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Defensive Publishing: An Empirical Study

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Abstract:
Defensive Publishing denotes publication of an invention with the purpose of creating prior art, and thus preventing patents being granted on this invention. Although widely employed, it has hardly been investigated empirically. Our study is based on 56 in-depth interviews, among others with most industrial firms in the German DAX 30 stock index. We find that 70 percent of the companies in our sample use defensive publications, for up to one third of their inventions. Interestingly, we find that the patent system itself is frequently used for defensive publishing. Our findings also challenge contributions connecting defensive publishing to patent races.

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1 Introduction

Excludability, complementary assets, and temporal advantages have been identified as central preconditions for appropriating value from inventive activity (Cohen et al., 2000; Levin et al., 1987; Teece, 1986). One—or in fact, *the*—fundamental precondition for appropriation from own use of an invention, however, has received little attention, maybe because it seems too obvious. This condition is "freedom to operate" (FTO), i.e., the right to practice the invention in the first place. One way to secure FTO is to make an invention public, a practice known as "defensive publishing." While broadly employed, as we will show, empirical research on defensive publishing is all but non-existent. In the present article, we aim to fill this gap.

FTO is evidently indispensable for a firm that makes use of its invention in its products or processes. One reason why it is nonetheless largely ignored in the literature may be that it is often secured "along the way" by filing for a patent. In that way, if the invention is novel and patentable and no overlapping patents exist, the inventor obtains both the desired FTO and, on top, an exclusion right. However, patenting entails considerable monetary and opportunity cost, and the exclusion right is often not required for appropriation. In particular when incorporating the invention into the inventor's own products, complementary assets (among them exclusion rights on complementary inventions) and temporal advantages often provide very effective protection (e.g., Cohen et al., 2000; Levin et al., 1987).

The obvious alternative to patenting is secrecy which, however, can prove a risky approach. Apart from the fact that trade secrets tend to leak out (Mansfield, 1985), an inventor easily forfeits her right to practice an invention if some other party re-invents and patents it. The risk of this happening increases with the steadily rising flood of patent applications.[1] Another implication of the latter is the widely criticized issuance of low-quality patents (e.g., Kahin, 2003), which may lead to patents being granted on inventions that some earlier inventor considered too trivial to patent. While the "prior use" defense may help to maintain FTO in such cases, this procedure is awkward and very often not effective.[2] Certainly, it is nothing innovators want to rely upon.

In light of the above, defensive publishing presents itself as an alternative to patenting and secrecy. Despite its obvious relevance for innovation and value appropriation, however, a

[1] The compound annual growth rate of the number of patent applications at, e.g., the EPO between 1996 and 2005 was 8.2%. The absolute number in 2006 was 208,502. Source: European Patent Office, *Annual Reports*, http://www.european-patent-office.org/epo/an_rep/index.htm (retrieved August 10, 2007).

[2] In such instances, laboratory notebooks often play a central role, but are very problematic both in terms of completeness and of reliability. For the analogous situation of proving who was first to invent under US patent law, the notorious "battle of the notebooks" is described by Adelman *et al*. (1998: 329).

dedicated empirical study is missing. We aim to fill this void. To do so, we inquire how widely firms practice defensive publishing, what methods they employ to effect it, under what conditions and for what types of inventions they prefer it, and in what industries it is prevalent. Given that the actual use of defensive publishing is a white spot on the map of innovation management research, we chose an exploratory research approach. To provide the necessary background, we also present the legal underpinnings of defensive publishing.

Our study is based on 56 semi-structured interviews with intellectual property experts, among them 44 company patent professionals from 37 different companies, mostly from Germany. In particular, our sample comprises, with one exception, all firms in the German DAX 30 stock index active in technology-based industries. Most of the other 12 interviewees are examiners or judges at the European Patent Office.

We find that defensive publishing is widely practiced, with more than two thirds of the firms in our sample making use of it. The share of inventions that are defensively published varies strongly between firms, reaching 30% and more in some cases. Also with respect to the method employed we find a broad diversity, including the use of specialized providers such as IP.COM and ResearchDisclosure.com, peer-reviewed journals, public notice boards, and company-owned journals. Interestingly, we find that also patent applications are sometimes used for the sole purpose of creating prior art.

As to the motives to choose defensive publishing over patenting and secrecy we find that they can be grouped under four headings. (a) *The patent (if granted) is of limited value*. This may be the case, e.g., because the invention is protected by complementary assets or because the patent would be costly to enforce. (b) *Defensive publishing is less costly than patenting*. We find that even in some large corporations the budget allocated to patent applications is fixed, such that their number is limited. (c) *Freedom to operate must be preserved*. Defensive publishing tends to be preferred over secrecy when freedom to operate is crucial, and the risk that a competitor duplicates and patents the invention is high. Interestingly, defensive publishing does not necessarily obviate secrecy: while *de jure* availability to the public is required, *de facto* availability can often be restricted or even avoided. In that case, the inventor effectively maintains secrecy. (d) *It appears uncertain if the invention is patentable*. We find that defensive publishing is relatively most attractive when uncertainty about patent grant is highest. As we will discuss, this result touches upon a central problem of today's patent system.

Finally, our findings challenge recent contributions analyzing the use of defensive publishing in patent races (Baker and Mezzetti, 2005; Bar, 2006; Lichtman et al., 2000;

Parchomovsky, 2000). Most interviewees considered it a “very theoretical” concept, and denied its practical relevance for a variety of reasons.

The large heterogeneity we found with respect to extent, methods, and drivers of defensive publishing is an interesting finding in itself and suggests that, as among scholars, also among practitioners no accepted wisdom on this topic exists. We aim to remedy this situation by deriving a number of management recommendations.

The paper proceeds as follows. Section 2 provides background on the effectiveness of patents and alternative protection mechanisms, and reviews the existing literature on defensive publishing. Section 3 establishes the legal framework. Research questions are formulated in Section 4, method and data of our empirical study are presented in Section 5. In Section 6, results are presented on the methods and frequency of defensive publications, the motives to pursue them, and their use in patent races. Section 7 concludes.

2 Background

Defensive publishing constitutes a particular means of intellectual property (IP) management, and thus must be analyzed in view of the alternatives, patenting and secrecy. Patents serve other purposes than just securing exclusivity. The more important such other uses, the less attractive defensive publishing should be. We review the relevant types of “strategic patenting” in Section 2.1. On the other hand, there are further means to secure appropriation beyond patents, as we lay out in Section 2.2. If these means are effective enough, a patent may not be required, but only freedom to use the invention. In that case, a defensive publication (DP) becomes more attractive. In Section 2.3, we review the extant literature on defensive publishing.

2.1 Strategic use of patents

Beyond the traditional use of patents to protect the inventor from imitation, patents have taken on various other functions (Arundel and Patel, 2003; Blind et al., 2006; Cohen et al., 2002; Grandstrand, 1999; Macdonald, 2004; Noel and Schankerman, 2006, Reitzig, 2004). To start with, *generating licensing revenues* is facilitated by patents (as opposed to trade secrets) since they establish absolute property rights (e.g., Arora, 1997; Arora et al., 2001; Hall and Ham Ziedonis, 2001). Thus, a higher relevance of licensing revenues should make defensive publishing relatively less attractive. However, as for patents to prevent imitation also for patents to secure licensing it should suffice to hold key patents in the relevant field, which

should make defensive publishing a viable alternative for complementary inventions (cf. Rinner, 2003).

