patent holders can lose out on monopoly profits, especially in new product markets (Bessen and Meurer, 2005). Royalty rates can be influenced by a number of factors such as the strengths and weaknesses of the parties, the licensee’s ability to circumvent the patent through innovation, and the expected outcome if legal proceedings are pursued by the patentee (Shapiro, 2003). The parties also have cross-licensing as an option if their patent portfolios are complementary in nature. Hereby, reciprocal agreements are made to use the other’s patents so that a product can still be brought to the market (Shapiro, 2000). Other forms of settlement include mergers and joint ventures (Shapiro, 2003).

Like the patent holders, the alleged infringers also have several options they can choose from. These mainly include avoiding the market altogether, participating further in the market at risk, negotiating with the patentee, or litigating, all of which result in some sort of costs (Rantanen, 2006). Patent litigation can hereby be an effective action against NPEs that generally want to

avoid lengthy trials (*ibid.*). Even the threat of litigation can provide “a counterbalancing force to the patent troll’s ability to extract a license” (Rantanen, 2006, p. 210). Both the patentee and the alleged infringer therefore need to evaluate different litigation strategies to ensure the best outcome for them.

2.3 The patent litigation-innovation relationship

While there has been uncertainty about the effectiveness of the patent system and its impact on innovation (Bessen and Maskin, 2009; Boldrin and Levine, 2013; Mezzanotti, 2020), less ambiguity surrounds the effects patent litigation has on innovation. The general consensus that can be derived from extant literature is that patent litigation has a negative effect on firm innovation. Yet, many of the studies conducted in this line of research come with certain limitations which merits another look at the patent litigation-innovation relationship.

A study by Cohen, Gurun and Kominers (2014) examined R&D investments of publicly listed firms that were subject to a patent suit by an NPE. It shows that firms that lose to a patent troll in court reduce their R&D investments by approximately 20% when compared to non-litigated but otherwise identical firms. Although, “it is not evident that this reduction in innovation is not made up for by increased innovation elsewhere” (Cohen, Gurun and Kominers, 2016, p. 522). Smeets (2014) shows similar results. According to the author, patent litigation reduces R&D intensity, defined as the ratio between a company’s R&D investments and its sales, in publicly listed firms that were the infringer. The mean reduction amounted to 2,4%-points, yet this effect could only be observed for small firms with less than 500 employees. Moreover, while this reduction in R&D investments speaks for the negative relationship between patent litigation and innovation, it is short-lived and can be considered small (Smeets, 2014).

Patent litigation also affects entrepreneurial activity measured by VC investments. According to Kiebzak, Rafert and Tucker (2016), an inverted-U-shaped relationship exists between patent litigation and VC investments. As a result of patent litigation, VC investments were reduced by \$22 billion or 14% over a five-year period prior to the study. Another negative relationship was found between patent litigation and the returns of R&D investments by Mezzanotti (2020). These results make sense when considering the huge transaction costs that are associated with legal proceedings. After a costly settlement or trial, especially small firms but also larger firms might

have to reduce their R&D spending. Furthermore, risk of getting litigated again in the future might deter firms from putting more money into further R&D investments after a patent case (Mezzanotti, 2020). These findings also line up with the reversed relationship between the two variables. According to Bessen and Meurer (2013, p. 429), “the more R&D a firm performs, the more likely it is to be sued”, which contradicts the perception of defendants being imitators and pirates, in fact they are innovators spending as much on R&D as the plaintiff.

Similar results regarding the financial consequences of patent litigation and, in turn, innovation of firms were documented by Lee, Oh and Suh (2019). The authors measured an average reduction of 9.5% in a defendant company’s cash level after litigation which curbs investments into new projects. Moreover, patent applications declined by approximately a third in the three years following patent litigation. Yet, this reduction of innovation is not only observable for the defendant firm. The authors also established a 3% decline in citations on the patent involved in the litigation which speaks for a more careful approach by competitors in light of potential arising litigation expenses. Similar results are reported in two studies by Galasso and Schankerman (2015, 2018). In the first study, the authors determine that patent invalidation leads to a 50% increase in citations to the focal patent, on average. Other firms in the industry, mainly small ones, capitalize on the invalidity ruling of a large firm, resulting in increased cumulative innovation. Although, it should be mentioned that these results only apply to the ICT and the medical instruments industry. In the second study, Galasso and Schankerman examine the effect patent litigation has on the alleged infringer’s innovation, measured by the number of patent applications. Consistent with Lee, Oh and Suhs’ (2019) findings, they find a 50% decrease in patent applications by the focal patent holder, on average. Again, mainly small firms are to blame for this effect. For them, firm exit is also more likely after the loss of patent rights on core technologies.

Table 1 summarizes the existing research in this field. Conclusively we can say that there is evidence that shows a negative relationship between patent litigation and innovation, measured by R&D investments, patent application, patent citations, and VC investments. Yet, these studies also show limitations regarding their proxies and results. For instance, even though it is not uncommon for patent applications to be used to measure innovation, especially for larger firms

with multiple disputes a year, it can be uncertain if a reduction in patent applications or R&D investments can be traced back to specific patent litigation cases.

Table 1: Main findings on the patent litigation - innovation relationship summarized

Author(s)	Main findings
R&D	
Cohen, Gurun, and Kominers (2014)	Losing to an NPE in patent litigation reduces a firm's R&D investments by 25%
Smeets (2015)	R&D intensity is reduced by patent litigation by 2.4%-points on average
Mezzanotti (2020)	Patent litigation lowers innovation by reducing R&D returns
Patent applications & citations	
Lee, Oh, and Suh (2019)	Patent applications following patent litigation decline by 34,3%; patent citations by other firms to the focal patent are reduced by 3%
Galasso and Schankerman (2018)	Patent invalidation leads to a 50% decrease in patent applications; small firms are more affected and market exit as a possibility
Galasso and Schankerman (2015)	Patent invalidation causes a 50% increase in citations to the focal patent, effect driven by loss of patent for large firms and consequent citations by small firms
VC investments	
Kiebzack, Rafert, and Tucker (2016)	Inverted-U-shaped relationship between patent litigation and VC investments

2.4 SMEs and patent litigation

Past studies on patent litigation have also shown differences depending on the size of the companies involved. In a study on Swedish firms by Bjuggren, Domeij and Horn (2017), the outcome suggested that the risks of entering patent litigation are much higher for SMEs. In comparison to bigger firms, they are less resilient to business interruption which often results in cases where the entire business might be at stake. Similarly, Galasso and Schankerman (2018) conclude that smaller firms involved in patent litigation have an increased probability of

stopping patenting completely. Lanjouw and Schankerman (2001) also discovered a heightened risk of patent litigation for smaller firms within newer and constantly changing technology areas. In a study within the semiconductor industry, Ziedonis (2003) concluded that small firms had a heightened propensity to engage in patent litigation. This raised the question whether small firms need to aggressively defend technological niches, or if it is due to the lack of bigger patent portfolios to trade with. The benefits of having a larger patent portfolio to trade with and thereby avoiding court litigation is something Lanjouw and Schankerman (2003; 2004) highlight. This results in a disadvantage for smaller firms compared to bigger firms with larger patent portfolios. Another issue that might complicate matters for new small innovating firms is the patent thicket, a phenomenon analyzed by Shapiro (2000). Broadly defined, a patent thicket is when an overlapping set of patents compel new entrants to access and license numerous patents in order to commercialize new technology. This is something that has been prominent within the computer software, semiconductors, the internet and biotechnology sectors (ibid.) Larger firms have also been found to be more associated with the use of preemptive non-use patents, merely used for blocking competitors and not to protect their own innovations (Walsh, Lee and Jung, 2016).

