ABSTRACT

Today intellectual property (IP) comprises an increasing share of firms' resources and IP rights (IPRs) are important sources of competitiveness. Consequently, there is an increasing interest in how to properly manage IP. IP lawyers need to better understand business decisions and business managers need to better understand IP law. These needs are addressed by a growing area of research on IP management in the intersection between IP law and management. This article presents a literature review of the broad field of IP management research, with the aim to provide IP law practitioners, managers, and academics with an overview of what we know about IP management, to guide readers on how/where to learn more, and how to move forward in both research and practice. A general conclusion is that the research is rich and quickly growing, but has too little focus and data on strategic IP management issues. Both research and practice need to adopt a more holistic perspective on IP, including different rights and integrating with strategic decision-making.

1. INTRODUCTION

Intellectual property (IP) constitutes an increasing part of firms' resources. As such, it is also becoming increasingly important for firms to properly manage their IP and IP rights (IPRs). IPRs and the management of IP impact how a firm organizes its business, how it profits, and how it competes. Thus, the practice of IP not only requires legal competence, but also management competence.

Just as there is a need for business managers to better understand IPRs, there is a need for IP law practitioners of various kinds to better understand business and management. But what do we know about this intersection between IPRs and management, from here on called IP management, and what do we need to learn more about? In fact, there is already a rich research literature on IP management. Much can be learned from this literature, but much still also needs to be better understood.

This article presents a review of the research on IP management. The aim is multifaceted. The first aim is to provide IP law practitioners, managers, and academics with a broad overview of what we know about IP management. The second aim is to provide guidance in how and where to learn more about various parts of the broad field of IP management for further studies. The third aim is to give directions for future actions, for practitioners as well as for academics.

The article continues by briefly describing the method. This is followed with a chapter presenting the results from the different parts of the literature review. Finally, the conclusions and directions for research and practice are presented.

2. METHOD

The review includes three substudies. The first substudy covers previous literature reviews of the field of IP management. The reviews were identified with a Google Scholar search for [review intellectual property management] and Web of Science search for [review AND literature AND intellectual propert* AND manag*]. The 100 first search results were studied, leading to the identification of twelve literature reviews, covering hundreds of research publications.

The second substudy covers special issues in various journals, special issues that are explicitly focused on management of IP. A search of Thomson Reuters Web of Science was used to ensure that no central special issues were missed. In total seven special issues were identified, including a total of 79 articles.

The third substudy of previous research was carried out as a systematic search for articles in Thomson Reuters Web of Science (which includes research published in quality journals). A search was made of central concepts in titles, keywords, and abstracts. The central concepts include broad concepts such as 'intellectual property' and 'management', but also narrower concepts such as 'patent' and 'trademark', see Table 3. The search was limited to journals within the research area Business Economics, which is a way to limit search results to studies focused on management and strategy aspects, rather than for ex-
ample purely legal aspects. A search was also made on Google Scholar to cover particularly well-cited research not included in Web of Science.

The search in the third substudy was carried out twice. Once in 2016, covering all literature historically up until 2016, and once in 2018, covering literature between 2016 and 2018. This design allows for identifying recent trends in research. In total the first search provided 607 publications, which were then scanned on title level to exclude obviously irrelevant publications, leading to a final set of 265 publications included in the systematic review. The second search provided 145 publications, including 100 relevant ones after the first scan of relevance. Compared to the amount of relevant publications identified in prior years, this number indicates that intellectual property management as a research field is still growing rapidly, with each year seeing an increased interest in research on the topic. Figure 1 illustrates the number of publications included in the different substudies.

3. LITERATURE REVIEW

This chapter is structured according to the different substudies. It starts with an overview of previous literature reviews in section 3.1. After that, a review of special issues is presented in section 3.2. Finally, the structured literature review is presented in 3.3.

3.1 Previous Literature Reviews

Previous literature reviews have either been broadly focused on IP management, like this one, or more narrowly focused on specific subfields. In total, 12 reviews were identified and they are here briefly summarized. This section focuses first on reviews of IP management in broad terms, then on reviews of technology commercialization and transfer, and finally on reviews of other related issues.

Previous reviews of IP management

Seven reviews explicitly focusing on research covering the topic of IP management are presented here. Granstrand (1999) makes an early review of the research landscape relating to IP. Grandstand notices that IP had already at the end of the 1990s had a long, but tiny research tradition. This tradition was at the time fragmented in terms of different types of IPRs (patents, trademarks, copyrights, etc.) and disciplines (economics, law, management, etc.). Granstrand identifies several previous reviews of the literature, ranging all the way back to the 1950s. These are typically not related to the management of IP, but mostly concern economics and more specifically the economics of the patent system.

1 These searches were performed on May 12, 2016.
2 The structured literature review is based on a search for management [manag*] in the "topic" of articles (includes searches for management in title, abstract, and keywords) and different key concepts in the title of articles. The key concepts include patents [patent*], intellectual property [intellectual property*], licenses [licens*], secrecy [secre*], design rights or design patents [design right* OR design patent*], trademarks [trademark*], and copyrights [copyright*]. * indicates that the ending of the concepts can have different forms, for example license or licensing. The first search was done in Thomson Reuters Web of Science on July 11, 2016, and included everything published before that. The follow-up search was done on May 16, 2018, and included publications between 2016 and 2018.