Cross-licensing and patent pools are widely used when companies are both sellers and buyers of patent licenses (Choi, 2003; Gallini, 2002; Lerner et al., 2005; Shapiro, 2001). Such arrangements are particularly relevant in "*complex technologies*," in which products consist of many individual inventions (Kash and Kingston, 2001). Electronics is a prime example of such a complex (as opposed to "*simple*") technology (Grindley and Teece, 1997; Hall and Ham Ziedonis, 2001). In this case, each firm is unlikely to hold the rights of use to all technologies embodied in its products. The prospect of cross-licensing thus renders patents in complex technologies more attractive, which should exert a negative effect on the attractiveness of defensive publishing. We will show, however, that a counteracting positive effect of complexity outweighs the negative one.

Defensive blockade is a use of patents closely linked to defensive publishing. The term denotes the practice that "firms patent in order to prevent their own technological room to manoeuvre being reduced by the patents of others" (Blind et al., 2006: 657). To the extent that this means to secure freedom to use the respective technology, a DP serves the same purpose, at lower cost. In contrast, when the patent shall be employed against infringement allegations by accusing the plaintiff in turn of infringement (Cohen et al., 2002), then a DP would be inferior. However, if the plaintiff is not a manufacturer but a specialized owner and licensor of intellectual property, patents as a means of retaliation are of no avail. With the recent rise of so-called "patent trolls," this situation has become highly relevant (Reitzig et al., 2007; Henkel and Reitzig, 2008). Given the broad range of often minor inventions that patent trolls could use to hold up a manufacturer, "blanket patenting" as a means to secure FTO will often be too expensive and time-consuming. Accordingly, DPs should come to the fore.

2.2 Effectiveness of patents

If an inventor is willing to forgo patent protection for mere freedom to operate secured by defensive publishing depends on the cost and the expected value of a patent application. The latter in turn depends mainly on the effectiveness of the exclusion right afforded by the patent and the effectiveness of alternative protection mechanisms. Addressing the questions of how firms protect their inventions and how effective they deem the various means of protection, a number of surveys have shown that patents fare relatively badly (Arundel, 2001; Cohen et al., 2000; Cohen et al., 2002; Harabi, 1995; Levin et al., 1987; Sattler, 2003, Taylor and Silberston, 1973). Surprisingly in light of the ever increasing number of patent applications it

turns out that, with the exception of the chemical and the pharmaceutical industry, patents are considered as relatively ineffective, while “lead time” and “superior sales and service efforts” are ranked highly. A further downside of patents is that they lead to knowledge spillovers (Horstman et al., 1985; Reitzig, 2003).

Given these findings, the additional value afforded by a patent application over mere freedom of use will often be rather limited, in particular in industries other than chemicals and pharmaceuticals and for technologies in which patent-related spillovers matter strongly. In these cases, DPs should be relatively more attractive.

2.3 Defensive publishing: Existing research

The literature on defensive publishing can, with some overlaps, roughly be grouped into four categories. Articles in the first category point out the benefits of defensive publishing for practical purposes, and make recommendations on when and how to use it (Adams and Henson-Apollonio, 2002; Barrett, 2002; Buxbaum, 2001; Colson, 2001a, 2001b, 2001c; Garnett, 1991; Schaier, 2001; Boettiger, 2007).

The second category comprises contributions addressing defensive publishing from an economics perspective, mostly as one of several aspects of cumulative invention (Bar-Gill and Parchomovsky, 2003; David, 2004; Maurer, 2002; Murray and O’Mahony, 2005). In more detail, Merges (2004) presents an account of defensive publishing in the field of genomics (see also Eisenberg, 2000, and Maurer, 2002). When the DNA code finally could be read in the 1990s, many firms started to exploit their research results via patent protection and licensing. Merck Pharmaceuticals, in contrast, went the way of defensive publishing. In collaboration with Washington University in St. Louis, Merck created, in 1994, the “Merck Gene Index,” a public domain database of expressed human gene sequences. The company committed to making as many gene sequences as possible publicly and freely available. This way, Merck could secure its rights to use gene sequences as inputs for its downstream research, without spending excessive amounts on patenting.

In the third category fall articles analyzing the use of DPs as a strategy in a patent race. Parchomovsky (2000) provides a conceptual legal analysis, while Lichtman et al. (2000), Baker and Mezzetti (2005), and Bar (2006) combine a discussion of legal aspects with game-theoretic models. With some simplification, the argument goes as follows. Two firms are in a race for an invention, and one firm finds it is about to lose the race. For example, the leader in the race may have attained 90% of an inventive step sufficient for a patent, the laggard only 50%. By publishing its current state of research, the laggard now sets back both itself and the

leader by decreasing the difference to the state of the art. Having set back the leader from 90% to 40%, the laggard has, if research technologies are sufficiently stochastic, a new chance of winning the race.

This logic has not remained without critics. Eisenberg (2000) raises the issue of the first-to-invent rule applied in the U.S., implying that a DP may not pre-empt a patent application if the related invention predates the publication by less than one year. In addition, she points out that the disclosure may accelerate the leading firm's research, help it in drafting its patent claims in such a way as to circumvent the disclosure, or may even serve as proof that the invention was non-obvious. Rinner (2003) adds that the disclosure may invite additional competitors and that it makes a later patent application also by the disclosing party more difficult. We will show that these points of critique are indeed relevant for decision makers, but not exhaustive. Additional fundamental criticisms were voiced by our interviewees, as we discuss in Section 6.4.

The fourth and final category comprises models of defensive publishing which do not deal with patent races. To our knowledge, only Johnson (2004) and Ponce (2007) figure in this category. Johnson (2004) develops a game-theoretic model which compares the options of patenting, secrecy and defensive publishing. His findings predict that defensive publishing will be preferred when an invention is easy to invent around, when patent trolls threaten to litigate the inventor, when the inventor is a large firm, and when the patent office is more likely to issue patents on obvious or non-novel inventions. Ponce's (2007) model analyzes the amount of disclosed information and the related trade-off between defeating subsequent patent applications with higher probability and greater knowledge spill-overs to rivals.

While, as we have shown, a considerable number of conceptual and theoretical articles on defensive publishing exist, empirical research on the topic is scarce at best. Johnson (2004) complements his game-theoretic analysis with data from websites dedicated to defensive publishing. Similarly, Baker and Mezzetti (2005) analyze IBM's *Technical Disclosure Bulletin* to supplement their game-theoretic model. In both contributions, the empirical data is used to show consistency with findings from the model. However, insights into the actual use of defensive publishing are very limited since each study draws on only one channel for disclosures. In addition, information about inventors' motives to publish defensively is not provided. Our study aims at filling these gaps.

3 The legal framework of defensive publishing

The nature of defensive publications is to be disruptive of the granting process of patent applications covering the same invention. Thus, in order to understand the logic of defensive publishing a closer look at its legal framework is required.

3.1 Novelty and Inventive Step

The European Patent Convention (EPC) lays down the requirements for patentability in Article 52(1): "*European patents shall be granted for any inventions which are susceptible of industrial application, which are new and which involve an inventive step*." Of these, novelty and existence of an inventive step ("non-obviousness") are relevant in our context, since DPs work by denying an invention its novelty or at least its inventive step.

In more detail, an invention is considered to be new by the EPC "*if it does not form part of the state of the art*" (Article 54(1)). It "*shall be considered as involving an inventive step if, having regard to the state of the art, it is not obvious to a person skilled in the art*" (Article 56). The *state of the art*, in turn, is defined by Article 54(2) as comprising "*everything made available to the public by means of a written or oral description, by use, or in any other way, before the date of filing of the European patent application*." Article 54(3) adds to the state of the art *"the content of European patent applications as filed […]"*

US patent law is different from that of most other legislatures in that it applies a first-to-invent rule (US Patent Act, Section 102). Compared to the first-to-file rule, this has an ambiguous effect on the attractiveness of DP. On the one hand, a DP will not pre-empt a patent application if a) the latter is filed less than 12 months after the DP and b) the invention predates the DP. In such a case, a DP might even trigger a competitor's patent application. On the other hand, a DP can help to establish priority for an inventor, who maintains the option to file for a patent within the following year.