According to Athreye, Fassio and Roper (2020), four out of five small firms do not patent any of their innovations. In comparison, two out of three large firms do not patent at all. The authors argue hereby that the difference is explained by the number of innovations developed which is simply higher in larger firms. The propensity to patent a specific innovation is the same when comparing SMEs and multinational enterprises (MNEs). Instead of patenting, both SMEs and large firms rely on other strategies to protect their IP. Lead-time advantages as the most common strategy, followed by secrecy and complexity are preferred over patenting for IP appropriation (Hughes and Mina, 2010). There are several reasons for this such as the competitors' ability to potentially invent around the patent, the disclosure and loss of know-how regarding the innovation, and the costs involved in patent applications (Holgersson, 2013). On the other hand, there are also several reasons why SMEs might decide to patent their innovations, for instance "to improve corporate image, to motivate employees, and to avoid litigation by retaliation power" (Holgersson, 2013, p. 22). While the latter is often perceived as a good reason to patent innovations by entrepreneurs, the topic of SMEs and patent litigation is much discussed in the

literature (Rodwell *et al.*, 2007; Hughes and Mina, 2010; Andries and Faems, 2013; Athreya, Fassio and Roper, 2020). SMEs oftentimes simply do not have the financial resources to deter imitators by initiating legal proceedings (Cohen, Nelson and Walsh, 2000).

2.5 Differences in patent litigation across countries

In a study on investors' legal protection and its enforcement, Vishny *et al.* (1998) concluded that laws and their enforcement differ considerably among countries. These results are consistent with the ones found by Teece (1998) and the varying possibilities for innovative firms to capture economic value depending on the country's legal institutions. Differences between legal institutions have shown to be consistent with patent litigation cases, where trial length and outcomes differ markedly between the countries (Cremers *et al.*, 2017). For instance, a country that stands out with a relatively large outcome of revoked patents is the UK. Germany, on the other hand, stands out as a country where infringement is a more likely outcome. This has caused the UK to be seen as an “anti-patent” jurisdiction and Germany has gained a “patent-friendly” reputation. The length of trials is another aspect shown to differ considerably between countries. In France, the mean duration of patent proceedings takes close to 30 months, in the UK and Germany, proceedings take around 13 months, and in the Netherlands about 15 months (Cremers *et al.*, 2017). A country that stands out even more is Sweden, where the median time to reach a final verdict is three years (Bjuggren, Domeij and Horn, 2015). Another big difference between countries is the litigation costs (Helmers, 2018). At the top, we find the United States with an average cost of patent litigation ranging between \$1 million to \$6 million, and the UK between \$1 million to \$2 million. In comparison, the average cost in Germany, France, Sweden, and the Netherlands is significantly lower, ranging between \$60.000 and \$250.000 (Bjuggren, Domeij and Horn, 2015; Helmerts, 2018). The differences of today's European patent litigation system have often resulted in criticism for its complexity and creation of unnecessary costs (Harhoff, 2009). Although, according to Cremers *et al.* (2017), the debate and reforms of the European patent litigation system have been undermined by a shortcoming of empirical data.

3. Data and methodology

Previous studies in this line of research mainly used a quantitative approach to investigate patent litigation. In this study, we combined quantitative data collection with an exploratory, qualitative research design. The quantitative element consists of creating a database with all patent infringement cases that involve a Swedish firm. From this we could derive general insights into what patent litigation looks like for Swedish firms and make comparisons to extant literature. For the second step, a qualitative approach was chosen in the form of interviews to study the challenges SMEs face in patent litigation, how they react to those challenges, and how the firms are affected, especially their innovation. In general, with this approach we could get an understanding of the underlying reasons and motivations firms have in patent litigation and dive deeper into the problem through the eyes of the respondents (Bryman and Bell, 2011). It also enabled us to gather meaningful experiences of respondents from which we can then form conclusions and create generalizations of the phenomenon (Berglund, 2007).

3.1 Data collection and sampling

In the initial step of our data collection, a database was created that comprised all patent litigation cases worldwide that contained at least one Swedish firm. Information on countries, dates, courts, outcomes, industries, plaintiffs, and defendants was collected. From this data set we could gain general insights into characteristics of Swedish patent litigation and draw conclusions about what patent infringement looks like for Swedish firms. Similarly to previous studies on patent litigation (Cremers et al., 2017; Uk and Zhao, n.d.), the information was retrieved through Darts-IP. The initial search provided 1427 infringement cases from 40 countries and 207 courts that involved a Swedish firm. The earliest case recorded started in 1946, the latest started in the first quarter of 2021.

Of the 1427 infringement cases, we discarded the ones without a patent mentioned and the ones that started before 2016. We argued that including earlier cases would not be beneficial for the recollection of the interviewees and that it would also improve the probability of the most relevant respondent still working within the company. This resulted in 469 cases. This number was further reduced to 44 cases involving 53 Swedish SMEs by excluding firms with more than

250 employees. This was done with the help of Retriever Business, a database that contains data on Swedish companies. Apart from employee numbers, the firms' specific industries and phone numbers were added. Firms, for which we could acquire an email address of a potential interviewee, such as a CEO or Director of R&D, were contacted directly by email. The rest were contacted by phone and asked for contact information of an employee knowledgeable on the firm's patent litigation cases. Consistent with Spender (1989), we stressed the legitimacy and non-commercial nature of our study to maximize the response rate. Of the 53 contacted firms, 14 agreed to an interview. Nine of those were plaintiffs, five defendants.

3.1.1 Interviews

As mentioned, we conducted 14 interviews with Swedish SMEs. As the respondents' experiences were likely to differ vastly, we used a semi-structured interview guide, shown in Appendix 1, that covered a range of topics, but gave the interviewees leeway in their answers (Bryman and Bell, 2011). They also enabled us to cover the same topics in each interview while giving the interviewers flexibility of *when* and *how* to ask the questions (Corbin and Strauss, 2014). While the respondents' individual experiences could be captured this way, it also ensured comparability across the different answers. The interviews were conducted in the first quarter of 2021 via phone or Zoom and lasted, on average, 33 minutes. They were recorded and transcribed for analysis purposes. As patent cases can sometimes contain sensitive information, the participants and their responses remain anonymous.

The firms operate in 10 different industries and were each part of a patent litigation case in either the US, Sweden, Germany, France, Italy, or Canada. All respondents were knowledgeable on issues regarding patenting within the firm, patent litigation, and the patent system in general through their position and history with the firm. Furthermore, as shown in Table 2, most respondents were part of the firms' founding processes and the effects and consequences of patent litigation were therefore oftentimes very significant to the entrepreneurs' lives. The firms had an annual revenue ranging between 500.000€ to 35.000.000€. In contrast, almost all of the counterparts were bigger firms in terms of employee number and revenue.

Table 2: Interviewed firms

Respondent	Industry	Outcome	Firm size	Interview length
Plaintiffs				
Founder & CEO	Construction	Settled	Micro	44:32
Founder & CEO	Construction	Lost	Micro	46:58
Founder & CEO	Mechanical engineering	Lost	Micro	42:57
Co-founder & CEO	Communication	Lost	Micro	24:38
Founder & CEO	Printing	Won	Micro	1:05:10
Founder & CEO	Textiles	Won	Small	11:18
Founder & CTO	IT	Ongoing	Medium	18:08
Co-founder & CSO	Human necessities	Lost	Medium	37:48
Director of R&D	Mechanical engineering	Lost	Medium	27:20
Defendants				
Founder & CEO	Medical	Lost	Micro	26:57
Co-founder & managing director	Instruments	Settled	Micro	37:35
Managing director	Manufacturing &	Settled	Micro	25:54
Co-founder & CEO	industrial	Settled	Small	38:17
CEO	Instruments	Won	Small	18:23
	Construction			

Notes: Firms are characterized by Micro if they have less than ten employees, as Small if they have less than 50 but more than ten, and as Medium if they have less than 250 but more than 50 employees.

The respondents were questioned on different topics. Firstly, questions related to the legal process itself were asked which resulted in insights into preparations for the case, patent litigation strategies, and the outcome of the case. Secondly, effects of patent litigation on the firm were studied, with a focus on innovation. Questions regarding innovation are operationalized and can be found in Table 3. Thirdly, respondents were also questioned on how they perceive the current patent system.

