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The Business of Intellectual Property

A Literature Review of IP Management Research

By Marcus Holgersson and Sarah van Santen

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 in 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 a Web of Science search for [review AND literature AND intellectual propert* AND manag*].¹ 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 3.² 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.

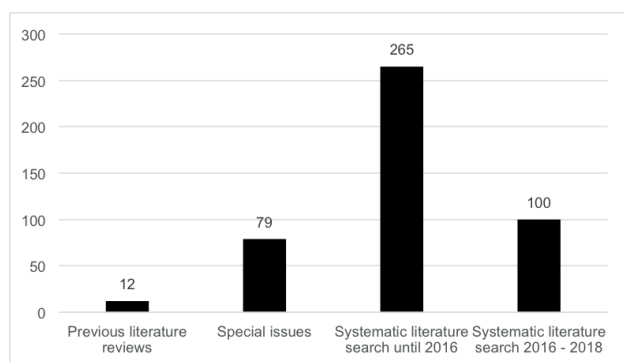


FIGURE 1 NUMBER OF PUBLICATIONS INCLUDED IN DIFFERENT SUBSTUDIES

3. LITERATURE REVIEW

This chapter is structured according to the different sub-studies. 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.³ 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.⁴

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.

³ Ove Granstrand, *The Economics and Management of Intellectual Property: Towards Intellectual Capitalism* (Cheltenham: Edward Elgar Publishing, 1999).

⁴ See, e.g., E.g., William D. Nordhaus, *Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change* (Cambridge, MA: MIT Press, 1969).

Hanel (2006) is the first identified review explicitly focused on management of IP. In line with the work of Granstrand⁵, 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.⁶ 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.⁷ Moreover, patents that have been enforced and proven valid are then more valuable than patents that have not been tested in court.⁸ Apart from this literature, Hanel also reviews areas in need of more research, such as the growing fields of IP valuation and securitization.⁹ Finally, Hanel identifies a number of differences in the management of IP among firms in different industries and of different sizes.¹⁰

Holgersson (2013) 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.¹¹ 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.¹² 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.¹³ 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.¹⁴ 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.¹⁵ 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.¹⁶ 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.¹⁷ 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.¹⁸ The latter is especially important for small firms, including in their relations with venture capitalists and other providers of external capital.¹⁹

Another review focusing specifically on patent management is published by Somaya (2012).²⁰ Based on an extensive review of patent strategy this review divides strategies found in literature into different generic strategies. The

⁵ Granstrand, *The Economics and Management of Intellectual Property: Towards Intellectual Capitalism*.

⁶ Petr Hanel, "Intellectual Property Rights Business Management Practices: A Survey of the Literature," *Technovation* 26, no. 8 (2006).

⁷ Jean O Lanjouw and Mark Schankerman, "Stylized Facts of Patent Litigation: Value, Scope and Ownership," (National Bureau of Economic Research, 1997).

⁸ Edward F. Sherry and David J. Teece, "Royalties, Evolving Patent Rights, and the Value of Innovation," *Research Policy* 33, no. 2 (2004).

⁹ For some references on IP valuation, see e.g., A. Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*, 2 ed. (New York: John Wiley & Sons, 2002); J.O. Lanjouw, A. Pakes, and J. Putnam, "How to Count Patents and Value Intellectual Property," in NBER Working Paper No. 5741 (1996); Richard Razgaitis, *Valuation and Dealmaking of Technology-Based Intellectual Property: Principles, Methods and Tools* (John Wiley & Sons, 2009); Gordon V Smith and Russell L Parr, *Valuation of Intellectual Property and Intangible Assets*, vol. 13 (Wiley, 2000).

¹⁰ This is explicated in another review, see Marcus Holgersson, "Patent Management in Entrepreneurial Smes: A Literature Review and an Empirical Study of Innovation Appropria-

tion, Patent Propensity, and Motives," *R&D Management* 43, no. 1 (2013).

¹¹ *Ibid.*

¹² See pioneering studies by F. M. Scherer, "The Propensity to Patent," *International Journal of Industrial Organization* 1, no. 1 (1983); Edwin Mansfield, "Patents and Innovation: An Empirical Study," *Management Science* 32, no. 2 (1986).

¹³ "Patents and Innovation: An Empirical Study."