Hanel (2006) is the first identified review explicitly focused on management of IP. In line with the work of Granstrand, Hanel identifies the growing importance of IP management and the growing interest in the scholarly field, partly as a result of the creation of the ‘Court of Appeals for the Federal Circuit’ (CAFC) in the US in the 1980s. This led to a now well established growth in patenting, in turn leading to an increasingly complex landscape of IP and IPRs, and an increasing number of litigations. Research has shown that litigated patents in general have more patent claims and more citations per claim, inventions that are part of complex multi-invention technologies are more likely to be part of litigation. Moreover, patents that have been enforced and proven valid are then more valuable than patents that have not been tested in court. Apart from this literature, Hanel also reviews areas in need of more research, such as the growing fields of IP valuation and securitization. Finally, Hanel identifies a number of differences in the management of IP among firms in different industries and of different sizes. Holgersson (2003) makes a review of three different but related research streams in patent management (i.e., a subfield of IP management), namely of patent propensity, appropriation strategies, and motives to patent. These different fields of studies have each been covered by multiple research studies. The first research stream, on patent propensity, in general shows that the propensity to patent a patentable invention varies widely across industries. For example, the propensity to patent is very high within the pharmaceutical industry while considerably lower in the electronics industry. At the same time, the patent output per R&D spending may be significantly higher in the latter industry, depending on the generally larger quantity of patentable inventions in complex and multi-invention industries. Differences in patent output across industries are thus more related to technological characteristics than to strategy differences. Several studies also indicate that the patent propensity is significantly higher in large than in small firms. This, however, does in fact seem to depend on strategy differences between large and small firms, in turn depending on the relatively limited resources of small firms. The second research stream shows that patenting is of relatively limited importance for innovation appropriation, i.e. for capturing value from innovation investments, as compared to other studied means of appropriation such as speed to market and secrecy. A common conclusion has been that patents are of low importance for firms. A problem with this conclusion is that it is based on a wide range of firms, not necessarily all being technology-based. A recent empirical study shows that the importance of patenting for appropriation is skewed among firms, where a large group of firms in fact rate patenting very important. In addition, appropriation is only one of several motives for firms to patent, which relates to the third research stream reviewed by Holgersson. Even though the most important motive is to limit imitation, other motives are to avoid trials, to improve bargaining power, to block others, and to improve the corporate image among outside actors. The latter is especially important for small firms, including in their relations with venture capitalists and other providers of external capital.

Another review focusing specifically on patent management is published by Somaya (2012). Based on an extensive review of patent strategy this review divides strategies found in literature into different generic strategies. The

---

11 Ibid.
13 “Patents and Innovation: An Empirical Study.”
first generic strategy is the proprietary strategy, focusing on how firms can protect and defend their competitive advantage from imitation. The second generic strategy is the defensive strategy, focusing on how firms defend themselves against the patents of others. The third generic strategy is the leveraging strategy, focusing on how firms can use patents to enable improved profit opportunities, either directly or indirectly.

An example of how patents can be used for indirect profit opportunities is through the enablement of R&D collaborations. The IP management in such situations is reviewed by Bader (2006). Bader summarizes different questions relating to IP strategy, stating that an “intellectual property strategy generally aims to improve the economic outcomes of investments made through innovations. The strategy should therefore address various key decisions such as: make or buy decisions, organizational association or isolation, innovation or adaptation of new technology, protection or exploitation of knowledge, public or private research funding, safeguarding or sharing of intellectual property, and pioneering advantages or disadvantages”.

Candelin-Palmqvist, et al. (2012) make a systematic review of literature on IPRs in the major management and innovation journals between 1970 and 2009. The authors conclude that IPRs are increasingly covered in the literature on innovation management. The authors also note that this literature predominantly focus on patents and use secondary data. They finally argue that more research is needed where IPRs are in focus, rather than as indicators of other things (such as innovation), that future research needs to connect IP to other company functions and performance, and that more research is needed with data on firm level, and especially with qualitative data as opposed to the large stream of studies using quantitative patent data.

Finally, Holgersson (2012) identifies 2,483 articles in a broad search of the research field, in order to subsequently identify the main references used in those articles. The 20 most cited references are presented in Table 1, and these could be described as foundational to the research field. For example, the articles by Levin et al., Teece, and Mansfield have been instrumental to form the field of innovation appropriation, and the article by Griliches is a key reference in studies using patents as indicators.
<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Journal</th>
<th>Title</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Jaffe, et al. (1993)</td>
<td>Quarterly Journal of Economics</td>
<td>Geographic localization of knowledge spillovers as evidenced by patent citations</td>
<td>177</td>
</tr>
<tr>
<td>13 Mansfield (1986)</td>
<td>Management Science</td>
<td>Patents and innovation: An empirical study</td>
<td>96</td>
</tr>
<tr>
<td>15 Heller and Eisenberg (1998)</td>
<td>Science</td>
<td>Can patents deter innovation? The anticommons in biomedical research</td>
<td>88</td>
</tr>
<tr>
<td>16 Kogut and Zander (1992)</td>
<td>Organization Science</td>
<td>Knowledge of the firm, combinative capabilities, and the replication of technology</td>
<td>88</td>
</tr>
<tr>
<td>17 March (1991)</td>
<td>Organization Science</td>
<td>Exploration and exploitation in organizational learning</td>
<td>87</td>
</tr>
<tr>
<td>18 Arrow (1962)</td>
<td>NBER</td>
<td>Economic welfare and the allocation of resources for invention</td>
<td>84</td>
</tr>
</tbody>
</table>

Note: # = Number of citing publications among the 2,483 identified publications, as of July 2016

A related area of research relates to technology commercialization and technology transfer. Lichtenthaler (2005) reviews the literature on knowledge and technology commercialization through external channels, such as licensing.26 One of his main contributions is his agenda for future research, where he concludes that external knowledge commercialization is an increasingly strategic activity, but few research studies capture the strategic dimensions of it. Lichtenthaler argues that licensing studies typically focus on purely monetary effects while more strategic aspects are missing, such as freedom to operate, gaining access to external knowledge through cross-licensing, etc.