Given that our empirical study comprises mainly German firms, we focus in the following on European patent law, commenting on peculiarities of German patent law where necessary. One aspect of the EPC's definition of "state of the art" is particularly relevant in our context. Article 54(2) refers to "*everything made available to the public.*" Thus, a DP must be "available to the public" in order to be effective. While this may appear tautological, the definition of "available to the public" is not clear-cut. For example, if a book describing a certain invention is available in most major libraries, the invention is doubtless available to

the public. But if only one copy of the book exists, and it is placed in a library on a remote tropical island, availability to the public *in the practical sense* is not given.[3]

The EPO tends to define the "state of the art" quite comprehensively[4] and has developed clear guidelines together with a body of case law on this issue. Still, the conditions under which a difficult-to-find document creates prior art are subject to some, at least perceived, legal uncertainty. Inventors opting for defensive publishing have to take this uncertainty into consideration when selecting the means for defensive publishing. Doubtlessly, however, the EPO's broad definition of "available to the public" permits inventors to establish prior art which almost certainly no competitor will discover.[5]

Finally, for creating prior art using DPs not only the question of availability per se is relevant, but also its date. Even if, e.g., a company leaflet undoubtedly creates prior art, the date of its publication may be hard to prove some years later. An incontestable "time stamp" will thus constitute another criterion by which inventors select their method of defensive publishing.

3.2 Patenting process

The purpose of DPs is to interfere with the granting or enforcing of patents, and they may do so in various ways. A closer look at the patenting process is thus warranted. Figure 1 depicts on its left-hand side the main milestones of the patent granting procedure at the EPO, and on

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[3] The issue of "public availability" is even more pertinent to electronic documents downloadable from the Internet. A document downloadable for one year on a frequently visited and topically fitting website certainly is to be considered available *in the practical sense*, while a document downloadable for one hour from an unlinked website is not. From a *legal* perspective, the EPO is restrictive in recognizing documents on the Internet as being part of the state of the art. In a recent decision, the EPO's Technical Board of Appeal required "strict standard of proof", taking the stance that Internet disclosures carry high uncertainties with respect to their date and the content at the relevant date, and remitted the case to the first instance (T 1134/06, 16 January 2007, http://legal.european-patent-office.org/dg3/biblio/t061134eu1.htm, accessed February 13, 2008). Internet publications thus *may* constitute part of the state of the art when their date, content, and accessibility can be proved (e.g., by a notary), but do not automatically do so.

[4] The *Guidelines for Examination in the European Patent Office* (European Patent Office, 2007) specify in Part C-IV, Chapter 6.1: "There are no restrictions whatever as to the geographical location where or the language or manner in which the relevant information was made available to the public; also no age limit is stipulated for the documents or other sources of the information."

[5] The *Case Law of the Boards of Appeal of the European Patent Office* (European Patent Office, 2006) provides a rather telling example (Chapter I.C.1.8): "In T 165/96, technical information about a feature of the invention had been disclosed, prior to the date of filing of the European patent application in question, in an insert in a minor small-ads newspaper (circulation: 24 000) distributed in the suburbs of Copenhagen. The patent proprietor argued that in view of the newspaper's limited circulation and readership ('man on the street' in suburban Copenhagen) the information in question had effectively remained confidential and could not be regarded as forming part of the state of the art. […] The board ruled that […] publication in such a manner fulfilled the necessary and sufficient conditions for citing a disclosure against the patent. Information was 'available' once people could theoretically become aware of it."

its right-hand side the respective ways in which a DP may become effective.[6] We assume that technology T has been invented at some earlier point in time by the "original inventor", who then defensively published it. The "second inventor" is the potential applicant at the EPO.

--- Insert Figure 1 about here ---

As Figure 1 shows, the DP can disrupt the patent granting process at different stages, and by different mechanisms. The earliest possible stage is that the (potential) second inventor finds the DP before even re-inventing T (stage 1 in Figure 1). Otherwise, the second inventor (as we assume) re-invents T, and either finds the pertaining DP (stage 2) or goes on to file a patent application. In the latter case, the examiner may find the DP (stage 3 or 4a) or, when the application has been made public, the original inventor or a third party (pursuant to Article 115 EPC) presents the DP as an objection (stage 4b). If neither of this has happened, the patent is granted (as we assume) and the original inventor or a third party has the opportunity, according to Articles 99–105 EPC, to file an opposition at the EPO within nine months after publication of the grant (stage 5a). In addition—or alternatively—she may try to negotiate a bilateral agreement with the patentee (stage 5b). If the patent grant went unnoticed by the original inventor, or she decided against an opposition, she (or a third party) may try to invalidate the patent in court either offensively (stage 6a) or, after having been sued for infringement by the second inventor, defensively (stage 7a). As in stage 5b, also in stages 6b and 7b a bilateral agreement may be the outcome. In contrast to the opposition, invalidation suits take place on the national level, not at the EPO. As we will show, an inventor typically has a clear preference as to when and how she puts a DP to use.

4 Research questions

This study focuses on the actual creation and use of DPs. In the following, thus, we formulate detailed research questions addressing the frequency of DPs, the ways how firms create DPs, and their motives to do so.

[6] An important difference between the EPO and the USPTO patenting process is the absence of an opposition period in the latter. Regarding differences, it should also be noted that the U.S. patent system comprises the institution of a "Statutory Invention Registration" (SIR), especially designed to accommodate defensive publications. The SIR succeeded the "Defensive Publication Program" in force 1968-1985 (see the USPTO's *Manual of Patent Examining Procedure* 711.06 III, http://www.uspto.gov/web/offices/pac/mpep/documents/0700_711_06.htm, accessed January 8, 2007). According to our interviews, both institutions are, resp. were, used infrequently.

Q1: *How often is defensive publishing chosen over alternative actions?* This research question is of obvious importance. While it is known how defensive publishing works and *that* it is done, hardly any data exist regarding the extent to which firms opt for defensive publishing instead of patenting or secrecy.

Q2: *What means of defensive publishing exist, and how often are they used?* Patent law and guidelines at the EPO regarding the state of the art impose no restrictions on the manner in which the relevant information is made public (see footnote 4). Practical aspects, however, do: in particular, cost, diffusion, and searchability. For a deeper understanding of the phenomenon we thus need to know in what manner DPs are carried out.

Q3: *How often are DPs effected using the patent system?* DPs within the patent system deserve particular attention. Given that each patent application (unless withdrawn before publication) creates state of the art, one of the motives for filing an application may be exactly this. Yet, surveys on the motives to patent (see Section 2.2) omit the motive related to DP.

Q4: *What are the motives to effect a DP?* The decision between patenting an invention and publishing it defensively is presumably driven by cost-benefit considerations, temporal aspects, and to some extent behavioral issues such as accepted customs. We inquire about the relative importance of these motives and potential further ones.

Q5: *What does the relative importance of the various motives for defensive publishing depend on?* Further exploring the issue raised in Q4, we expect, e.g., cost aspects to be especially of interest for smaller firms where patent budgets are tight. Beyond firm size, another important moderating factor should be the nature of the underlying technology. We would expect that, in industries based on complex technologies, the argument that patents on core inventions constitute complementary assets to the focal invention is relatively more important as an argument pro DP. A counteracting mechanism is, of course, that in such industries patents may be more valuable as currency in cross-licensing (see Section 2.1). In order to test this theoretical prediction, we will put a particular focus on electronics as the prime example of an industry based on a complex technology.