¹⁴ *Ibid.*; Anthony Arundel and Isabelle Kabla, "What Percentage of Innovations Are Patented? Empirical Estimates for European Firms," *Research Policy* 27, no. 2 (1998); Erik Brouwer and Alfred Kleinknecht, "Innovative Output, and a Firm's Propensity to Patent: An Exploration of Cis Micro Data," *Research Policy* 28, no. 6 (1999); Norhène Chabchoub and Jorge Niosi, "Explaining the Propensity to Patent Computer Software," *Technovation* 25, no. 9 (2005).

¹⁵ Holgersson, "Patent Management in Entrepreneurial Smes: A Literature Review and an Empirical Study of Innovation Appropriation, Patent Propensity, and Motives."

¹⁶ Richard C. Levin et al., "Appropriating the Returns from Industrial Research and Development," *Brookings Papers on Economic Activity* 14, no. 3 (1987); Najib Harabi, "Appropriability of Technical Innovations an Empirical Analysis," *Research Policy* 24, no. 6

(1995); John Kitching and Robert Blackburn, "Intellectual Property Management in the Small and Medium Enterprise (Sme)," *Journal of Small Business and Enterprise Development* 5, no. 4 (1998); Brouwer and Kleinknecht, "Innovative Output, and a Firm's Propensity to Patent: An Exploration of Cis Micro Data."; Wesley M. Cohen, Richard R. Nelson, and John P. Walsh, "Protecting Their Intellectual Assets: Appropriability Conditions and Why Us Manufacturing Firms Patent (or Not)," in NBER Working Paper 7552 (2000).

¹⁷ Marcus Holgersson and Ove Granstrand, "The Importance of Patents for Innovation Appropriation and Open Financing - a New View," in R&D Management Conference (Cambridge, UK2016).

¹⁸ Anthony Arundel, "The Relative Effectiveness of Patents and Secrecy for Appropriation," *Research Policy* 30, no. 4 (2001); Emmanuel Duguet and Isabelle Kabla, "Appropriation Strategy and the Motivations to Use the Patent System: An Econometric Analysis at the Firm Level in French Manufacturing," *Annals of Economics and Statistics / Annales d'Économie et de Statistique*, no. 49/50 (1998); Granstrand, *The Economics and Management of Intellectual Property: Towards Intellectual Capitalism*; Cohen, Nelson, and Walsh, "Protecting Their Intellectual Assets: Appropriability

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".²¹

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.²²

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 appropriation²³, and the article by Griliches is a key reference in studies using patents as indicators.²⁴

ty Conditions and Why Us Manufacturing Firms Patent (or Not)."; Nikolaus Thumm, "Motives for Patenting Biotechnological Inventions: An Empirical Investigation in Switzerland," *International Journal of Technology, Policy and Management* 4, no. 3 (2004); Knut Blind et al., "Motives to Patent: Empirical Evidence from Germany," *Research Policy* 35, no. 5 (2006); Paola Giuri et al., "Inventors and Invention Processes in Europe: Results from the Patval-Eu Survey," *Research Policy* 36, no. 8 (2007); Marcus M. Keupp et al., *Sme-Ip 2nd Report: Economic Focus Study on Smes and Intellectual Property in Switzerland* (Publication No 5 (06.09), Swiss Federal Institute of Intellectual Property, 2009); Gaétan de Rassenfosse, "How Smes Exploit Their Intellectual Property Assets: Evidence from Survey Data," *Small Business Economics* 39, no. 2 (2012).

¹⁹ Holgersson, "Patent Management in Entrepreneurial Smes: A Literature Review and an Empirical Study of Innovation Appropriation, Patent Propensity, and Motives."; de Rassenfosse, "How Smes Exploit Their Intellectual Property Assets: Evidence from Survey Data."

²⁰ Deepak Somaya, "Patent Strategy and Management," *Journal of Management* 38, no. 4 (2012).

²¹ Martin A. Bader, *Intellectual Property Management in R&D Collaborations: The Case*

of the Service Industry Sector (Heidelberg: Physica-Verlag, 2006), p. 25.

²² Hanni Candelin-Palmqvist, Birgitta Sandberg, and Ulla-Majja Mylly, "Intellectual Property Rights in Innovation Management Research: A Review," *Technovation* 32, no. 9-10 (2012).