Similar concerns are raised by Aaboen and Holgersson (2016), in the context of university commercialization and technology transfer offices (TTOs). Their analysis concludes that the TTO literature has a too simplified view of IP management.27 The literature focuses almost only on patents, typically with the implicit assumption that all valuable inventions should be patented. The review also shows that the number of patents and the number of patent licenses are used as measures of how well the TTOs function, which is too simplified considering the broad range of IP strategies available. The latter goes in line with the results from a review by Bozeman (2000), who argues that too much research emphasis is put on technology transfer evaluation, rather than processes and activities that can improve technology transfer.28

Reviews on Related Issues

As described above, a common focus in on patents as measures of innovation, but also on measures of patent values. Meyer and Tang (2007) review the literature on the latter. A number of previously used measures of patent values are identified, including patent family size, length of renewals, number of patent clauses, number of backward and forward citations, and whether or not patents have been subject to litigation.29 The arguments are that a patent that is well-cited on average is more valuable than one that is not well-cited30, and that patents with a high number of patents and the number of patent families, typically with the implicit assumption that all valuable inventions should be patented. The latter goes in line with the results from a review by Bozeman (2000), who argues that too much research emphasis is put on technology transfer evaluation, rather than processes and activities that can improve technology transfer.28

Special issues are specific journal issues focused on a particular area of research. Several journals have published special issues on IP management during the last 15 years, and especially during the last five years, and these provide a good introduction to different aspects of IP management, see Table 2. Some of the most important findings in these issues are summarized here, but interested readers are encouraged to dive deeper into the different findings and areas of research by reading the issues and the included articles.

International Journal of Industrial Organization (2003): The Economics of Intellectual Property at Universities

This special issue is mainly relating to economic and policy aspects of IP rather than management, with a few exceptions. Patenting and licensing are (at least implicitly) seen as the main strategies for universities, in a process involving invention disclosure by researchers to TTOs, invention evaluation by TTOs, patenting decision, and finally licensing to external actors.34 Another article in the special issue focuses on research collaborations between universities and firms, and shows that universities are more likely to collaborate with firms working with new technologies than with those improving their existing technologies.35 This is explained by the argument that firms working with existing technologies have more to lose (e.g., through knowledge spillovers) than those developing completely new ones.

The special issue in California Management Review is the first identified special issue with an explicit focus on IP management. The issue focuses on case studies, and illustrates the breadth of strategies available within IP management.46

The issue points at a number of important aspects for future research and practice of IP management. One is the importance of IP management to cross all different IPRs, not only patents.37 For example, one article focuses on how patenting can be complemented with defensive publishing / strategic disclosures.38 A second aspect is how to involve different disciplines and functions in IP management39, for example by establishing a common language of communication across functions40 and by integrating IP management in the R&D activities and increasing IP awareness41. Finally, several articles in the special issue point at the need of integrating IP management with business model design and strategy work.42

An important question and field of study in the special issue is IP management in R&D collaborations and in different forms of open innovation. For example, one article focuses on how to manage patent pools to deal with complex technical platforms with dispersed patent rights.43 Another one describes a case of an innovation ecosystem and how IP management is used to manage this ecosystem.44 A third one points at the opportunities for pharmaceutical firms to license out compounds that are not used internally.45

In complex technologies building upon several related inventions, firms can benefit from technical modularity combined with different levels of IP modularity.46 Firms can then combine proprietary innovation strategies with more open innovation strategies. Finally, corporate transactions, i.e., M&As and investments, involving such complex technologies may become very complex due to the technical overlaps between different firms, divisions, and products. In such situations, managers have to deal with the so called IP disassembly problem, i.e., the problem to disassemble all interdependent technologies and IP rights. One article in the special issue provides a managerial framework to solve such problems.47


This so called virtual special issue collects articles related to IP management that are published in journals related to 'Strategic Management Society' (SMS), including articles from Strategic Management Journal (SMJ), Strategic Entrepreneurship Journal (SEJ), and Global Strategy Journal (GSJ). This virtual special issue collects previously published articles, but may also include future publications, relating to IP management. Many of the articles included here are not specifically focused on IP management, but rather strategy or management more generally.48

The articles that do however focus on IP management cover a few different areas. One such area is innovation and R&D collaborations, just as in the issue in California Management Review described above. One study shows that IPRs protect against opportunism in contract relations, while a certain amount of IPR sharing may be necessary for efficient collaboration.49 Another study shows that service providers who get to keep the control of their IPRs are more innovative than those losing the control to their clients.50 Thus, in contract R&D the clients’ need to control the results must be balanced against the contractors’ incentives and willingness to innovate.

---

Another interesting area of research in this virtual special issue is related to information spillovers in connection to employee movement. A couple of articles show that firms can decrease spillovers when employees are hired-over by others by acting deterrent in patent enforcement. This behavior moreover decreases the propensity to leave the firm among employees.

A final interesting area is that of the relation between patenting and profitability. One study shows that a patent increases the returns from an invention with 40-50%\(^6\). A related study shows that holding patents increases prices of companies being acquired.\(^5\) The argument is that the patents help protecting the new combinations of technologies being created in the interplay between the buyer and the acquired firm. Finally, research in this virtual special issue identifies a positive impact of patents in acquiring external capital (including various forms of venture capital).\(^6\)

International Journal of Industrial Organization (2014): Industry standards, intellectual property, and innovation

This special issue does not have a management focus, and many articles in the issue just use IPRs and patents as measures of other things (such as innovations). There are however a couple of more management-related findings. One, based on modelling rather than empirical data, is that the establishment of a single technical standard may lead to free-rider problems, and eventually under-investments in R&D. Two separate and competing standards may therefore in some cases be needed to combine resource efficiency with interoperability and investment incentives.\(^5\) Another finding is that value-based pricing models in FRAND (‘Fair, Reasonable, And Non-Discriminatory’) licensing is difficult to apply in reality where the value concept is multi-dimensional.\(^5\)

Research-Technology Management (2014): Intellectual property approaches for a new era

This special issue is introduced by pointing at the increasingly wide distribution and dispersion of IP across firm boundaries due to increasing innovation collaborations and the digital revolution in both design and manufacturing, creating new questions for IP management.\(^3\) The articles in the issue deal with these trends in different ways.