Q6: *Is the relevance of defensive publishing likely to increase or to decrease over time? And if so, why?* Various factors which potentially affect the attractiveness of defensive publishing vary strongly over time, notably the number of yearly patent applications and the technical means of effecting DPs. We conjecture that both trends make defensive publishing increasingly attractive. Beyond these, other time-varying influences might exist.

5 Method and data

We conducted a total of 56 semi-structured interviews between April 2005 and November 2006, part over the phone, part face-to-face. Among our interview partners were 44 company patent professionals from 37 different companies, 6 examiners and 3 judges at the EPO, 2 patent lawyers, and the CEO of a firm offering services related to defensive publishing.

Of the 44 patent professionals we interviewed, 27 were working for companies listed in the German DAX 30 stock index. With one exception, our interviews covered all 22 DAX 30 companies active in technical industries.[7] We chose this index because it comprises the most important multinational German companies and gives a broad overview over different industries. In order to check for effects of DAX 30 membership, nationality, and size, we conducted 10 further interviews with other large (German or international) companies, and 7 with German SMEs. As explained above, for the firms not contained in the DAX 30 the industry focus was put on electronics.

The firms in our sample are thus partly representative (21, those in the DAX 30 stock index) and partly deliberately selected (16). This selection was made in order to obtain a clear picture of our object of study, but naturally restricts the validity of statistics. Thus, when we provide quantitative summaries in the following, they have to be interpreted with this caveat. Still, with the structure of our sample in mind they provide valuable insights.

Most interviewees in firms hold the position of head of IP or head of R&D. The interviews had an average duration of 34 minutes and were mostly recorded and transcribed. In eight cases, the interview could not be recorded and handwritten notes were taken.

The evaluation followed the approach of qualitative content analysis (Mayring 2004), to provide an objective and systematic evaluation of the data. The analysis was performed using the qualitative analysis software package NVivo7. For the evaluation an initial code network was generated on the basis of the interview guideline which provided the general definition of categories. In a second step, about one quarter of the interviews were coded, during which process the network was adapted and extended by the subsumption of nodes under already existing categories or the formation of new ones. The interview material was hence analyzed step by step, and the coding network evolved simultaneously. In a final step, all interviews were coded again. The final coding network consists of 110 nodes on 5 levels. In total, 1544 text segments were coded and allocated to one or more nodes.

[7] We use the composition of the DAX 30 as of January 16, 2006. We excluded 8 firms indicating as their main field of business “banking” or “trade.” In some firms, we conducted more than one interview in order to capture the perspectives of different business units, or of different functions within the patent department.

6 Results

While it is generally known *that* defensive publishing is practiced, knowledge about *how*, to what *extent*, and *why* firms do it is limited to anecdotal evidence. In this section, we open up this black box and provide empirical evidence. The analysis yields a number of unexpected insights, and allows tentative predictions about the growing relevance of DPs.

6.1 Types of defensive publications

Addressing our research questions Q1 to Q3, we encountered a puzzling heterogeneity with respect to the types of DPs employed. With more than two thirds of the companies in our sample using DPs, we could cluster their types into three groups: "classical" DPs, DPs within the patent system,", and "disguised publications." We characterize each category in turn.

6.1.1 Classical defensive publications

Classical DPs comprise all types of DPs outside the patent system which are not intentionally hidden (unlike "disguised publications," see below). In this category, the Internet has triggered a radical, and ongoing, change in the way and the extent DPs are effected, by dramatically increasing effectiveness of DPs. As two interviewees put it,

> *(a) "With the Internet era there has been a change of paradigm in defensive publications."* [8] (Interviewee 1, EPO)
>
> *(b) "My view on defensive publishing has changed over time, in large part due to the Internet. Access to publications was always an issue. Due to the Internet, it has become much easier to find things. […] It works better for both sides. […] Defensive publishing is in the process of going from a somewhat theoretical type of thing to something that works better."* (Interviewee 2, other multinational company[9])

In the past, company-owned journals dedicated to defensive publishing were relatively common among large corporations in the field of electronics, and three of the firms we interviewed had published such journals. IBM's Technical Disclosure Bulletin is probably the best-known example. Today, however, only one of the three continues to do so, the other two

[8] Where necessary, the quotes have been translated from German by the authors.

[9] With "other multinational company" we denote (German or foreign) multinational firms not in the DAX 30.

having switched to a specialized Internet-based provider.[10] As Table 1 shows, such providers (IP.COM, ResearchDisclosure.com) constitute the most frequently used medium (12 mentions) for "classical" DPs. In addition to indicating an important means of defensive publishing (i.e., the Internet in conjunction with specialized providers), this finding as well as quotes (a) to (c) contribute to an answer to our research question Q6, suggesting that the relevance of defensive publishing is on the rise.

--- Insert Table 1 about here ---

> *(c) "[Provider] is very suitable for us since, on the one hand, they publish it in a way which makes it accessible worldwide over the Internet, [and] additionally document it via a notary who, if need be, can provide proof."* (Interviewee 3, DAX 30)

These providers publish invention disclosures both in print and online. The print version ensures public availability in the legal sense, while the online version provides *de-facto* public availability (in particular, searchability for patent examiners). This duplication highlights a peculiarity of the Internet as a publication medium: while being extremely effective, it is of limited legal reliability.[11] In fact, the Internet per se (i.e., without a specialized provider) was not mentioned as a medium for DP. Rather, interviewees would avoid it due to perceived uncertainty:

> *(d) "Well, such a website is easy to manipulate. And who proves that this [the publication] really had been there in this way?"* (Interviewee 4, other multinational company)

> *(e) "Good luck in getting this recognized in court or at the patent office, that it is really regarded as a publication and actually had this publication date."* (Interviewee 5, SME)

While the Internet has dramatically increased the potential for de-facto availability of DPs, such easy availability is desirable only when the DP shall become effective in early

[10] IBM, for example, did so in 1998 (http://www.ibm.com/ibm/licensing/patents/disclosures.shtml, retrieved February 05, 2008). Other corporations such as Motorola, Siemens, and Xerox did likewise.

[11] See also Section 3.1, Footnote 6. For the US and Europe, the firms actually would not need the print journal for irrefutably creating prior art since they fingerprint and notarize each publication. This proves integrity and date, thus ensuring that also an Internet publication is recognized in court. The print journal, however, is recognized as creating state of the art in *all* legislations, and in addition reassures clients.

stages (1 to 4a, see Figure 1) of the patent granting process. Two companies in our sample take a different approach. They make it difficult to access their DPs by posting them on a notice board at the factory gate, with disclosures confirmed by a notary. Given the broad definition of "state of the art" applied by the EPO (see Section 3.1), this practice should be reliable in creating prior art in Europe, while at the same time restricting *de-facto* availability. If, however, a disclosure on a notice board is recognized also by courts abroad appears less certain, which is why some other interviewees voiced concern about this approach. The differential assessment of this practice by our interviewees highlights the trade-off between *desired* reliability in creating prior art and, for some inventors, *undesired* public availability of the information. In addition, it highlights the heterogeneity between respondents in their assessment of defensive publishing and, in particular, of different ways to effect it.