²³ Levin et al., "Appropriating the Returns from Industrial Research and Development."; David J. Teece, "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy," *Research Policy* 15, no. 6 (1986); Mansfield, "Patents and Innovation: An Empirical Study."

²⁴ Zvi Griliches, "Patent Statistics as Economic Indicators - a Survey," *Journal of Economic Literature* 28, no. 4 (1990). See also Adam B. Jaffe, Manuel Trajtenberg, and Rebecca Henderson, "Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations," *Quarterly Journal of Economics* 108, no. 3 (1993); Jerry A. Hausman, Bronwyn H. Hall, and Zvi Griliches, "Econometric Models for Count Data with an Application to the Patents-R&D Relationship," *Econometrica* 52, no. 4 (1984).



TABLE 1 MOST CITED PUBLICATIONS BY THE RESEARCH FIELD ²⁵

Author (Year)	Journal	Title	#
1 Griliches (1990)	Journal of Economic Literature	Patent statistics as economic indicators - A survey	258
2 Levin, et al. (1987)	Brookings Papers on Economic Activity	Appropriating the returns from industrial research and development	209
3 Cohen and Levinthal (1990)	Administrative Science Quarterly	Absorptive capacity: A new perspective on learning and innovation	205
4 Teece (1986)	Research Policy	Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy	178
5 Jaffe, et al. (1993)	Quarterly Journal of Economics	Geographic localization of knowledge spillovers as evidenced by patent citations	177
6 Nelson and Winter (1982)	- (book)	An Evolutionary Theory of Economic Change	168
7 Hall and Ziedonis (2001)	The RAND Journal of Economics	The patent paradox revisited: An empirical study of patenting in the U.S. semiconductor industry	126
8 Hausman, et al. (1984)	Econometrica	Econometric models for count data with an application to the patents-R&D relationship	116
9 Barney (1991)	Journal of Management	Firm resources and sustained competitive advantage	109
10 Teece, et al. (1997)	Strategic Management Journal	Dynamic capabilities and strategic management	106
11 Jaffe (1986)	American Economic Review	Technological opportunity and spillovers of R&D: Evidence from firms' patents, profits and market value	101
12 Cohen and Levinthal (1989)	The Economic Journal	Innovation and learning: The two faces of R&D	97
13 Mansfield (1986)	Management Science	Patents and innovation: An empirical study	96
14 Trajtenberg (1990)	The RAND Journal of Economics	A penny for your quotes: Patent citations and the value of innovations	94
15 Heller and Eisenberg (1998)	Science	Can patents deter innovation? The anticommons in biomedical research	88
16 Kogut and Zander (1992)	Organization Science	Knowledge of the firm, combinative capabilities, and the replication of technology	88
17 March (1991)	Organization Science	Exploration and exploitation in organizational learning	87
18 Arrow (1962)	NBER	Economic welfare and the allocation of resources for invention	84
19 Mansfield, et al. (1981)	The Economic Journal	Imitation costs and patents: An empirical study	83
20 Merges and Nelson (1990)	Columbia Law Review	On the complex economics of patent scope	83

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

²⁵ As identified by Marcus Holgersson, "Innovation and Intellectual Property: Strategic Ip Management and Economics of Technology" (Chalmers University of Technology, 2012).

²⁶ Ulrich Lichtenthaler, "External Commercialization of Knowledge: Review and Research Agenda," *International Journal of Management Reviews* 7, no. 4 (2005).

²⁷ Lise Aaboen and Marcus Holgersson, "Technology Transfer Offices, Incubators, and Intellectual Property Management," in *Academy of Management Conference (Anaheim, USA2016)*.

²⁸ Barry Bozeman, "Technology Transfer and Public Policy: A Review of Research and Theory," *Research Policy* 29, no. 4-5 (2000).

²⁹ M. S. Meyer and P. Tang, "Exploring the "Value" of Academic Patents: Ip Manage-

ment Practices in Uk Universities and Their Implications for Third-Stream Indicators," *Scientometrics* 70, no. 2 (2007).

³⁰ Dietmar Harhoff et al., "Citation Frequency and the Value of Patented Inventions," *Review of Economics and Statistics* 81, no. 3 (1999).

³¹ Jean O. Lanjouw, Ariel Pakes, and Jonathan Putnam, "How to Count Patents and Value Intellectual Property: The Uses of Patent Renewal and Application Data," *The Journal of Industrial Economics* 46, no. 4 (1998).