Table 3: Operationalization of variables used to measure innovation

Variables	Indicators	Interview questions
R&D	R&D expenses (Smeets, 2014; Mezzanotti, 2020)	How were you affected by the dispute and the process economically? (R&D)
Patenting behavior	Patent applications Willingness to patent (Bjuggren, 2017)	Has the experience of participating in patent litigation affected your willingness to seek new patents?
Changes to innovation	Cumulative innovation (Galasso and Schankerman, 2015)	How do you feel that your own innovation has been affected in different ways? Has the dispute affected the continued development and commercialization of the technology and if so how?

Notes: The following variables R&D, *changes to innovation*, *changes to patenting behavior* and their indicators revolve around the concept of innovation. *R&D* is explored through R&D expenses, an approach similar to one taken by Smeets (2014) and Mezzanotti (2020). *Changes to innovation* refers to the increased cumulative innovation mentioned by Galasso and Schankerman (2015). *Patenting behavior* is explored by looking at patent applications after the patent litigation case in question. Moreover, consistent with Bjuggren, Domeij and Horn (2017), we ask about the firms' willingness to seek new patents after having participated in patent litigation.

3.2 Data analysis

For the analysis of the interviews, this study made use of the Gioia research methodology. This method was used because the design enables both creative imagination and systematic rigor in conducting qualitative research (Gioia, Corley and Hamilton, 2013). All of the semi-structured interviews were transcribed, with the help of a transcription software or manually. The interviews conducted in Swedish were translated to English after the transcription was done. In a first step, both coders reviewed two interviews, identifying 1st-order categories based on the interviewees' answers. Using NVivo as a qualitative data analysis software, the 1st-order categories were then developed into 2nd-order themes (see Appendix 3 for examples of the coding process and the full set of 2nd-order themes) based on their similarities and differences, but also from a more theoretical perspective where the themes could help us understand and explain the observed phenomena (Gioia, Corley and Hamilton, 2013). These 2nd-order themes were then used to code all remaining interviews, first individually and then together in a second round of coding. If new categories were found in the remaining interviews that did not fit the first set of 2nd-order themes, a new theme was created. Lastly, with a theoretical perspective, these themes were further developed into the aggregate dimensions that are presented and analyzed in the next sections.

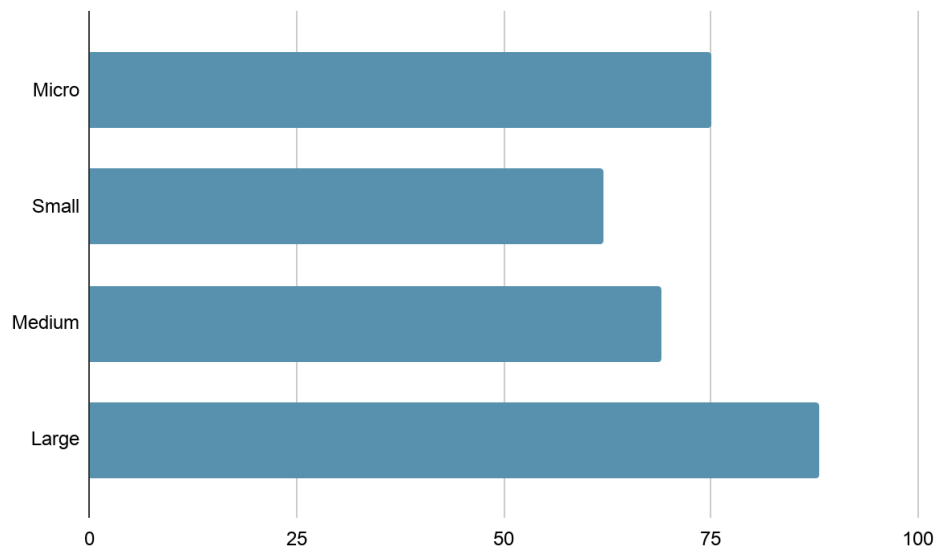
4. Empirical findings

This section is divided into quantitative findings and qualitative findings. The quantitative data that was gathered from Darts-IP contributes to extant research with new insights into litigation data on Swedish firms and is presented first in chapter 4.1. The qualitative findings in chapter 4.2 are based on the aggregate dimensions identified during the coding process, and are split up into four sections: patent litigation strategy, the patent litigation-innovation relationship, consequences for the firms, and SMEs and the patent system.

4.1 Swedish firms and patent litigation

The ten most active Swedish parties are involved in 48% of the total cases. As shown in Appendix 3, AstraZeneca is the party that was involved in the highest number of cases with 306 which equals 21% of total cases. The 1427 infringement cases involve 2485 different firms, 539 of which are Swedish. 49% of those Swedish firms are involved as plaintiffs, 51% as defendants.

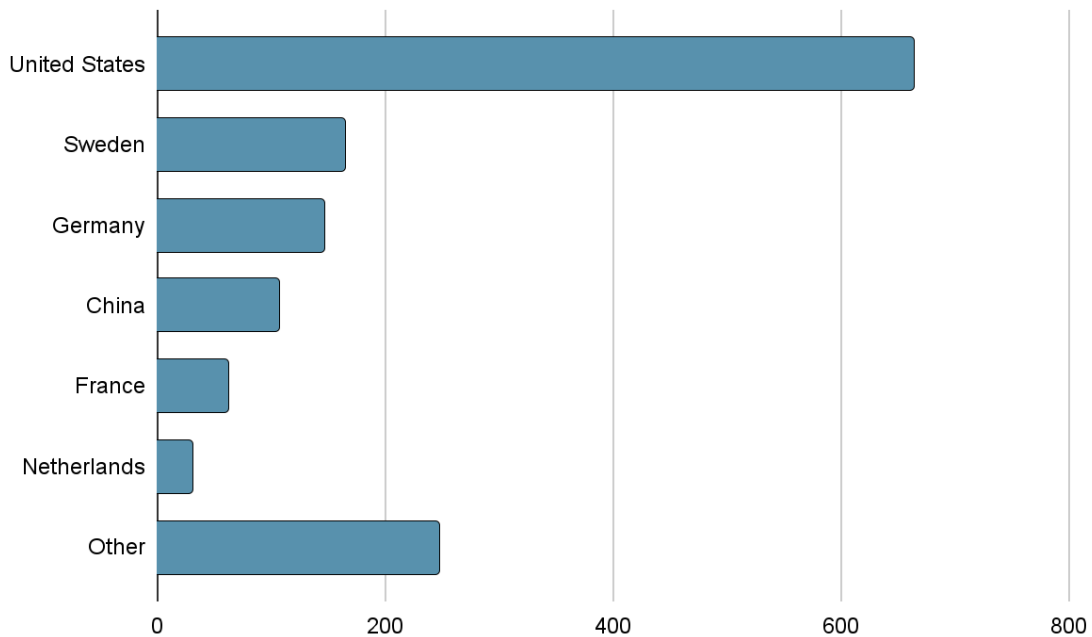
Figure 1: Swedish firm size distribution



Note: The above distribution shows firm size based on employee numbers from 2019. Of the total number of 539 Swedish firms, 81 were found inactive, and 164 could not be found within Receiver Business. Of all the 206 SMEs, 17% are part of a large Swedish corporation and 21% have foreign owners.

Moreover, as shown in Figure 2, almost half of all cases took place in the US. Sweden and Germany are the next most prevalent countries regarding the number of cases, followed by China, France, and the Netherlands. These numbers can be explained by the size of the patent litigation systems in each country. Since the beginning of records, more than 5 times the number of patent suits have been filed in the US than in all European countries combined (Darts-IP, 2021). Furthermore, in all of the six countries shown in Figure 2, except the Netherlands, the majority of cases were initiated by a Swedish firm. This shows that Swedish firms are very willing to protect and enforce their rights, even if it means filing legal proceedings abroad which might in many cases be more expensive than domestic disputes.