The publication channels discussed so far are dedicated to defensive publishing. In contrast, all other means of publication listed in Table 1 serve a second (or rather, main) purpose. Articles in peer-reviewed and other journals, presentations (at conferences, scientific workshops or lectures), displays at trade fairs, and flyers all allow, to varying degrees, building a reputation (for the inventor as for the firm), generating visibility, networking, and marketing one's products. Also by delivering an easy-to-reverse-engineer product, the respective firm accomplishes a DP "along the way."

What is intriguing about such "double purpose" publications is that they are all but unrecognizable as DPs, and in sum are used by more firms than the "single purpose" types of DP. That is, the majority even of "classical" DPs likely go unnoticed.

6.1.2 Defensive publications within the patent system

Somewhat surprisingly, we found that a third of the companies in our sample (11), most of them larger ones, would sometimes create prior art by applying for a national patent without pursuing the application.

> *(f) "We for our part decided to effect defensive publication via a fast patent application."* (Interviewee 6, DAX 30)

A national patent application which is later published creates state of the art in the respective country at the time of filing, and in other countries when it is made public. As at the EPO, publication in Germany takes place after 18 months, or earlier at the request of the applicant—an option which makes a patent application not only a reliable, but also a

relatively fast way of defensive publishing. For the small fee of € 50[12] an inventor can thus secure freedom to use the technology—and can then choose to either terminate the process by not paying any further fees, or to maintain the option to pursue the application.[13] Apparently, also the effort that such patent applications require is limited, as the following quote shows:

> *(g) "You just send the whole junk to the patent office, and when you are in a good mood you add one or two patent claims. And this will be published some time, and then you effectively have the state of the art."* (Interviewee 7, DAX 30)

In addition to being inexpensive and reliable, national patent filings are also perceived as helping to satisfy the German act on employee inventors (*Arbeitnehmererfindergesetz*):[14]

> *(h) "What we sometimes did is we filed a German patent application, because the cost of a German patent application is only 150€ [sic]. […] Also in this special situation with the German inventor law […] we fulfilled our legal requirements and we had for a very cheap price a publication."* (Interviewee 8, DAX 30)

In a similar way one can use the German utility patent (*Gebrauchsmuster*), as stated by one interviewee.

> *(i) "[…] then we'd rather file for a utility patent, so it is published shortly."* (Interviewee 9, DAX 30)

One mention received the practice to place, or effectively to hide, an invention within the patent application for another invention.

> *(j) "What we sometimes do is that we write something in a patent application with respect to different subjects, […] we add some pages in between*" (Interviewee 10, other multinational company)

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[12] The amount of € 50 is the fee for an application in electronic format, see http://www.dpma.de/formulare/a9510.pdf (accessed February 5, 2008). In addition, annual fees of initially € 70 for maintaining the application become due from the third year onwards.

[13] Pursuant to § 44(2) German Patent Act, the applicant can delay the request for search and examination for up to seven years. The option to file in other countries exists for one year after filing.

[14] This act governs how firms have to deal with inventions by their employees. In the normal case, firms have two options. They either have to file for a patent, after which the inventor is entitled to royalties depending on the commercial use of the invention. Alternatively, they have to cease the right to the invention to the inventor, who is then free to apply for a patent himself. There are, however, legally correct ways of circumventing these two options by bilateral agreements between firm and employee.

This approach is at odds with Article 82 EPC stipulating "unity of invention," and the unfitting pages will be removed at some later stage—but only after publication of the application. It thus seems to be a viable concept, which combines indisputable creation of prior art with very limited public availability. It thus borders on disguised publications, which are discussed next.[15]

6.1.3 Disguised publications

Disguised publications are executed in such a way as to make them difficult to find. According to our interviews, a disguised publication may appear in a journal devoted to a different discipline, be written in an unusual language, published in a remote country, posted somewhere on the internet, or put as a unique copy into some library. Unusual languages make the disguised publication even harder to find. Quotes (k) and (l) illustrate this practice.

> *(k) "We publish with a limited chance that people will see it. Maybe you can publish in Denmark in a small magazine for farmers*." (Interviewee 10, other multinational company)

> *(l) "[in the* company *I worked with before] this was done now and then, to publish in an absolutely inappropriate journal in Kirghiz language. To make sure nobody finds it*." (Interviewee 11, EPO)

On the plus side, this type of DP prevents diffusion of the invention to competitors. In addition, it enables the inventor to enter into bilateral agreements with a later patent applicant (in stage 5b or later) which, according to an interviewee at the EPO, might explain quite a number of withdrawn oppositions (presumably filed by the original inventor who then negotiated bilaterally with the applicant).

On the negative side, since such DPs will neither be found by competitors nor by patent examiners (stages 1, 2, 3, 4a, see Figure 1), using this method requires either a close monitoring of the competition (enabling the inventor to put the DP to use in stages 4b, 5, or 6) or entails the risk of lengthy and expensive litigation (stage 7). Furthermore, most interviewees voiced doubts if a disguised publication would stand up in court. Several interviewees even considered it sort of illegal, or at least a breach of conventions. Most knew

[15] A second way of creating disguised publications within the patent system, mentioned by one interviewee, is to use the patent system of smaller or more distant countries. One company had filed, several years ago, patent applications in an Arab country.

the concept, but only two interviewees acknowledged using it—one via a little read journal in a foreign language, one via a placement of a printed copy in a library.

6.2 Frequency of use of defensive publishing

As stated above, 26 companies out of 37 in our sample (70%) use defensive publishing at least at times. Out of these 26 companies, 21 companies perform defensive publishing "in the narrower sense" (i.e., not via the patent system), and 11 companies use the patent system for DPs. Six companies use both methods in parallel. Table 2 provides an overview. Interestingly, the share of firms making use of DPs is largely similar for all groups we consider. While we do find some support for Johnson's (2004) claim that large firms are more prone to use DP than SMEs (with 73% vs. 57%), the sample of SMEs is clearly too small for a substantiated conclusion even if it was representative. For the conjecture that defensive publishing is more widely used in the electronics industry we do not find any support.

--- Insert Table 2 about here ---

More detailed information is obtained by looking at the *share* of inventions that are defensively published. Of the 26 firms using DPs, 22 were willing and able to provide this data. Two quotes from large, IP intensive firms in the electronics industry illustrate how important defensive publishing as a means of IP management is in some cases.

> *(m) "The share of all reported inventions that are patented is about 60 to 70 percent […] and we keep secret only a small share [the balance being published as a DP]."* (Interviewee 4, other multinational company)

> *(n) "[The frequency of defensive publications] strongly depends on the field of technology within the company. I would say that, in some fields, about 30 percent [of inventions] are dealt with using this means of publication."* (Interviewee 12, other multinational company)

We find the distribution of the share of DPs among all inventions to be strongly right-skewed, with a minimum of less than 1% and a maximum of 35%. Only minor differences exist between the distribution for firms using defensive publishing "in the narrower sense," for those employing the patent system for that purpose, and for those doing both (see Table 3). The median lies within the range of 6 to 10% for the first group and in total, and within 1 to 5% for the other two groups. Table 3 provides further details.

--- Insert Table 3 about here ---

Also the share of defensively published inventions does not lend support to the conjectures mentioned above. Of the five firms leading the statistics, four are large, and three of them are active in the electronics industry. These shares hardly differ from those for all 22 firms which had provided the pertaining data (of which 20 were large and 9 active in the field of electronics). A representative survey will allow a valid test of these hypotheses.