³² D. Harhoff, F.M. Scherer, and K. Vopel, "Exploring the Tail of Patented Invention Value Distributions," in *Economics, Law and Intellectual Property*, ed. Ove Granstrand (Dordrecht: Kluwer Academic Publishers, 2003).

³³ M. Manhart and S. Thalmann, "Protecting

Organizational Knowledge: A Structured Literature Review," *Journal of Knowledge Management* 19, no. 2 (2015).

³⁴ Richard A. Jensen, Jerry G. Thursby, and Marie C. Thursby, "Disclosure and Licensing of University Inventions: 'The Best We Can Do with the S**T We Get to Work With,'" *International Journal of Industrial Organization* 21, no. 9 (2003).

³⁵ Andreas Panagopoulos, "Understanding When Universities and Firms Form Rjvs: The Importance of Intellectual Property Protection," *International Journal of Industrial Organization* 21, no. 9 (2003).

Previous Reviews of Technology Commercialization and Transfer

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 is 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 covering relatively many countries and patents renewed for relatively many years are more valuable than others³¹. An important finding in this stream of literature is that patent values are very skewed, with a few patents being very

valuable, but most patents having hardly any value at all.³² This may be part of the explanation behind the relatively limited importance for appropriation, as identified above.

Finally, given the increasing interest for data, an interesting stream of research is covering information and knowledge management, which is reviewed by Manhart and Thalmann (2015). They analyze 48 articles with a different focus to what has been covered above. Their review especially focuses on the use of IT systems, and how IT systems can be designed not only to diffuse and spread knowledge, but also to protect it. The review also identifies a need for increasing research on the management of tacit knowledge, in addition to the research on explicit and codified knowledge.³³ This relates to the systematic review of research on management of trade secrets, which is presented in section 3.3.

3.2 Special Issues

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.

TABLE 2 SPECIAL ISSUES RELATED TO IP MANAGEMENT

Special issue	Journal	Year, volume, issue	Number of articles
The Economics of Intellectual Property at Universities	International Journal of Industrial Organization	2003, Vol. 21, No. 9	10
Intellectual Property Management	California Management Review	2013, Vol. 55, No. 4	11
Innovation, Intellectual Property and Strategic Management	Strategic Management Society 'virtual special issue'	2014	26 (not fixed)
Industry Standards, Intellectual Property, and Innovation	International Journal of Industrial Organization	2014, Vol. 36	8
Intellectual Property Approaches for a New Era	Research-Technology Management	2014, Vol. 57, No. 5	5
Patent Use	Research Policy	2016, Vol. 45, No. 7	6
Intellectual Property Management	Management Decision	2017, Vol. 55, No. 6	13

California Management Review (2013): Intellectual Property Management

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.³⁶

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

Strategic Management Society 'virtual special issue' (2014): Innovation, Intellectual Property and Strategic Management

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.

³⁶ Alberto Di Minin and Dries Faems, "Building Appropriation Advantage," California Management Review 55, no. 4 (2013).

³⁷ Abdulrahman Al-Aali and David J. Teece, "Towards the (Strategic) Management of Intellectual Property: Retrospective and Prospective," California Management Review 55, no. 4 (2013).

³⁸ Tilo Peters, Jana Thiel, and Christopher L. Tucci, "Protecting Growth Options in Dynamic Markets: The Role of Strategic Disclosure in Integrated Intellectual Property Strategies," California Management Review 55, no. 4 (2013).

³⁹ James G Conley, Peter M Bican, and Holger Ernst, "Value Articulation," California Management Review 55, no. 4 (2013).

⁴⁰ William W Fisher III and Felix Oberholzer-Gee, "Strategic Management of Intellectual Property: An Integrated Approach," California management review 55, no. 4 (2013).

⁴¹ Fabrizio Cesaroni and Andrea Piccaluga, "Operational Challenges and St's Proposed Solutions to Improve Collaboration between Ip and R&D in Innovation Processes," California Management Review 55, no. 4 (2013).

⁴² Al-Aali and Teece, "Towards the (Strategic) Management of Intellectual Property: Retrospective and Prospective."; Cesaroni and

Piccaluga, "Operational Challenges and St's Proposed Solutions to Improve Collaboration between Ip and R&D in Innovation Processes."; Ove Granstrand and Marcus Holgersson, "Managing the Intellectual Property Disassembly Problem," California Management Review 55, no. 4 (2013).