Figure 2: Country Distribution (Total Case Count)



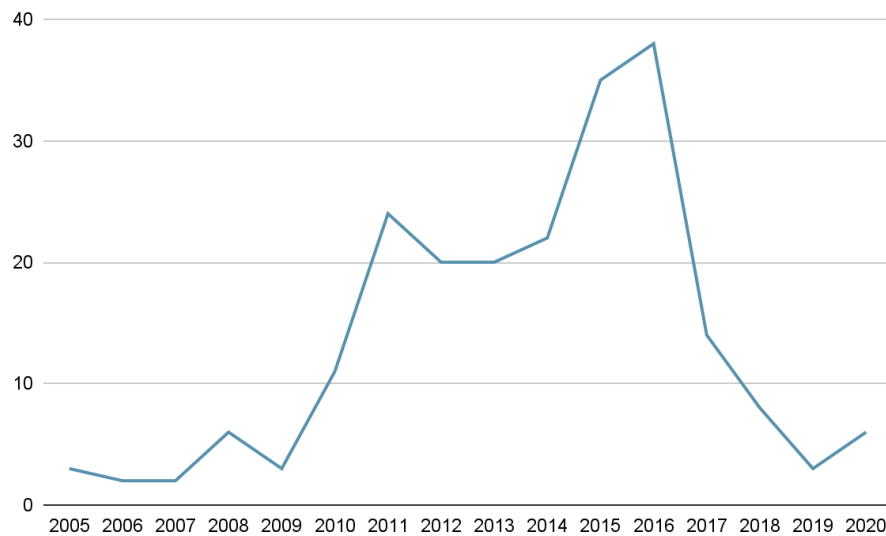
One favored way of looking at patents in research is by segregating them based on their technological class (Ghapar, 2019). There are numerous patent technology classifications that have been used through the years, and of those, the majority are based on either the US Patent Classification or the International Patent Classification (IPC) (Schmoch, 2008). WIPO (2020) defines IPC as an easy and effective way to classify patents. The two most common IPCs among Swedish patent infringement cases are human necessities and physics, see Appendix 4 for the full distribution.

As mentioned previously, the duration of patent trials can vary greatly between countries. This is also the case in our data set. The length of the cases was measured with the timeframe between the first document and the last document for cases with more than one document listed. It is worth mentioning that most cases, especially in the US, are settled. Cases with only one document in Darts-IP might be settled quickly out of court and disregarding those cases will indubitably not represent the reality. Nevertheless, our numbers are very consistent with those published by WIPO (2018) and fairly consistent with those from Bjuggren, Domeij and Horn (2015) and Cremers *et al.* (2017). Cases in the US take, on average, the longest with 25 months. Similarly, cases in France last, on average, almost 25 months as well. Sweden follows with 20 months, while Germany lays at 16. China has the shortest trials with a 12 month average. As longer trials are naturally more costly, plaintiffs should take these numbers into consideration when deciding if and in which countries they initiate legal proceedings.

4.1.1 NPEs

Moreover, 15% of cases (217) were initiated by an NPE and make up a considerable part of our data set. Consistent with extant literature (Reitzig, Henkel and Heath, 2007; Cohen, Gurun and Kominers, 2016), the number of cases involving an NPE increased sharply in the last two decades until 2017, as seen in Figure 3. According to Cohen, Gurun and Kominers (2016), this phenomenon is most prevalent in the United States. We can corroborate this because almost 90% of the NPE cases from our data set are from the United States. What is noticeable though is the sharp decrease in NPE cases after 2016. This development can most likely be explained by rulings from the U.S. Supreme Court in 2017. Patent holders were significantly restricted in their power to slow innovation by competitors (Downes, 2017). Due to this ruling, patent holders are not allowed anymore to start legal proceedings in any federal court, for instance the patentee-friendly court in Texas. Instead, the defendant has to have some presence in the state where the patent holder is suing (*ibid.*).

Figure 3: NPE Cases Development (Total Case Count)



4.2 SMEs' experiences in patent litigation

4.2.1 Patent litigation strategies

Our interviews with the SMEs show that plaintiffs most commonly became aware of patent infringements through the market from a competitor's new product launch. In some cases, the respondent was notified by another actor in the firm's business network, like a retailer or customer. In others, the plaintiff presented the innovation to the defendant prior to the case to enter a license agreement or another form of partnership. The respondents then became aware of copies launched by the other party sometime after the initial meeting. Interviewees that were defendants on the other hand were always notified of the alleged infringement by another party. This was either done by the plaintiff directly by mail, at an exhibition, or indirectly by a law firm offering their services in the case. Subsequently, the majority of cases started with the threat of litigation. Two of the defendants who were litigated by NPEs in the US had either a subsidiary or a collaboration within the country, making it hard or impossible to ignore the trials. As one of them put it:

“The problem here was that they dragged our US side into the process, if they had not done so we could have ignored this process for quite some time, avoiding emails and strange phone calls.”

Regarding the preparations for the legal process, most of the interviewees highlighted the importance of doing research on the other parties and their patent or product, building a strong case. For plaintiffs, it consisted of gathering evidence on the infringing product or process, pushing on the similarities and reasons for why there is a case for infringement. For the defendants it was rather reading up on the patent itself, trying to find the weak spots and arguing why it is not an infringement. Two companies highlighted the importance of documenting everything leading up to a new innovation to repel any opponents' claims regarding the innovation's originality. One company pushed on the importance of getting a good lawyer to increase chances of winning the trial. To add to this, another respondent that lost his case thought that they could have won if they had swapped lawyers with the other party. The majority of the plaintiffs that initiated legal proceedings due to patent infringement were met with a countersuit, as the other parties tried to invalidate the respondents' patents. Some cases also, according to the plaintiffs, involved false testimonies by the alleged infringer which turned out to be an effective strategy that led to a favorable case outcome. The defendants had to deal with similar strategies. One financially strong counterpart threatened to add more patents to the ongoing case to increase lawyer costs for the defendant and, similarly, the two NPEs in our sample tried to exploit the high costs of the trials to reach a settlement that is favorable for them through royalties or damages paid. One defensive strategy that could be observed for two defendants in these cases, was the moving of assets in light of the upcoming trials. For example, damages to be paid from a lost trial were thereby avoided by one respondent's counterpart.

4.2.2 The patent litigation-innovation relationship

The patent disputes had different effects on the involved firms and their R&D. A few of the companies stated that the litigation process had no effect on their R&D. For example, one of these companies stated that they do not have much choice since they are an R&D company and have to spend a certain percentage on development. Half of the interviewees stated that the large litigation costs had a negative impact on their R&D.

“A small firm has not unlimited amount of capital, of course now we needed to pay the fees to [...] and this money of course we could have invested in development”.

One of the defendants had to downsize their entire team due to the six months of uncertainty the NPE caused them. Another firm stopped selling the innovation involved due to uncertainties from the case, rendering R&D investments spent on a second generation of the product redundant.

In general, there were very few changes to the companies' technologies due to the litigation cases. Eleven of the interviewees stated that they did not make any changes to the innovations involved in the process. Two of the firms that modified their innovation in some way were plaintiffs that won their case. One made it more complex in order to make it harder to replicate, and the other one added a lower and premium variant of the innovation. The third firm, a defendant who settled, had to make changes to their product by excluding the part of the innovation that was infringing. One defendant who lost their case argued that it was not worth innovating around the other party's patent because the patent they infringed was soon to expire. One of the bigger firms among the plaintiffs with several ongoing litigation processes stated that while they were not making any changes themselves, they could see competitors designing around their patents.

“Not the product. Because we are the leaders in this industry. It is rather that we see that others change their products because of us and our patents. We have on several occasions seen that it is clear that they designed around our patents. It's okay in some way, because either we have not written the patent well enough or they have come up with an alternative solution. At the same time, we have seen that their alternative solutions are worse than the ones we had. And then our patent has achieved its goal, that we can have the best products.”

Almost all of the SMEs reported changes in their patenting behavior following a patent litigation case. Yet, only one defendant firm increased the number of patent applications after settling with a patent troll. In contrast, three plaintiff firms, two losers and one winner, have decreased their tendency to apply for new patents. After winning the case as a plaintiff but facing huge costs despite the outcome, the one interviewee stated *“I do anything I can to avoid applying for a*

patent". Similarly, one of the losers said "*I'm never applying for a new patent. Will never do it.*" The third respondent decreased the tendency to patent but increased the tendency to seek protection through designs and trademarks. Moreover, half of the SMEs changed the way they patent because through their involvement in patent litigation they got a better understanding of what it means to have a strong patent. Specifically, respondents made changes to the way patents are formulated so that misconceptions by a competitor or a judge can be mitigated or prevented. Respondents also now seek more input from patent attorneys at this step to create a stronger patent.