One article focuses on ‘additive manufacturing’, as part of the digital revolution, and how that puts pressure on IP policy changes. When this type of manufacturing increases, there is a need to adapt the IPR system(s) to better accommodate such manufacturing strategies.\(^3\) Another article instead focuses on how IP policy changes put pressure on IP management. For example, the changes in ‘America Invents Act’ impact R&D managers’ work, especially in terms of how they need to evaluate the commercial potential of inventions earlier and the increasing importance of temporary secrecy strategies due to the shift to a ‘first-to-file’ system in the US.\(^6\)

The issue also includes research contributing to the growing research on how to manage IP in open innovation.\(^6\) When R&D collaborations are ended, or in other terms when open innovation is closed, IP-related problems may arise that need to be mitigated through IP ownership provisions and/or licensing contracts.\(^6\) Firms that master this can build a strong IP portfolio through several sequential R&D collaborations.\(^5\)

---


\(^{62}\) Ibid.
Finally, the theme of IP management in TTOs is covered. According to that research, the standard model for IP management among TTOs and universities is not generally applicable, and limits commercialization opportunities and leaves useful technologies on the shelf. TTOs often have limited resources and the ambition to make them profitable is unlikely to be realized. Many TTOs might instead be more useful if using a more open strategy with less focus on proprietary licensing and more focus on building long-term and flexible relationships with industry to make better use of research results.

The special issue in Research Policy focuses on how patents are used related to three different areas: the role of appropriation and information disclosure on technology markets, the role of appropriation with IPRs within innovation collaborations, and the factors behind use/non-use of patents. This special issue is mostly based on quantitative primary data.

Patents have been assumed to function in two different ways in technology trade, having both an appropriation effect and an information effect. The former relates to patents’ function of protecting inventions from imitation, and thereby improving the value of the technology for buyers. The latter relates to patents’ function as information carriers on technology markets. Based on data from 860 technology trade negotiations a study finds support for the former function but not the latter.

Related results on innovation collaboration rather than technology trade show that firms involved in innovation collaboration rate formal appropriation mechanisms such as patents more important than other firms. Furthermore, the results show that technologically leading firms tend to patent more than followers when involved in open innovation, since they have more to lose from information spillovers than followers.

One of the key questions in the special issue is how large the share of all patents is that are actually being used. Two different studies come to similar results, that 40-45% of patents are never used. The most common reasons are that commercialization opportunities are still explored, and that the invention was patented to block others and to stop invent-arounds, rather than to protect own products, services, and processes. As much as 67% of patent applications are made to block other patents. Thus, it turns out that the motives of not using patents, and of patenting inventions that will not be used internally, are strategic, and non-use of patents is not mainly a question of undirected or aimless behavior.

The most recent special issue on IP management is published in Management Decision. Some of the articles mainly use patent data as measures of innovations, but there are a number of articles focusing on the management of IP. For example, a couple of articles focus on how to organize invention evaluation and patent prosecution, both internal organization and external organization, including the use of external patent attorneys.

Even though many articles in the issue focus only on patents, a number of articles take the broader view incre-

---

67 Ibid.
70 Walsh, Lee, and Jung, “Win, Lose or Draw? The Fate of Patented Inventions.”
71 Torrisi et al., “Used, Blocking and Sleeping Patents: Empirical Evidence from a Large-Scale Inventor Survey.”
76 Ibid., p. 1092
asingly asked for in much previous research, including different IPRs such as patents, industrial designs, trademarks, and copyrights. For example, the choice between patenting, defensive publishing, and secrecy for new inventions, is conceptually analyzed. The choice can be analyzed along the dimensions of appropriation advantage and freedom to operate (FTO), leading to new distinctions along these dimensions. First, there is a distinction between direct and indirect appropriation advantage, where the former is advantage directly impacting sales and margins, while the latter concerns indirect benefits such as bargaining power, blocking others, attracting customers, etc. Patents provide both direct and indirect appropriation advantages. Defensive publishing, on the other hand, does not provide any appropriation advantage. Second, there is a distinction between static and dynamic FTO. It is used "to denote on the one hand the freedom for business to operate based on current technologies (static freedom to operate) and on the other hand the freedom for business to operate based on future developments and improvements of current technologies (dynamic freedom to operate). Patents provide static FTO and some dynamic FTO, thanks to the bargaining power and cross-licensing opportunities related to patents, while defensive publishing only provides static FTO. Secrecy, on the other hand, does not provide any FTO. Needless to say, there are also possibilities to combine different strategies over time and across inventions.

Finally, the now common theme of IP management in innovation collaborations and open innovation is covered in a number of publications. For example, the issue includes results showing that open innovation is related to stronger rather than weaker motives to patent as compared to closed innovation, and that IP protection is related to more openness, which is in turn related to better innovativeness. Moreover, one article shows that technology in-licensing, as a specific form of open innovation, is not limited to established firms, but is common also among startups.