6.3 Reasons for using defensive publications

Having established by what means and to what extent defensive publishing is used, we now turn to our research questions Q4 and Q5 regarding the motives for defensive publishing and their relative importance. We structure our analysis along a simple formal representation of the expected values of a patent application, a DP, and secrecy. Each line has two or three additive terms which refer to the value of exclusivity, the value of freedom to operate, and to various types of cost:

$$E[V_{PatAppl}] = V_{Excl} \cdot P_{Grant} \cdot P_{Enf} + V_{FTO} - C_{Pat} - C_{Spillov} \quad (1)$$

$$E[V_{DefPubl}] = V_{FTO} \cdot P_{Recog} - C_{DP} - C_{Spillov} \quad (2)$$

$$E[V_{Secrecy}] = V_{Excl} \cdot (1-P_{Re\text{-}inv}) + V_{FTO} \cdot (1-P_{Re\text{-}inv} \cdot P_{Appl} \cdot P_{Grant} \cdot P_{Enf}) \quad (3)$$

The main argument for defensive publishing given by our interviewees is that the incremental value of an exclusion right (the first term in Equation (1)) over freedom to use the invention is too low to justify the higher cost of patenting. Freedom to operate (FTO), however, is important enough to make defensive publishing worthwhile, and the loss of secrecy (creating the cost $C_{Spillov}$ of knowledge spillovers) is not regarded as too problematic. In more detail, the following aspects were mentioned.

Exclusivity: Defensive publishing (2) becomes relatively more attractive than a patent application if the value V_{Excl} of exclusive use (in (1), also figuring in (3)) is low. This may be so because the economic importance of the invention is low (mentioned by most interviewees); because patent-based exclusivity, if at all attained, takes several years from application to grant; because (relevant in the US) the invention relates to a business method, and exclusivity on such inventions is considered as of little value; and/or because (in complex

technologies) some patented "key" inventions serve as complementary assets making exclusivity on minor, supplemental inventions unnecessary:

> *(o) "Sometimes you find that you have protected your products so well that certainly no competitor would dare to imitate them. In such a comfortable situation I have to ask myself, is it worth it to add further patents to the 11 patents on the product that I already own?"* (Interviewee 13, DAX 30)

V_{Excl} denotes the value of perfect exclusivity. However, the expected value of a patent application (1) additionally depends on the probability of the application being granted (P_{Grant}) and, if granted, the probability of successful enforcement (P_{Enf}). The lower these probabilities are, the more they reduce the exclusivity-related value of a patent application. Both aspects matter strongly for practitioners. Uncertainty with respect to patentability of an invention, mainly due to its being too close to the state of the art, was in fact one of the two most frequently mentioned reasons for defensive publishing, with more than a dozen (unprompted) mentions. Similarly, difficulties in enforcing a patent (mostly due to problems of detecting infringement) reduce the expected value of a patent application relative to that of a DP.

Just as the value of patent-based exclusivity is multiplied by P_{Grant} and P_{Enf} in order to obtain $E[V_{PatAppl}]$, so the value of exclusivity by secrecy (first term in (3)) must be multiplied by the probability $(1–P_{Re\text{-}inv})$ that the invention is not re-invented by some other party (which may be simplified by spillovers due to imperfect secrecy). This aspect received no explicit mentions—likely because it was taken for granted—but is given for sake of completeness.

Freedom to operate figures in all three equations. Equation (2) shows that if a DP is with high probability recognized in court as creating prior art ($P_{Recog} \approx 1$, which can be achieved by choosing a reliable medium for the DP), then the value related to FTO of a DP is largely identical to that of a patent application (1). This consideration is reflected in one of the two most frequently mentioned reasons for DP: without needing an exclusion right themselves, companies want to keep others from obtaining one. In one case, a firm uses defensive publishing in order to maintain FTO not for itself, but for its buyers—in order to maintain competition and thus higher demand for its inputs on the buyer end.

FTO being valuable implies that the option of keeping an invention secret becomes less attractive, due to the risk that others re-invent and patent the invention. The term $(1–P_{Re\text{-}inv} \cdot P_{Appl} \cdot P_{Grant} \cdot P_{Enf})$ in Equation (3) captures these effects, comprising also the probabilities that the second inventor successfully applies for, receives, and enforces a patent:

(p) "Regarding secrecy, one has to be aware that one is defenseless if someone else files [for a patent on the respective invention]." (Interviewee 9, DAX 30)

Cost, finally, is another important criterion. Many interviewees mentioned lower cost C_{DP} of defensive publishing as a reason to choose it over patenting, which creates the cost C_{Pat} (see (1) and (2)). While much depends on the details of the option chosen, a DP is typically much cheaper, not least because it does not require a patent professional and has little to no formal requirements. Especially when a company has no in-house patent attorneys, each mandate given to external attorneys causes considerable variable cost, tilting the balance towards defensive publishing. Sometimes, finally, the reason for defensive publishing is, quite simply, a fixed budget for patent applications. As one interviewee put it, *"we can't patent everything that is submitted to us."*

Cost considerations may also, however, favor secrecy over DP. One interviewee pointed out that also DPs need to be carefully drafted, "cleaned up" and, in particular, delineated from related patent applications. This requires effort and cost, captured in C_{DP} in (2). Given limited time and budgets, many inventions that, in his opinion, should be defensively published are left in the drawer.

Finally, both patents (1) and DPs (2) cause a cost $C_{Spillovers}$ by generating information spillovers. However, no interviewee raised this point—likely because the spillovers have little effect due to low economic value of the invention, or because the medium is chosen in such a way as to minimize these spillovers (in the extreme case, by a *disguised* publication).

Looking at the three equations at large, we find an intriguing effect of the probability of patent grant (P_{Grant}). While the value of a patent application increases in P_{Grant}, the value of secrecy decreases in this variable. Hence, the value of a DP is most likely to be higher than that of the alternative options *for intermediate values* of P_{Grant}—that is, for maximum uncertainty about patentability. Given that this uncertainty was one of the two most frequently mentioned reasons for DP, we thus find that DP is, among other things, a reaction to uncertainty in the patent system—more precisely, to difficulties in predicting success of a patent application. The following quote illustrates this point, while the final quote (r) summarizes several aspects.

(q) "[When] an invention is, let's say, weak […] it is not sure you get a patent on that. On the other hand you are afraid that someone else does receive a patent grant." (Interviewee 11, EPO)

(r) "Minor changes are often not worth a patent application; these then tend to be made public increasingly. In particular in areas where you aren't sure if something is really patentable. Furthermore, patent applications are quite costly." (Interviewee 4, other multinational company)

6.4 Patent race

To catch up with a leading competitor in a patent race is a rather specific potential reason for defensive publishing, which is why it deserves a separate treatment. Judging by the number of publications, it even appears to be one of the most important aspects of defensive publishing (Eisenberg, 2000; Parchomovsky, 2000; Lichtman et al., 2000; Rinner, 2003; Baker and Mezzetti, 2005; Bar, 2006). An empirical perspective, however, is lacking. Thus, in the following we evaluate interviewees' assessment of the theoretical argument that defensive publishing might be employed by a laggard in a patent race (see section 2.3). We obtained opinions from most interviewees working with companies (36 out of 44).

As to practical use of this strategy, none of the respondents knew of a case where a DP was used in a patent race. As to the theoretical argument, 26 respondents dismissed it radically as a "very theoretical" concept, while 9 said "it could be" that firms act this way. However, 8 out of these immediately named restrictions of and reasons against the model. In addition, acquiescence (the tendency to agree) will likely have biased the response to the positive side.

In the following we analyze the criticisms raised by our interviewees, conservatively reporting the number of unprompted mentions.[16] We give in brackets first the number of mentions made by interview partners who dismissed the model, followed by the number of mentions by those who considered it in principle possible. Table 4 provides an overview.