Defendants, in general, are now more cautious when it comes to new product development and patenting. Most notably, more time is invested into researching competitors' products and patents in the early stages of new product development, or as one interviewee put it they "*make sure that we do the due diligence for all the new inventions.*" And lastly, one firm filed an additional patent specifically for the upcoming patent case for further protection.

4.2.3 Consequences for the firms

As shown earlier, three of our 14 respondents won their respective patent case. Yet despite the final verdict by the court, these outcomes were not as black and white as they might seem. One of the winners missed out on damages from the other party due to a procedural error by the attorney. As previously mentioned, one of the two counterparts involved in another one of the winners' cases moved assets prior to the trial to avoid paying damages, while the other one was a small family-owned firm that the respondent did not want to put out of business and therefore made them a distributor instead. And lastly, the third winner stopped selling the innovation involved during the case and discarded the investments that were made into the second generation of the product. Mixed opinions were also reported regarding the settlements. Most commonly however, the respondents perceived the settlements as a loss; either because of the settlement agreements with the patent troll for the opposing party, the costs involved or the other negative effects the case had on the firm. The respondent attributed their losses to different reasons such as misperceptions of the judge when it comes to the similarity of the technologies, the performance of the lawyers, and the characteristics of the patent. One of the plaintiffs' losses resulted in a complete firm exit because they were so reliant on the patent and innovation.

For all the respondents, the costs involved were described as huge burdens for the firm. Most notable were the lawyer fees. Some firms were forced to hire expensive lawyers to have a chance to win in court while many others had to participate in trials abroad which increased transaction costs further. Moreover, as only three respondents won their case, the majority of firms were also heavily affected by costs resulting from settlement agreements or damages to be paid. Moreover, the costs of the trials also affected the possibility to pursue further legal options. Two firms said they would have appealed the judge's decision, had it been financeable. Similarly, one firm stopped pursuing infringers in the US due to their experiences and the costs from their first patent case. In total, respondents reported costs ranging from 100.000€ to 3.000.000€ which amounted to, on average, 21% of the firms' net sales in the year of the outcome.

Another factor that has affected the firms is the amount of time spent on the litigation process. Almost all firms stated that the process took a few years from beginning to end, the shortest one being six months and the longest one four to five years. As one interviewee for a smaller company said *"It was a lot of time spent on what could have been used for other things"*. One of the medium-sized firms interviewed stated that their CEO had to spend two months abroad to take care of the litigation. The Director of R&D in another medium-sized firm described that the litigation process absorbed at least a couple of man months from him and a team of legal staff. One interviewee in one of the micro-sized firms declared that he and one employee spent around one and a half years to produce evidence and prepare for the process.

Looking back at the disputes, we can see that, except the two NPEs, all the counterparties involved are competitors of the interviewed firms. Although, in five of the cases there was some kind of relationship or collaboration between the firms prior to the litigation case. This resulted in knowledge and information sharing, making the infringement possible. One of the plaintiffs argued that they will continue being a very open-minded company, but that they have learned that they will not start any new collaborations unless there is some kind of agreement between the involved parties.

One of the plaintiffs who won their infringement case stated that they nowadays communicate the dispute to customers as a strategy to keep possible infringers away, something they say has

worked out. Another plaintiff who lost his case, argues that they are still happy with the outcome due to the fact that the counterparty did not succeed in getting their patent invalidated. Although, the interviewee also states that he would not like to go through the process again:

“It's, it's a nightmare, all the time you need to spend. So yeah, we try to do everything to avoid a dispute between us and another company [...] it's a waste of time and money”.

Other effects on firm

As most of the respondents founded and built up the firms themselves, the patent cases also had detrimental mental and creative effects on the interviewees directly and thereby on the firm indirectly. Some respondents reported stress and time spent on these cases as hindrances to and distractions from the every-day business of running a firm. For instance, one firm mentions that dealing with the legal proceedings had negative effects on work ethic while another firm was affected by the threat of bankruptcy due to the upcoming case. Furthermore, respondents also mentioned consequences on creative power from the trials. Focus was taken away from business development and had to be invested for the patent case and to scan the market for further threats. One firm stood out in this context in the sense that, according to the respondent, the patent case was a part of everyday business and which did not have any significant effects on the firm. The interviewee also implied the case did not involve any hard feelings:

“[...] this was kind of more or less a fight between gentlemen, and I think the managing directors of the two companies have met afterwards, no bloodshed. I mean it's business [...]”.

Some firms also stated that the case outcome limited future opportunities as aspects of their innovations or a certain market could not be pursued anymore. One firm was also faced with the uncertainty of going bankrupt due to the case which caused several engineers to leave the company. Another also mentioned the negative effects the involvement in patent litigation had on their funding which they were very reliant on by saying that a firm involved in patent litigation is less attractive for an investor. In another case, the legal process led to a loss of confidential know-how which was disclosed during the trial to the competitor. Lastly, one of the firms that

were sued by a patent troll invested in IP insurance to reduce the impact of potential litigation in the future, especially in the US.

4.2.4 SMEs and the patent system

During the interviews, quite a lot of frustration and critique against the patent system was voiced. A majority of the interviewees emphasized the extreme costs that follow a litigation process. Most of all, respondents commented how these huge costs made it hard or even impossible for smaller firms to enforce their patent rights. As two interviewees said:

“[...] the system does not work at all for small businesses.. [...] the risk in relation to the profit is far too large”, and “There is too little protection for the little ones. It costs far too much money for you as a small player to be able to assert yourself “.

Consequently, many of them argued that due to these high costs the system favors large companies with extensive resources. Two of the medium-sized firms in the study stated that the only reason they could enforce their patent rights was because they had financial support from owners who could help them with the litigation costs. As one of them stated:

“The disadvantage is that it is extremely expensive. The only reason we can go in and take patent fights is because we have very rich owners who can support it. We have to go to them and ask for money to be able to afford this. It would never have come together if we were to finance the patent litigation ourselves. That's the big downside, if you do not have 25 million in your pocket you have no chance to do this.”

Some of the interviewees also noted there is a lot of money in patenting and litigations, for example the patent offices and especially the lawyers. *“But the lawyers spin on, because they make huge money from this process.”*

Another issue a few companies highlighted was the complexity in Europe, both for applying and enforcing your patent rights. Different countries mean new applications, translations, different litigation systems, and additional costs. On the other hand, the litigation system in the US was also criticized, mainly for being extremely expensive, but also because of the patent trolls. One

of the defendants from a US case noted that they felt very lonely, not knowing how they could protect themselves, and reaching out to Business Sweden² was of little avail, since they only pointed towards a lawyer. A couple of the plaintiffs who lost their litigation cases in Sweden blamed the court for being uneducated on the patents' technologies, resulting in an unfair trial and outcome.

“You should not include the nuts that sit in the first instance, they should not sit with their ignorance and decide who wins. It's wrong. They do not have the competence and it feels completely idiotic that they should sit there and decide.”

Last of all, a few of the plaintiffs concluded that a patent is something that should protect you and your innovation, but in fact it is just a deterrent. One of them compared patenting to a burglar alarm in your house. Hopefully the alarm scares the burglar away, if it does not it is up to you to confront them or not. The director of R&D in one of the medium-sized companies described:

“One might think that you have the right to intellectual property. But not really, it's, it's quite seldom that you can really trust that a patent will hold all the way. So, when you go into IP protection, it's important to have a strategy and not only lean towards a single patent”.