### 3.3 Structured Literature Review

Based on the structured search of research until 2016, 265 relevant publications were identified. These are the basis for this section, and the three most cited publications in each area of research are presented in Table 4. This is complemented with results from a structured search of research between 2016 and 2018, where 100 relevant publications were identified. Thus, in total this section builds on 365 publications. The majority of the identified publications relate to patents, intellectual property, and licensing, see Table 3.

A couple of notes are needed. First, the structured literature review covers part of what has been covered in literature reviews and special issues included above, meaning that there are some overlaps. Second, this review cannot fully account for all the results in the 365 publications, but focuses on giving a broad overview of the most important themes of research and results. Third, each section here focuses both on past research, covered in the search of literature until 2016, and current research trends, covered in the search of literature between 2016 and 2018.

### TABLE 3: NUMBER OF ARTICLES IN DIFFERENT AREAS COVERED BY THE SYSTEMATIC SEARCHES

<table>
<thead>
<tr>
<th>Area</th>
<th>Total number of identified publications until 2016</th>
<th>Number of identified relevant publications until 2016</th>
<th>Total number of identified publications 2016 - 2018</th>
<th>Number of identified relevant publications 2016 - 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent</td>
<td>253</td>
<td>96</td>
<td>68</td>
<td>46</td>
</tr>
<tr>
<td>Intellectual property</td>
<td>124</td>
<td>72</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>License</td>
<td>84</td>
<td>50</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>Secrecy</td>
<td>82</td>
<td>17</td>
<td>29</td>
<td>6</td>
</tr>
<tr>
<td>Design</td>
<td>28</td>
<td>11</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Trademark</td>
<td>15</td>
<td>10</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Copyright</td>
<td>21</td>
<td>9</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>607</td>
<td>265</td>
<td>145</td>
<td>100</td>
</tr>
</tbody>
</table>
TABLE 4 THE MOST CITED PUBLICATIONS IN DIFFERENT FIELDS OF IP MANAGEMENT, AS IDENTIFIED IN STRUCTURED LITERATURE REVIEW

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Journal</th>
<th>Title</th>
<th>GCS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 Fabrizio och Di Minin (2008)</td>
<td>Research Policy</td>
<td>Commercializing the laboratory: Faculty patenting and the open science environment</td>
</tr>
<tr>
<td></td>
<td>2 Bray och Lee (2000)</td>
<td>Journal of Business Venturing</td>
<td>University revenues from technology transfer: Licensing fees vs. equity positions</td>
</tr>
<tr>
<td></td>
<td>2 Hannah (2005)</td>
<td>Organization Science</td>
<td>Should I keep a secret? The effects of trade secret protection procedures on employees' obligations to protect trade secrets</td>
</tr>
<tr>
<td></td>
<td>3 Tryzyna (1987)</td>
<td>Journal of the Patent and Trademark Office Society</td>
<td>Are patents protectable under the design patent act</td>
</tr>
<tr>
<td></td>
<td>2 Chaudhry et al (2009)</td>
<td>Business Horizons</td>
<td>Preserving intellectual property rights: Managerial insight into the escalating counterfeit market quandary</td>
</tr>
<tr>
<td>Copyright</td>
<td>1 Dickson och Coles (2000)</td>
<td>Technovation</td>
<td>Textile design protection: Copyright, CAD and competition</td>
</tr>
<tr>
<td></td>
<td>2 Cotter (2008)</td>
<td>Iowa Law Review</td>
<td>Fair use and copyright overenforcement</td>
</tr>
</tbody>
</table>

Note: GCS = Global Citation Score (total number of citations from publications included in Web of Science) as of July 2016


82 Hoenen et al., “The Diminishing Signaling Value of Patents between Early Rounds of Venture Capital Financing.”


Patent Management

The field of patent management is the largest one in the systematic literature review. Typically the research is based on quantitative secondary data. Some of the largest areas of research are presented here, as well as some more specific results.

Relatively recent research shows that patents contribute to improved profit margins for both small and large firms. This goes in line with some of the results discussed above, that patents provide a 40–90% premium on returns from inventions and that patents are positively related to venture capital financing. This leads to the question of how firms can receive these benefits, is it enough just to increase patenting? No, it has to be the right type of patenting. Two factors that explain a company’s patenting performance is the internal legal patenting expertise and previous patenting experience in the top management, both of these contribute positively.

A large research stream within patent management is that of patent analytics and how patent information can be used for technology forecasting, patent mapping, etc. This research stream utilizes the rich data available in patent documents and in aggregated patent information, and uses this as basis for decision making tools. This literature started growing in the early 1990s. A common approach is to relate a company’s patent portfolio to an industry or to other companies. Similar approaches can be used in international comparisons of different countries. Other publications focus on patents-based evaluation tools of new technologies; patent roadmaps to better plan future patenting, models for evaluation of patent infringement risks based on text analysis of patent documents.

Another stream of research is that of patent tactics. This relates to what firms should patent, how to build portfolios of related patents, such as patent fences, and how to protect inventions in countries with weak IP regimes. A related stream of research, part of which is described above, is showing differences in patent tactics and patenting across different actors, industries, or nations.

University and academic patenting is a field that has grown since the 1980s, as already noted above. One question is whether academics’ efforts to patent compete with their publishing activities. A couple of publications show that professors who patent perform better in publishing than others, and that professors’ scientific quality is correlated with the quality of their patents. This points at a complementary rather than competing relationship between patenting and publishing in academia.

A final area of past research is focused on non-practicing entities, patent assertion entities, and patent trolls. For example, the prevalence of patent trolls, how they profit, and how other companies and policy actors should act to deal with them have been studied.

Turning to the more recent publications, the research in this category is still diverse, focusing on such topics as front-end patenting decisions, litigation, management of patent portfolios, as well as the organization of the patent function in a firm.