--- Insert Table 4 about here ---

First, interviewees doubted that the focal firm knows being in a race in the first place—that is, it will typically not know with sufficient precision what other firms are actually doing (3+1). And even assuming this was the case, the competitor's position in the race will rarely be known sufficiently well (16+3). As one interviewee put it:

[16] In some cases, the discussion went into more detail and we suggested to the interviewee further potential points of critique. In all cases, he or she assented (where acquiescence can of course not be excluded). However, due to limited interview time we could not discuss every potential criticism with each interviewee, and thus could not generate a complete list of reactions to *prompted* points of critique.

(s) "*This assumes that each party has the ability to assess, with the required precision, how far along it is relative to its competitor. This does not seem to be a very realistic assumption.*" (Interviewee 14, other multinational company)

A no less important restriction to the model seems to be that either the leading company or the laggard could apply for a patent even for intermediary results (9+4), and several interviewees stated that this would be the obvious thing to do. This argument is closely linked to the criticism that the disclosure would harm the laggard by destroying novelty of its invention (5+3), making a later patent application impossible. Even the assumption of a minimum "inventive step" underlying the model is considered questionable. In practice, interviewees found it difficult to say at what point "*the invention becomes an invention*" (3+0):

(t) "*In our industry at least we see that the issue of 'inventive step' doesn't play such a big role, and for that reason I'm having some difficulties to follow that logic.*" (Interviewee 3, DAX 30)

Further reasons why our interview partners rejected the model are that third parties might enter the race due to the disclosure (3+0) or the disclosure might actually help the leader when solution approaches differ (1+0). Interviewees stated furthermore that companies typically follow different solution paths to solve a problem (3+0). Considering the process leading to a patentable invention to happen on a continuum was also considered unrealistic; rather, interviewees described the process as an inventive "leap" (1+1). Finally, interviewees questioned the strategy in the context of a first-to-invent system (1+2).

Overall, "defensive publishing in a patent race" is an interesting theoretical concept, but seems to be of little to no practical relevance. While one might conjecture that it is better applicable to non-complex technologies (e.g., chemistry) than to complex ones (e.g., electronics), the share of negative assessments is even higher among interviewees from the chemical industry (8 out of 9) than on average. Our interviewees confirmed the points of critique raised by Eisenberg (2000) and Rinner (2003), but added important additional ones—in particular, that one's relative position in a race, and the fact that there is a race going on in the first place, will rarely be known.

7 Summary and conclusions

We have presented a study on defensive publishing, a tool of IP management which is widely used but hardly researched. Addressing our research question Q1 concerning the use of DPs,

we have shown that a considerable share (70%, 26 out of 37) of the companies we interviewed make use of DPs, publishing between 1% and more than 30% of their inventions defensively. As to the means of publication that are used (Q2), we found that for classical DPs the most frequently used medium are specialized internet providers followed by peer-reviewed journals. Disguised publications would appear, e.g., in a journal devoted to a different discipline, but seem to be rarely used. Johnson's (2004) conjecture that larger firms should be more likely to use DPs could not be supported, nor the competing conjecture that small firms should be heavier users of DPs for budget reasons. A representative survey is needed to address these questions.

A particularly interesting finding (Q3) is that DPs are often effected within the patent system. Ten companies (27%) would, in order to generate a DP, file for a national patent or a utility patent without pursuing the application. Furthermore, interview statements suggest, in line with recent survey evidence (de Rassenfosse et al., 2008), that a good share of the value even of *pursued* patent applications derives from their creating prior art. This finding adds an interesting new twist to the understanding of the steadily increasing flood of patent applications.

Addressing the motives for defensive publishing (Q4), we have structured our analysis along a formal representation of the value of the alternative options. The main motive is, not surprisingly, that the incremental value of an exclusion right over freedom to operate is too low to justify the higher cost of patenting. This may be due to a low economic value of the invention, or to protection by "key" patents, other complementary assets, or lead time. Additionally, the expected value of a patent application will be reduced by a low probability of patent grant and of successful enforcement of the patent (if granted). Guaranteed freedom to operate, however, is important enough to make defensive publishing preferable to secrecy, despite potential knowledge spillovers to competitors.

A very interesting and somewhat unexpected motive for defensive publishing relates to uncertainty. Interviews and our formal representation show that a DP is most attractive relative to patenting and secrecy when uncertainty about patentability is highest. The use of DPs is thus linked to a notorious problem of today's patent system, which is exacerbated by the exponentially rising numbers of patent applications and ever more complex technologies. It adds to the inefficiency that uncertainty over the grant of pending applications creates by hampering markets for technology (Gans et al. 2007).

Our study also sheds light on an alleged motive for DP which has been widely discussed in the literature (Lichtman et al., 2000; Parchomovsky, 2000; Baker and Mezzetti,

2005; Bar 2006), namely, the use of defensive publishing by a laggard in a patent race. Most of our informants working for firms (26 out of 36, 72%) dismissed the argument radically, and none of our interview partners could remember such a case in practice. They confirmed the points of criticism raised in theoretical discussions by Eisenberg (2000) and Rinner (2003), and added new ones: Inventors often would not know that they are in a race in the first place, and if they knew then they would still hardly know the competitor's position in the race. Also, many suggested the laggard should rather file for a patent on its intermediary result since they perceived the idea of a "minimum inventive step" as unrealistic—a view which suggests that the legal requirement of "non-obviousness" does little to restrict patentability of minor or even trivial inventions.

On factors impacting the relative importance of motives for DP (Q5), our study has yielded only limited insights. We neither found cost aspects to be more relevant (due to budget constraints) to small firms, nor lower benefits of exclusivity (due to complementary assets, in particular other patents) to be more relevant in complex technologies. In turn, defensive publishing in a patent race was not found to be more relevant in simple than in complex technologies. Again, a large-scale survey is called for to address these questions.

Our final research question Q6 asked if the relevance of DP can be expected to increase or decrease over time, and why. Our study gives reason to believe that it will indeed increase. To start with, several problems are aggravating—the patent arms race, the resulting increasing likelihood of inadvertent infringement, and the rise of patent trolls—to the solution of which defensive publishing can contribute. Furthermore, due to the Internet DPs have become both more efficient and more effective. Finally, adding minor patents to already large portfolios for the purpose of cross-licensing makes sense only to the extent that patent quality is not adequately accounted for in licensing negotiations. Given that IP holders are becoming increasingly sophisticated with respect to licensing and patent valuation, we expect patents on minor inventions to decline in value. A similar argument holds for the signaling value of patents. Consequently, defensive publishing should come to the fore.

Some limitations of our study need to be mentioned. First, it is not representative, such that any quantitative results need to be interpreted with care. A large-scale survey based on our findings will be able to address this issue. Second, the study is focused on Germany and its results might thus not be fully generalizable. However, despite the U.S. exception of the first-to-invent rule, patent laws and the novelty-destroying effect of prior publication are largely the same across all major jurisdictions, such that DP can be expected to work in most countries in more or less the same way. In fact, the German law on employee inventors

("*Arbeitnehmererfindergesetz*") should make DP *less* attractive in Germany, such that our study should yield a conservative assessment of the use of DP.

Our study leaves several questions unanswered, and thus provides ample scope for future research. First, we think that the *multiple purposes* of patent applications—to establish prior art and to provide an option to go through with the application—need to be investigated in more detail. It might turn out that a good share of the patent flood inundating patent offices worldwide is in fact aimed more at establishing freedom to operate, not exclusion rights. And even for those applications that are seriously pursued, a good share of their value might be due to the creation of prior art (cf. de Rassenfosse et al., 2008). In a similar vein, also the multiple purposes of technical publications, conference presentations etc. deserve further study in order to isolate the value contribution related to defensive publishing.