Possible changes to the patent litigation system

The interviews revealed two main suggestions on how to change and improve the current patent systems. Firstly, as previously mentioned, the interviewees oftentimes felt lonely in their dispute against a bigger firm, especially those with trials abroad. A commonly mentioned solution was therefore a support system for smaller firms involved in an infringement case. A system like this could for example be introduced by the Swedish government to offer guidance and resources for small Swedish firms and *“hold your hand against the big dragons.”* Secondly, as noted before, a few of the interviewees highlighted the problem and complexity regarding patenting and litigation processes in Europe. They argued that this problem could be fixed with a unified system between the European countries, a system that would include one patent application for the entire union as well as a unified patent court. This would then solve the problem with

² Business Sweden is a state-owned business developer that helps Swedish entrepreneurial companies grow internationally and facilitate investments from international companies within Sweden (Business Sweden, 2021).

different languages and interpretations across different patent systems. Another solution suggested by an interviewee that could be helpful for entrepreneurs is a course about how to write and apply for a strong patent. He states that while there are options like this available today, these are usually offered by patent law firms and larger companies that are motivated by financial interests. Instead, courses like this should be held by experienced entrepreneurs that have filed patents themselves and have been involved in patent litigation. Some firms on the other hand, while giving critique of the current patent system, could not offer any concrete solutions on how the system could be changed to reduce the impact patent litigation has on a small player.

Table 4: Summary of qualitative findings

Patent litigation strategies	<p>Threat of litigation as first step in most cases</p> <p>Infringements followed collaborative meeting with counterpart in some cases</p> <p>Involvement of US partner firms increased NPEs' leverage over Swedish SMEs</p> <p>Research and collecting evidence as important preparative steps</p>
The patent litigation-innovation relationship	<p>Negative impact on R&D for half of the firms through reduction of money and time allocated</p> <p>No changes to technologies involved in cases for almost all firms</p> <p>Reduction of patent applications in 3 firms; changes in patent formulations to create stronger patents for half of the respondents</p>
Consequences for the firms	<p>Wins/losses not always perceived as wins/losses</p> <p>Costs as huge financial burdens</p> <p>Time spent on cases as distraction from other business activities</p> <p>Communication of wins as viable strategy to deter further infringements</p> <p>Mental and creative effects exacerbated by respondents' involvement in the founding process of the firm</p>
SMEs and the patent system	<p>Companies with extensive resources favored in patent litigation</p> <p>Complexity in European patent systems as hindrance for firms</p> <p>Patent litigation support system called for by SMEs</p> <p>Unitary Patent System as promising solution to some of the issues mentioned</p>

5. Analysis and discussion

5.1 Patent litigation strategies

“Prevention is better than cure” (Rodwell *et al.*, 2007, p. 27). As the empirical data shows, there is a threat of patentees losing important knowledge regarding the innovation in collaborations and meetings with contractors and partners. These findings are consistent with those of a study by Rodwell *et al.* (2007) in which they find that only one in ten SMEs perform due diligence checks on potential partners prior to a collaboration. Yet, patent infringements are rather common in collaborations and licensing agreements which is why firms should make sure that a prospective partner can be entrusted with IP (*ibid.*). Granted, information on the innovation is already disclosed through the patent application which competitors can make use of (Duguet and Kabla, 1998), yet some of the interviews suggest that the infringements are a direct result of meetings with the counterpart. While such preventative measures can by no means stop all infringements, as seen in the case of NuCurrent versus Samsung, they can deter some infringers and make IPR theft more difficult.

Consistent with Yang (2019), the cases usually started with the threat of litigation from the plaintiff, mainly to force the alleged infringer to negotiate and settle out of court. We can see that this strategy was rather ineffective in many cases, as only four of the cases were ultimately settled. To add to Yang (2019), threats were also used as a deterrent to prevent further infringements by communicating a won litigation to customers, subcontractors, and other parties in their business network. We believe that firms should generally capitalize on a positive case outcome this way and also include won cases in future letters to infringers to give the threats more credibility. Similarly, SMEs should be aware of how to prevent or deal with patent litigation with a patent troll. One option is to invest in insurance which can soften the financial blow of patent litigation (Babin and Jarrell, 2018). One of the firms we interviewed chose this option but only after their involvement in a patent case with an NPE.

Another viable option is to ignore the demand letter. In a study by Chien (2012), one in five startups chose this option and reported costs of \$2.400 on average. One of our interviewees

considered this option but was ultimately forced into settling with the patent troll because a subcontractor was targeted as well. The option of answering the patent trolls' demands with the threat of litigation might have also been an effective strategy in this situation because NPEs usually try to avoid going to court (Rantanen, 2006). Considering the high costs of patent litigation, this strategy might not be all that viable for SMEs though. Ultimately, we can say that while it might seem that firms have a variety of strategies to choose from when it comes to patent litigation, the circumstances surrounding the case and the firms' situations, for example the involvement of a partner firm or a firm's limited resources, do not always allow for a lot of flexibility.

5.2 The patent litigation-innovation relationship

Previous work (Cohen, Gurun and Kominers, 2014; Smeets, 2014; Mezzanotti, 2020) that used a quantitative approach to investigate the relationship between patent litigation and R&D in firms was able to measure specific effects on R&D investments and R&D intensity. Yet, due to the qualitative nature of our study and the small firm size of our sample, we were limited in quantifying the effects on R&D. What we could establish is, consistent with extant literature, that SMEs reduce resources, in terms of money and time, and in some cases personnel, spent on R&D due to the costs involved in a patent case.

Through our interviews, we had the chance of investigating the effects patent litigation has on specific technologies, something that has, to our knowledge, not been done in previous literature. One could assume that depending on whether a firm wins or loses the case, patent litigation should affect if and how a firm chooses to further develop an innovation. For example, losing a patent case as a defendant should lead to increased innovation to innovate around the plaintiff's patent and pursue further profits in the market. Since most of the defendants settled, they did not really have any reasons to innovate based on a loss, and the only losing defendant decided not to due to the patent expiring shortly. At the same time, plaintiffs losing their exclusive rights through a patent case should encourage further developments due to the loss of monopoly profits. However, among the firms studied, only two plaintiffs who won their case made changes to their technologies. This finding was unexpected since plaintiffs that already have strong

patents were the ones willing to innovate further. This led us to believe that patent litigation results in little to no cumulative innovation in SMEs.

Consistent with Lee, Oh and Suh (2019) we found a decreased tendency to apply for new patents after the patent case for three of our respondents. Nevertheless, the majority of respondents did neither decrease nor increase the number of patent applications. In accordance with Galasso and Schankerman (2018) though, patent litigation led to firm exit, i.e. the cessation of patenting, for two of our interviewees, one of which due to bankruptcy. The biggest takeaway in this regard though is the change in patenting behavior, something that has not been mentioned in the literature before. The majority of respondents continue to apply for patents but have changed the way their patents are written. Respondents saw the flaws in their own patents through their participation in patent litigation and most firms made changes to the way they patent accordingly to ultimately create stronger patents. For the firms, this was part of the learning process and helps with business development which enables a better protection of IPR. This is knowledge they probably would not have gotten had they not been in a litigation process which put their patents to the test. At the same time, these findings display that there is a lack of expertise on how to write strong patents in many SMEs.

5.3 Consequences for the firms

Entering patent litigation brings the risk of both patent invalidation and huge costs with it. As mentioned earlier by Allison and Lemley (1998), a patent only needs to be invalidated on one condition in order to be invalidated. This is an issue two of our plaintiffs had to experience first-hand as the firms lost both the litigation case and their patents. Similarly, another of the firms lost their case but not their patent, here the loss was rather due to weak patent claims. Considering four out of eight plaintiffs lost their litigation case that went to court, this further displays the risks of entering patent litigation from a patentee's perspective. The losses are also in line with previous findings of plaintiffs losing slightly less than 50 percent of the cases (Bessen and Meurer, 2005). Furthermore, despite the small sample size, more settlements could be expected. Only 36% of our cases resulted in settlements which is significantly less than numbers reported in previous literature (Cremers, 2009). Looking at only the US cases however, we can

see that the settlement numbers of four out of five cases, with one still ongoing, are fairly consistent with those reported by (Lanjouw and Schankerman, 2003a).