---

Not unlike previous years, a number of articles focuses on mapping and predicting technological development using patent data and various methods for patent analysis. Methods used include network analysis to map the emergence and disappearance of patent classes and the related evolution of technology, text matching to detect technological similarities between patents, machine learning to forecast developments and patent analysis to identify lead user patents in a B2B environment. Recent research also focuses on identifying new technological directions in the form of promising technology and technological opportunities using patent clustering and outlier ranking. Hence research effort has been exerted to map the path of technological evolution and develop methodologies for predicting its course, thereby revealing new opportunities for advancement.

A familiar category is also formed by research focusing on the front-end of patent management, the patenting decision in specific. Research in this group describes patenting motives, the outcomes of various patenting decisions, and the management of patenting activity. While patenting motives of established firms are still a relevant topic of study, recent years see an increase in attention for patenting decisions as made by SMEs and startups both in a descriptive, as well as in a prescriptive sense. This increased attention for the patent management of new and/or small firms is interesting in light of previous research that established the difficulty of IP management for these firms due to their limited resources and IP management capability. This makes the study of startups and SMEs an especially interesting topic that research efforts are increasingly being focused on. Likewise, a notable development in this area is the explicit incorporation of human and organizational factors in patent decisions and patent management, for example by incorporating employee skills as a predictor of patent propensity, by explicitly studying the organization of a firm’s patenting activity in terms of team diversity and leader experience and by using an action research methodology to study patent application and evaluation processes.

Another interesting development is the increased incorporation of various forms and measures of boundary spanning innovation and IP management practices in the study of patent management. Many papers for example incorporate either some measure of open innovation or explicitly focus on the relationship between patenting and open innovation in firms. Others look at the use of external sources of knowledge, absorptive capacity, technology acquisition strategies, the use of external patent attorneys, and more. All this implies a growing awareness of the ever-increasing connectivity of the organizational landscape and the increasing porousness of organizational boundaries as a result, which has endured implications for firms’ IP management.

Lastly, while much attention is and has traditionally been paid to patenting decisions, litigation strategies, and macro-level effects, recent years have seen an increase in papers focused on the strategic, managerial dimension of patent management at the firm-level. This includes the earlier mentioned incorporation of human and organizational factors in studying front-end patent management, but also includes strategic considerations in the management of patents in and beyond the front-end. For example, one study focuses on how patent management can be used in managing ecosystem stability. Others focus on strategic portfolio management by developing portfolio typologies and strategic decision-making tools for evaluating patent portfolios.

In short, while many trends in the field of patent management are continuous over time, recent years have seen new and promising developments like an increased focus on startups and SMEs, an increasing incorporation of various types of openness and connectivity, and a strategic perspective on patent management that includes a concern for human and organizational factors.

111 Abdelkafi et al., “To Standardize or to Patent? Development of a Decision Making Tool and Recommendations for Young Companies.”
113 Agostini and Nosella, “A Dual Knowledge Perspective on the Determinants of Sme Patenting Results of an Empirical Investigation.”
115 Holgersson and Granstrand, “Patenting Motives, Technology Strategies, and Open Innovation.”
IP Management

Just as for patent management, the systematic search for IP management literature resulted in the identification of many publications. This is the area in the review with most connections to and integration with general management and strategy. It is also the area with more in-depth studies of management, for example through case studies, as compared to quantitative studies across large numbers of firms. However, even though IP is a broad concept, the identified literature often implicitly focuses on single IPR types, typically patents.124

The strategic importance of IP is lifted in several articles.125 When IP stands for an increasingly large share, now often a majority, of company values, the management of IP must be lifted to top management level due to IP’s importance for creating and sustaining competitive advantage.126 Specific patent strategies should therefore be linked to corporate strategy to improve competitiveness127, and IP management should be integrated with general management and business strategy.128 One of the main questions in strategy is that of integration and disintegration, and here IP management has an important role to play as an enabler of both integration and disintegration.129

A large theme of IP management research, which has been identified above as well, is how to manage IP in collaboration R&D and open innovation. Chesbrough started to discuss this already in his original publication on open innovation130, and since then several publications have shown the role that patents and IPRs can play to enable innovation contracting131, and that the protective function of patents may be especially needed for firms who collaborate with others to limit opportunism.132

---

129 Granstrand and Holgersson, “Managing the Intellectual Property Disassembly Problem.”
Turning to more recent publications on IP management, many of the articles still discuss the role of IP management in a context of boundary spanning innovation, either by explicit reference to the role of IP in open innovation practices, by studying online communities, crowdsourcing, outsourcing, research alliances, and innovation ecosystems. Research efforts have zoomed in on the phenomenon to determine how IP can be used to facilitate instead of hinder open innovation efforts, and how risks of open innovation in terms of, for example, knowledge spillover or loss of control over IP can be mitigated. While this trend is not new, research on IP and open innovation is getting increasingly nuanced, studying, for example, the use of different types of IP rights in open innovation, as well as differential use of IP rights in different phases of open innovation efforts.

Still prevalent is research on the relationship between IP (management) and various kinds of innovation outputs. Recent studies find for example that protection of IP can facilitate innovative performance in an organizational learning culture and that firms with a higher degree of internationalization have more use for IP protection with regard to technological innovation. On the other hand, IP protection was noted to be an insufficient condition for attracting foreign direct investment.

In summary, while a lot of work on IP management focuses on patent management and therefore either ends up in the first category or ends up taking patents as an indication or operationalization of IP, some works take a broader perspective to include all types of IP. This research is continuously concerned with the relationship between IP and innovation output and increasingly concerned with the role of open innovation while some initial efforts can be seen to incorporate knowledge management into the discussion on IP management and vice versa.