Second, the *way* in which DPs are used as weapons merits further analysis. Preliminary findings show that inventors would not use a DP as an objection during the examination stage; rather, companies would use the DP to file an opposition, or even use it only when accused of infringement. Challenging empirically, but intriguing with respect to the intended disclosure function of the patent system it is to analyze how often DPs become effective in bilateral agreements.

Third, we were puzzled by the *high heterogeneity* between firms with respect to defensive publishing. For example, one of the DAX 30 firms publishes about 30% of its inventions defensively using the patent system, while others rely nearly exclusively on "classical" DPs. Similarly, the share of inventions published as DPs as well as general views on the topic differed widely between firms. While unobserved heterogeneity in firm characteristics will provide a partial explanation, it seems to us that the main explanation is, plainly, a lack of accepted wisdom about defensive publishing.

Finally, representative data should be collected to provide an unbiased view of the use of DPs (ideally in an international comparison) and to test pertaining hypotheses.

Several recommendations for management can be derived from our study. First, in light of the high heterogeneity that we found between firms with respect to both the use and the assessment of defensive publishing, practitioners need to develop a balanced and well-founded understanding of this means of IP management. Second, they should re-assess internal guidelines for patenting and question the widespread "more is better" attitude. Third, they should consider informing the public about their DPs. Since these constitute contributions to a knowledge commons, doing so might both be good marketing and help to start a virtuous cycle of disarmament in the patent arms race.

We consider it likely that corporations will embrace defensive publishing to an increasing extent in the future. Sharing our assessment, one interviewee from a large corporation stated, "*if we had this [conversation] in five years from now, it would be much more engrained in IP strategy. […] I feel like the attention to it is increasing.*"

Figures and Tables

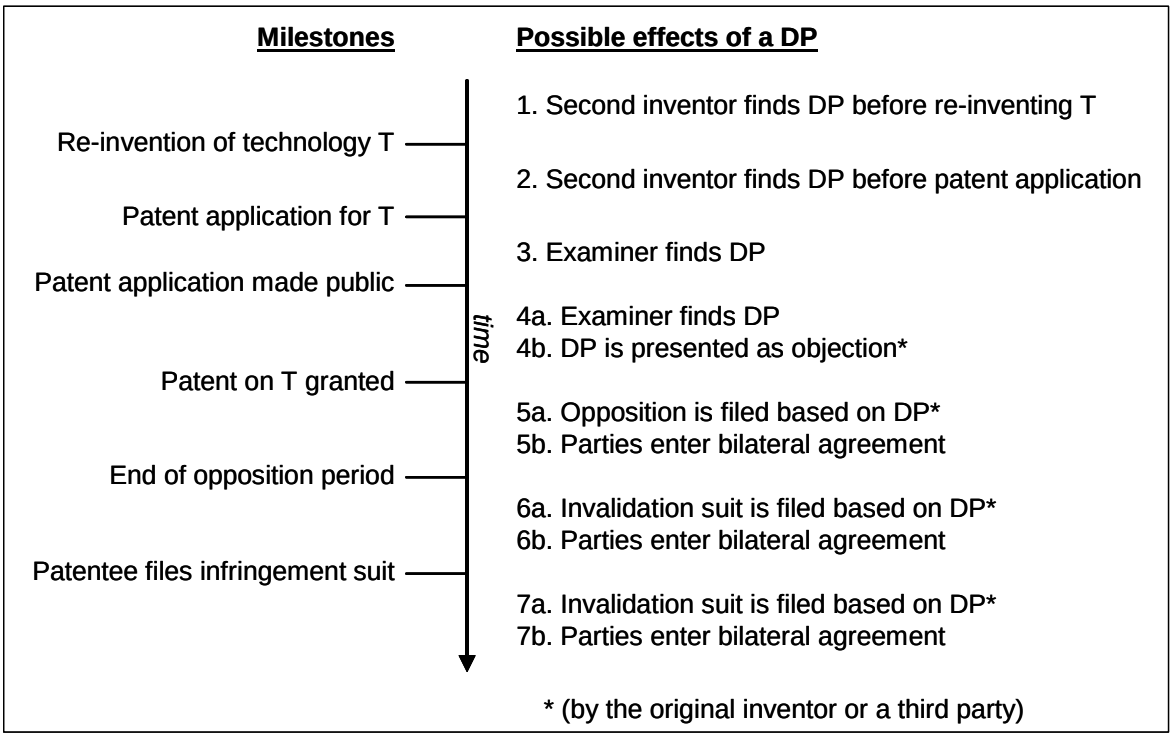

Figure 1: Milestones in the patent granting process and possible effects of a defensive publication. Initial situation: Technology T has been invented and made public in a defensive publication by the first inventor. Simplified presentation.

Types of "classical defensive publishing"	**Has the medium DP as its sole purpose?**	**Number of firms in the sample using this means of DP (N=37)**	
Internet providers specialized to DP	**X**	12	32%
Peer-reviewed journals		7	22%
Conferences, scientific workshops		4	11%
Trade fairs		4	11%
Product delivery (invention can be reverse engineered)		2	5%
Notice board at factory gate	**X**	2	5%
Trade association journals		1	3%
Lectures and lecture notes		1	3%
Company journals dedicated to defensive publications	**X**	1	3%
Flyer		1	3%

Table 1: Frequency of use of various types of DP.

	N	Firms using defensive publications				Firms not using DP
		total	DP in the narrower sense	DP within the patent system	both	
total	37	26 (70%)	15	5	6	11
by size :						
German large firms (DAX 30, other)	28	20 (71%)	10	5	5	8
Foreign large firms	2	2 (100%)	1	0	1	0
German SMEs	7	4 (57%)	4	0	0	3
by industry:						
Electronics, electrical engineering	17	11 (65%)	10	1	0	6
Automotive	3	2 (67%)	1	1	0	1
Chemistry and pharmaceuticals	8	7 (88%)	1	0	6	1
Engineering	2	2 (100%)	0	2	0	0
Other	7	4 (57%)	3	1	0	3

Table 2: Frequency of use of defensive publications in sample. "DP in the narrower sense" denotes all DPs effected outside the patent system (classical plus disguised DPs).

Method of DP:	N	Median %	Min. %	Max. %	<1%	1-5%	6-10%	11-20%	21-30%	>30%
					Number of firms in given range					
DP in the narrower sense	12	in [6-10]	<1	25	2	2	3	2	3	0
DP within the patent system	5	in [1-5]	2	29	0	3	0	1	1	0
Both	5	in [1-5]	<1	35	1	2	1	0	0	1
DP total	22	in [6-10]	<1	35	3	7	4	3	4	1

Table 3: Share of each company's inventions that are defensively published

Reason why model is questioned	No. of interviewees mentioning the reason (unprompted), N = 35	By general assessment of model	
		reject-ted, n=26	"could be", n=9
Companies do not know position of competitor in race	19	16	3
Laggard would rather apply for patent on an intermediary result	13	9	4
Laggard would harm itself regarding "newness"	8	5	3
Companies do not know what the competitor is actually doing	4	3	1
Criterion "inventive step" in practice not very strict	4	3	0
Further competitors might be induced to enter the race	3	3	0
Dependent on legal basis	3	1	2
Companies follow different solution paths to solve a problem	3	3	0
Invention is not a continuous process	2	1	1
Disclosure might help leading contender	1	1	0

Table 4: Frequency of reasons against using defensive publications as strategy in patent race

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