The benefit-cost ratio of patenting and patent enforcement has been widely mentioned in extant literature with many scholars finding that patent litigation is too expensive, especially for SMEs (Cohen, Nelson and Walsh, 2000; Rodwell *et al.*, 2007; Holgersson, 2013; Athreye, Fassio and Roper, 2020). Similar to the findings by Holgersson (2013), the interviewees reported the costs resulting from patent litigation as huge financial burdens. While we see a huge variance in the costs between the seven cases that specified them, we cannot observe any patterns regarding differences in the patent system or trial lengths. Moreover, costs in relation to the firms' net sales of the year in which the case ended also differ a lot and range from 3% to 35%. On average, the seven firms had to spend 21% of their net sales on one patent litigation case. And these expenses only represent the direct costs involved in patent litigation, such as damages and attorney fees. Added to this are the indirect costs from the time spent before and during the case and "other disruption costs such as loss of goodwill, loss of market share, and disruption of innovative activities" (Bjuggren, Domeij and Horn, 2017, p. 239), all of which could be observed in some of our interviews.

Other effects on firm

Compared to chapter 5.2 (The patent litigation-innovation relationship), the other effects of patent litigation are rather indirect in nature. Yet, all of them affect the firm, its productivity and innovativity, in a negative way. One aspect to emphasize is that in all cases except two, the interviewee had a personal connection to the firm. This exacerbated the negative mental and creative effects of the patent case on the entrepreneurs because through the litigation process the whole firm they founded was at risk. While larger firms may have the respective legal departments and the funds to deal with patent cases, patent litigation in an SME therefore often means that the CEO has to resolve the dispute that can stretch on for years, while handling every-day business operations at the same time. This further stresses how smaller firms are disadvantaged in patent litigation compared to larger firms.

5.4 SMEs and the patent system

From the literature we can see that patent systems differ between countries in many regards. Similarly to Vishny *et al.*, (1998) our interviews stress the differences in legal systems which have consequences for patenting and patent enforcement. It is vital for firms to be aware of these differences as they can influence how patents should be applied for and enforced. For instance, if a firm looks to apply for a patent in the US which grants broader patents and therefore protects more of the innovation, it has to be aware that the patent might be interpreted in a different way in Europe, both due to the difference in patent litigations in these countries and differences that might arise during translation.

The single biggest critique from the studied firms regarding the litigation process was the huge costs that this incurred on the SMEs. Considering that many of these firms had a yearly revenue between ten to twenty million SEK, adding litigation costs of up to thirty million obviously had a huge impact on the firms' financial situation. Worth mentioning is that two of the medium-sized firms who were ten times bigger than some of the other interviewed firms, stated that they could only enter the litigation process because they received financial support from the owners. These results further emphasize Bjuggren, Domeij and Horns' (2017) findings that the risks for entering patent litigation is much higher for SMEs, especially regarding the 50 percent chance of losing if the case goes to court (Bessen and Meurer, 2005). As mentioned by many of the interviewees, this suggests that the high costs in the litigation systems favor large firms with extensive resources. This adds to the already found disadvantage for SMEs and their lack of a larger patent portfolio to trade with, which would allow them to avoid going to court (Lanjouw and Schankerman, 2003, 2004). Altogether, these findings suggest that Boldrin and Levine (2013) could be correct in their conclusion that the primary effect of today's patent system is large firms blocking innovation and constraining competition, and not increasing innovation as it is supposed to do. The same authors pointed out that the ever-growing patent system is largely built by groups with economic incentives to see more patents. Some of the interviewees noted this as well, directing critique towards the patent offices and lawyers. Not surprisingly, the interviewees involved in litigation processes in the US also commented on the nuisance of patent trolls. As they were not listed as a patent troll in the Darts-IP database, we only discovered that two of the

counterparts were NPEs during the interviews. This might suggest that Darts-IP fails to track all NPEs, and the sharp decline in the number of NPE cases seen in Figure 3 could be questioned.

Possible changes to the patent litigation system

One commonly called solution for the problems that arise in patent litigation is a support system for SMEs. While Rodwell *et al.* (2007) agree that European SMEs lack official support, they also mention initiatives that are designed to assist small firms in patent litigation. The problem hereby is that these existing programs are mostly country specific and not implemented in Sweden. For example, a help-desk hotline where firms can get assistance on IPR issues exists only in the US. Moreover, most of the initiatives that currently exist focus on preventative measures and do not address the central issue of patent litigation costs. The authors also argue that firms should prioritize self-help measures to prevent patent litigation such as IPR risk assessments, training staff, avoiding risky markets, nominating an IPR manager, and due diligence checks on contractors, as previously mentioned.

Similar to Harhoff (2009), some interviewees noted the high costs and complexity regarding patenting and patent litigation in different European countries. In short, they suggested introducing a unified European patent and patent litigation system. A solution to this problem has been noted by government officials, and the process to implement it is ongoing. According to the European Patent Office (EPO, 2020) the new patent system is expected to launch in early 2022. The main features include protection for up to 25 member states with a single patent, the reduction of costs by removing national validation procedures and financial support for translations for SMEs (*ibid.*). The implementation of this system will also solve the problem mentioned by Cremers *et al.* (2017) regarding markedly different outcomes between the different countries. While the so-called Unitary Patent has the potential to address the current challenges firms face in patent litigation, it might also bring new problems with it. One the one hand, more firms might opt for IP protection through patenting, instead of lead-time advantages or secrecy, which might in turn increase the number of NPEs in Europe. One the other hand, even though firms can protect their innovations through centralized litigation in multiple countries at the same time, it also increases the risk of losing patent protection across Europe which might further incentivize NPEs to go after innovators due to a larger patent litigation system.

6. Conclusion

The aim of this study was to understand how firms behave in patent litigation and how SMEs and their innovation are affected. Through our study, we found some effects that are consistent with previous literature in this line of research, but also contribute to existing evidence by gaining new insights into how SMEs are affected by a patent infringement case.

Our results show that firms' patent litigation strategies varied depending on the context of the infringement case. In theory, firms had different options they could take but, in reality, especially the smaller firms were constricted by the circumstances of the case and their limited resources in which strategies they could employ. Regarding innovation, we can state that patent litigation had negative effects on R&D. This can be credited to the fact that the financial resources necessary to cover the costs involved in a patent case cannot be allocated to R&D in the same amount anymore. In regard to the innovations that were involved in the infringement cases, we found that the majority were not affected as firms did not make any changes to them due to the outcome of the case. Patent behavior on the other hand was affected in a number of different ways. On the one hand, mixed results were found regarding the firms' tendency to patent. On the other hand, many firms changed the way they formulate their patents to create stronger patents.

The empirical results also indicate that the costs resulting from patent litigation are the biggest problem for SMEs that have limited resources at their disposal. To mention here are also the unnecessary costs that arise due to litigation with patent trolls which have become an increased problem (Cohen, Gurun and Kominers, 2016), especially since SMEs are more likely to be targeted by NPEs (Chien, 2012). Direct costs such as attorney fees and damages are one of the hurdles for small firms to overcome. One way that might remedy the problem of high costs of patenting and patent litigation for SMEs in Europe is the Unitary Patent System that is to be introduced by the EPO in 2022. While these direct costs have been an established problem, our results also indicate that indirect costs, such as time spent on the case and mental and creative effects can accumulate, put further strain on SMEs and the employees and negatively affect productivity and innovativity. These findings add to previous research that entering patent litigation involves a higher risk for SMEs than for larger firms (Lanjouw and Schankerman,

2004). Conclusively, while patents as a way to protect IP are meant to spur and inspire innovation, we can see that, for SMEs, there are faults in the current patent system.

6.1 Managerial implications

In addition to the main conclusion above, the exploratory approach of the study and the interviewees experience resulted in, to say the least, “expensive” knowledge worth presenting to other entrepreneurs. As most of our interviewees stated, there is a lot you can do when it comes to preparations and strategies concerning patenting and patent litigation. First off all, it is important to keep proper documentation when developing and innovating, as this could help in future infringement cases. This ensures that firms can provide proof of what and when things occurred which ultimately helps build a stronger case. Secondly, firms also have to conduct a thorough analysis on previous patents in the market. If too similar patents exist there is a strong chance they can be used against the firm in a litigation process. Thirdly, how to write a patent and its claims is very important and might result in a lost litigation if not done correctly, as some of our interviewees had to experience. The consultation of patent attorneys and engineers can help create a strong patent in this context. The strength of the patent involved can then influence what strategies firms can use in an infringement case. Note that even if the patent is strong enough to withstand litigation, there are still other strategies that could complicate matters. For example, the losing side could decide to move all its assets to another firm, resulting in no damages to collect, or the infringer could just deny the infringing product to be theirs. This further displays that entering a legal process should be done with caution. Lastly, another important aspect to consider are possible costs and profits resulting from the legal process. Before entering a litigation process, it is therefore essential to assess and compare the risks and benefits, such as the huge costs, possible patent invalidity, exclusivity, and damages received. Going for a settlement or ignoring infringements might be the best option in some cases.