License Management
Licensing plays an important role in IP management and in corporate strategy, which is reflected in a relatively large amount of research on licensing. The review indicates that research on licensing is dominated by formal modelling and quantitative data analysis.

One question that has been addressed by several studies is what the determinants of in- and out-licensing decisions are. For example, it has been found that in-licensing decisions are impacted by organizational structure, and by previous licensing experience, cost and value benefits of licensing, awareness of licensing opportunities, and the licensees’ R&D capabilities. The latter is related to absorptive capacity, meaning that internal technological competence is needed to successfully benefit from external technologies. The primary driver of in-licensing decisions is however a need to quickly create a competitive advantage, while costs and loss of autonomy are important downsides. These different determinants may not only impact the decision of whether or not to license, but also what type of license to use.

147 E.g., Kumar and Turnbull, “Optimal Patenting and Licensing of Financial Innovations.”
In addition to the empirical results described above, the licensing literature includes a lot of conceptual and modelling research. This literature focuses on how to design licenses given a specific business model\textsuperscript{15} This also includes different license clauses\textsuperscript{16} and different payment schemes\textsuperscript{17}, such as ‘upfront’, ‘milestone’, and ‘royalty rate’, and how to combine them. This connects to a very important area of research, namely how to price licenses.\textsuperscript{18}

More research is needed here, however, for example to establish FRAND license royalty principles and to establish internal pricing and internal licensing schemes for fair and reasonable taxation.

Turning to the more recent literature on license management, two main research problems can be distinguished in recent publications. That is, research efforts seem to be mainly directed to questions regarding (the design and evaluation of) the licensing contract on the one hand, and the use and organization of licensing activity on the other hand.

This includes, for example, how to calculate future cash flows from licensing contracts\textsuperscript{19}, and how to calculate innovator revenues in university licensing contracts.\textsuperscript{20}

Meanwhile the management of licensing activities has inspired research around the use of in-licensing by startups\textsuperscript{21}, the role of human capital in licensing outcomes\textsuperscript{22}, and the importance of attention both by R&D as well as top management in using licensed knowledge for the creation of product innovation.\textsuperscript{23} Especially interesting in this last category is that the previously mentioned trend in patent management to start including human and organizational factors seems to be present in part in research of licensing as well. These studies focus on the organization of the licensing function as an essentially human activity, forming a valuable complement to studies on the more formalized aspects of contract design and valuation.

**Secrecy Management**

As compared to research on other types of IPRs, research on secrecy often puts trade secrets in the context of alternative IPRs, and the research is thereby not as limited as research on other types of IPRs.\textsuperscript{24} An analysis of the small research stream on management of secrecy shows that the studies are often conceptual and/or based on modeling, rather than on empirical data.\textsuperscript{25} This should come as no surprise, given that trade secrets are by their nature difficult to measure.

There are some interesting exceptions, however. For example, empirical research has shown that employees’ ambitions to uphold secrecy depends on the employer’s protocol for secrecy. Thereby, the management and enforcement of trade secrets is actually impacting how well secrets are kept.\textsuperscript{26} In the university setting, this becomes especially complex as researchers need to balance publishing for academic reasons with secrecy for commercial reasons.\textsuperscript{27}
Turning to the more recent literature on secrecy, two topics are in focus. Firstly, the strategic decision to keep trade secrets versus patenting or publishing and what conditions affect the importance of secrecy as a way of protecting IP, i.e., how secrecy is used and managed at the level of the inventor or firm. Secondly, the effect of (legal changes in) trade secret law on a number of macro and micro level outcomes, including market value in acquisitions, venture capital investment, and level of disclosure. This draws on developments in trade secret law and studies its impact on a number of economic outcomes, therefore approaching secrecy mostly from a legal perspective as a mostly independent condition. In contrast, the first group mainly treats secrecy as a managerial decision or as a process to be managed.

Management of Design Protection, Trademarks, and Copyrights

The literature on management of design protection, trademarks, and copyrights is very limited, despite the fact that they are probably the most common ones. The low numbers of citations also indicate that the research has not made a big impact, see Table 4. Due to the limitations, these fields are covered jointly here.

Just like for patents, there are differences across industries and firms in the propensity to register community designs in EU and in the propensity to register trademarks. Thus, registered design rights and registered trademarks cannot be used as direct measures of design or marketing output. Also, just like for patents, research indicates that the management of designs and design protection needs to be integrated with the corporate strategy.

The copyright literature identifies digitalization as a source of both challenges and opportunities. Many of these are applicable to other types of IPRs as well, such as designs, for example in terms of rights related to drawings and designs in 3D printing.

Finally, the field of copyright is related to the vast amount of research on open source software and different types of licenses in this setting. Some of this is related to the management of open and closed innovation models in software.

Turning to the more recent literature on these types of IPRs, one single paper in the sample discussed the use of industrial designs for SMEs in open innovation processes. This paper discusses the use of different IP rights and concludes that industrial designs currently provide the most efficient type of IP protection for SMEs. Likewise, this paper uniquely discusses the role of copyright in protecting IP, finding that it is the least used form of intellectual property protection by SMEs yet suggesting it can be useful strategically due to the low costs involved. The second publication on copyright discusses the development of the music industry and how this can historically be explained through market effects rather than by looking at copyright law.

The sample of papers in the trademark category conforms to a generally noted trend to study startups and SMEs. That is, out of three papers in this category, two looked at SMEs’ different uses of IPRs and startups decisions between trademarks and patents under a number of conditions, respectively. The last paper in this category used experimental methods to study trademark dilution through third party use of the trademark.