6.2 Limitations and avenues for future research

The limitations and suggestions are closely connected and will therefore be discussed simultaneously in this section. The first limitation to mention is that our study is restricted to a Swedish setting. One could argue that Sweden is representative, especially in Europe, yet we

have also seen that patent systems can vary across countries. Some findings from the Swedish court cases could, therefore, be attributed to the legal system in Sweden which is known to be less efficient than in other countries (Bjuggren, Domeij and Horn, 2015). This warrants a look at SMEs from other countries as well, to see if they are similarly affected by patent litigation across Europe and in the US and if they receive more support in foreign litigation cases than Swedish SMEs. Moreover, while effects on innovation could be established in our study, they were rarely consistent across our sample. Further qualitative research could help address this issue and also investigate the reasons why innovation has not been affected in some SMEs. Lastly, the Unitary Patent System is hailed as a solution for some of the challenges that SMEs are facing. It would therefore be remiss not to investigate the changes the new system brings, how it affects patenting in SMEs, and how the patent litigation process and its consequences on firms might be transformed. In this context, it would also be interesting to examine *if* and *how* NPEs adapt to the policy changes in Europe and what patent litigation strategies are most effective in the new system.

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Appendix

Appendix 1

Interview guide, interviews with entrepreneurs in patent-related disputes

Can you tell us a little about your own background?

Tell us about the innovation and work that has led to the dispute

[In cases where the respondent himself was responsible for the lawsuit] How did you think about the choice to initiate legal proceedings? What spoke for / against? What input did you get from others, such as patent attorneys or lawyers?

Describe the dispute and the legal process

Did you win/lose/settle? Did it feel like a win/loss?

How were you affected by the dispute and the process?

Economically (Ask about R&D investments following dispute)

In terms of time

Mentally

Creative

How do you feel that your own innovation has been affected in different ways?

Has the dispute affected the continued development and commercialization of the technology?

Has the experience of participating in a patent litigation affected your willingness to seek new patents?

Now in retrospect, what would you have done differently?

What knowledge do you wish you had?

Has it been worth the hassle?

How can the legal system be changed to reduce the impact a dispute has on a small player?

Appendix 2

Table 5: 2nd-order themes

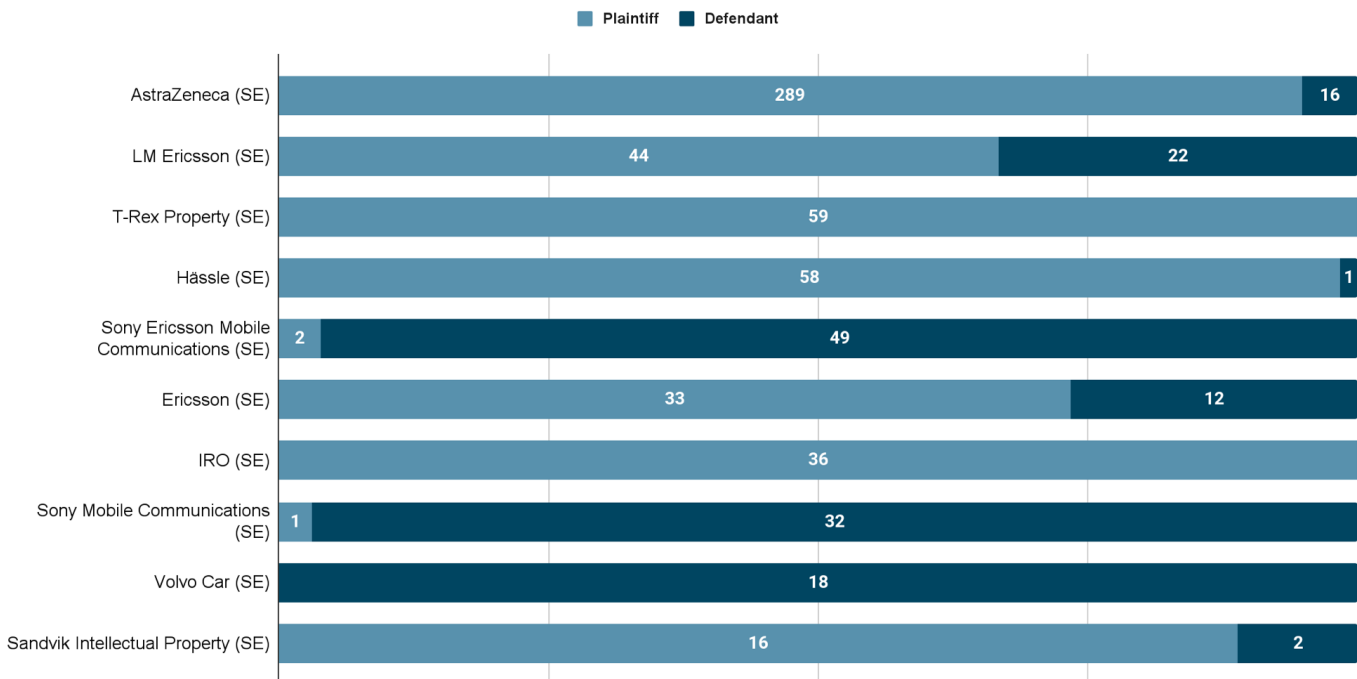
General information on firm innovation
General information on firm interviewee
General information on firm market
General information on firm patenting
Noticing or receiving notice of possible infringement
Perception of degree of infringement
Motivation to enter legal process
Legal preparations
During the legal process
Legal strategies
Other parties involved
Outcome win
Outcome loss
Outcome settlement
Outcome costs
Outcome perception
Timeframe
After the legal process
Effects on R&D
Changes to patenting behavior
Changes to innovation itself
Creative effects
Mental effects
Other effects on firm
General thoughts on the patent system
Critique on the patent system
Changes to the patent system

Table 6: Example of coding

Quote	1st order theme	2nd order theme	Aggregate dimension
<i>“The lawyer’s cost became very significant. It created a big hole”</i>	Lawyer costs	Costs	Consequences for the firms
<i>“It cost me so much, creative power to, you know, to protect my rights”</i>	Loss of creativity	Creative effects	Consequences for the firms

Appendix 3

Figure: 4 Most Active Parties (Total Case Count)



Notes: This figure shows the 10 Swedish firms that were involved in the highest number of cases. It also shows the ratio of the firms acting as a plaintiff versus a defendant.

Appendix 4

Table 7: IPC definitions and number of cases

IPC	Definition	Number of cases
A	Human necessities	590
B	Performing operations; transporting	277
C	Chemistry; metallurgy	319
D	Textiles; paper	34
E	Fixed constructions	74
F	Mechanical engineering; lighting; heating; weapons; blasting	79
G	Physics	463
H	Electricity	335

Notes: This figure shows the distribution of the eight categories in our initial dataset of 1427 cases. As mentioned earlier, patents oftentimes are classified by combinations of more than one IPC. That is why the total number of cases is >1427. Within the dataset there are 105 different IPC subcategories, where the five biggest subcategories are IPC class A61 (medical or veterinary science; hygiene) found within 492 cases, C07 (organic chemistry) in 263 cases, H04 (electric communication technique) in 233 cases, G06 (computing; calculating or counting) in 169 cases, and G09 (educating; cryptography; display; advertising; seals) in 80 cases. Notice that many of the innovations within the litigation cases have more than one patent or IPC subcategory applied to them, for example the combination of IPC A61 and C07 can be found within 201 cases.