4. CONCLUSIONS AND DIRECTIONS FOR RESEARCH AND PRACTICE

After this broad review of research on IP management, what can be concluded and what directions for actions can be given to practitioners and academics? A first conclusion is that research on IP management has had increasing growth, especially since the early 2000s. This can be illustrated by a number of special issues being published during recent years and a growing number of publications more generally, as illustrated in Figure 2.

A second conclusion is that the literature mainly focuses on single types of IPRs, typically patents. This limitation is identified in previous reviews, in special issues, and in the structured literature review. From the publications studied it is clear that most researchers (and quite often practitioners as well) substitute IP management for patent management and pay relatively little attention to other types of IPRs, their uses and interdependences with the rest of the IP portfolio. IP management in its essence includes the entire scope of formal IPRs and informal appropriation strategies however, so that a part of the picture is obscured when patents are singularly studied, or managed. Research as well as practice need to take a more holistic perspective on the concepts of IP and IPRs, especially when the basis for competitiveness dynamically moves between different types of intellectual resources, such as technical inventions, data, and user communities, and the related IPRs.

Just as the research and practice of IP management need to integrate different types of IPRs, a third conclusion is that it also needs to be integrated with general management and business strategy. The recent increase in the study of organizational factors in the management of IP is welcomed. Even though several advancements have been made in this area, partly thanks to several special issue specifically requesting such research, there is still much room for further advancements in both research
and practice. For example, more knowledge is needed about how to efficiently and effectively organize the IP function, which is in practice often quite isolated from business strategy decisions as well as from technology decisions. The provision of IP intelligence may here function as an internal door-opener for IP lawyers and IP managers. More knowledge is also needed about how to design IP strategies to align with new business models (and vice versa), and their various components involving more or less collaboration and competition across firm boundaries.

A fourth conclusion is that there is a sustained attention for the role of open innovation in the management of IP and vice versa. Boundaries between organizations, industries, and technologies are increasingly blurring with a noticeable impact on the management of IP. While discussions on the commensurability between IPRs and open innovation have dominated the debate on their relationship, recent years seem to indicate an effort to instead find the right usage of IP in open innovation and more generally in collaboration, competition, and coopetition across firm boundaries. This nuance of the debate is encouraged, as the discussion on commensurability of IP and open innovation suggests a false dichotomy between ‘closed’ innovation characterized by strong IP protection and knowledge hoarding, and ‘open’ innovation characterized by free sharing and a lack of IP protection. Instead various types of openness in innovation exist in parallel (and even in mutually reinforcing relationships). Therefore the question of how to manage IP in open innovation contexts and how to facilitate open innovation efforts through the right mix of IP strategies seems more productive at this stage of development in the field.
The above conclusions become even more relevant as the business landscape is changing, partly as a result of digitalization. Digitalization is not only changing the technology base of firms, but also how they do business. Business models are increasingly building on various forms of platforms and/or business and innovation ecosystem, and research has shown that IP management has a very important role to play here, for example in controlling how accessible different interfaces and components should be. Moreover, IP is taking an increasingly central place in new industries. For example, service firms have historically built their competitiveness on the efficient and effective use of human resources with an offering ensured by their trademarked brands. In the process of automation, human resources are replaced by different forms of robots and artificial intelligence, and profits may no longer accrue to the firm who controls human resources, but rather to the firm who controls the rights to key technologies enabling automation.

In this setting, different industries and technologies will converge, meaning also that actors with different types of IP strategies and IP cultures will eventually collide. For example, the automotive industry converges with parts of the computer, software, and ICT industries. Practitioners need to make proactive efforts in preparing for, or avoiding, IP culture and strategy collisions. Researchers, on the other hand, may find interesting new avenues for research when the industrial differences in IP strategy identified in several publications and research fields are gradually converging, being erased, or leading to increasingly litigious industries.

As identified both here and in previous reviews, the IP management field has had an overweight of studies utilizing quantitative secondary data, such as patent statistics, where many relevant strategy- and management-related variables are missing. Many of these requests for additional research call for studies where in-depth primary data is collected, for example with case study research designs or with new survey designs focusing specifically on IP management. There is here large potential in collaborations between practitioners and researchers that can move the field of IP management forward.

Finally, for the IP (law) function or unit of a firm there are ample opportunities and benefits of integrating different types of IPRs and integrating (being integrated with) more strategic decision-making, see Figure 3. While there are of course huge differences in how well-integrated IP (law) functions are in different firms, they are most often involved in the front-end of patent application as well as in the back-end of IP enforcement. In between is a range of strategic issues relating to IP, where the IP (law) function is however often less involved despite its relevance for such decisions, as described above. A combination of internal IP education efforts and top management support may be needed to make organizations ready for what IP management has to offer.

ACKNOWLEDGEMENTS

This article was written within the research project Intellectual property management in digitalizing businesses at Chalmers University of Technology. The financial support of Vinnova, grant numbers 2016-02126 and 2016-04666, and the competent research assistance by Jacob Moos are gratefully acknowledged.
Marcus Holgersson

Marcus Holgersson is Associate Professor at the Entrepreneurship and Strategy division at Chalmers University of Technology. His research and teaching deal with management, economics, and strategies of innovation and intellectual property. He is especially interested in the connection between IP strategies and technology/innovation/business/corporate strategies, and the connection between IP strategies and firm performance. Dr. Holgersson has held visiting positions at University of Gothenburg, Stanford University, and UC Berkeley.

Sarah van Santen

Sarah van Santen is a doctoral student at the department of Technology Management and Economics at Chalmers University of Technology. In her research, she looks at the strategic management of innovation and IP, focusing on closed as well as open strategies and business models. Research interests include strategies and management of innovation, strategic decision-making, organizational network theories, and strategy emergence. She holds a bachelor’s- and master’s degree in Organization Studies from Tilburg University.


186, 187, 188, 189