⁴³ Simon den Uijl, Rudi Bekkers, and Henk J de Vries, "Managing Intellectual Property Using Patent Pools," California Management Review 55, no. 4 (2013).

⁴⁴ Bart Leten et al., "Ip Models to Orchestrate Innovation Ecosystems," California management review 55, no. 4 (2013).

⁴⁵ Henry W Chesbrough and Eric L Chen, "Recovering Abandoned Compounds through Expanded External Ip Licensing," California Management Review 55, no. 4 (2013). See also see also Marcus Holgersson, Tai Phan, and Thomas Hedner, "Entrepreneurial Patent Management in Pharmaceutical Startups," Drug Discovery Today 21, no. 7 (2016).

⁴⁶ Joachim Henkel, Carliss Y. Baldwin, and Willy Shih, "Ip Modularity: Profiting from Innovation by Aligning Product Architecture with Intellectual Property," California Management Review 55, no. 4 (2013).

⁴⁷ Granstrand and Holgersson, "Managing the Intellectual Property Disassembly Problem."

⁴⁸ E.g., e.g., Margaret A. Peteraf, "The Cornerstones of Competitive Advantage: A Resource-Based View," Strategic Management Journal 14, no. 3 (1993); Birger Wernerfelt, "A Resource-Based View of the Firm," Strategic Management Journal 5, no. 2 (1984); David J. Teece, Gary Pisano, and Amy Shuen, "Dynamic Capabilities and Strategic Management," Strategic Management Journal 18, no. 7 (1997); Oliver E. Williamson, "Strategy Research: Governance and Competence Perspectives," Strategic Management Journal 20, no. 12 (1999).

⁴⁹ Stephen J. Carson and George John, "A Theoretical and Empirical Investigation of Property Rights Sharing in Outsourced Research, Development, and Engineering Relationships," Strategic Management Journal 34, no. 9 (2013).

⁵⁰ Aija Leiponen, "Control of Intellectual Assets in Client Relationships: Implications for Innovation," Strategic Management Journal 29, no. 13 (2008).

⁵¹ Rajshree Agarwal, Martin Ganco, and Rosemarie H. Ziedonis, "Reputations for Toughness in Patent Enforcement: Implications for Knowledge Spillovers Via Inventor Mobility," Strategic Management Journal 30, no. 13 (2009).

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.⁵¹ This behavior moreover decreases the propensity to leave the firm among employees.⁵²

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%.⁵³ A related study shows that holding patents increases prices of companies being acquired.⁵⁴ 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).⁵⁵

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.⁵⁶ 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.⁵⁷

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.⁵⁸ 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.⁵⁹ 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.⁶⁰

The issue also includes research contributing to the growing research on how to manage IP in open innovation.⁶¹ 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.⁶² Firms that master this can build a strong IP portfolio through several sequential R&D collaborations.⁶³

⁵² Martin Ganco, Rosemarie H. Ziedonis, and Rajshree Agarwal, "More Stars Stay, but the Brightest Ones Still Leave: Job Hopping in the Shadow of Patent Enforcement," *Strategic Management Journal* 36, no. 5 (2015).

⁵³ Paul H. Jensen, Russell Thomson, and Jongsay Yong, "Estimating the Patent Premium: Evidence from the Australian Inventor Survey," *Strategic Management Journal* 32, no. 10 (2011).

⁵⁴ Christoph Grimpe and Katrin Hussinger, "Resource Complementarity and Value Capture in Firm Acquisitions: The Role of Intellectual Property Rights," *Strategic Management Journal* 35, no. 12 (2014).

⁵⁵ Edward Levitas and M. Ann McFadyen, "Managing Liquidity in Research-Intensive Firms: Signaling and Cash Flow Effects of Patents and Alliance Activities," *Strategic Management Journal* 30, no. 6 (2009); David H. Hsu and Rosemarie H. Ziedonis, "Resources as Dual Sources of Advantage: Implications for Valuing Entrepreneurial-Firm Patents," *Strategic Management Journal* 34, no. 7 (2013).

⁵⁶ Luís Cabral and David Salant, "Evolving Technologies and Standards Regulation," *International Journal of Industrial Organization* 36 (2014).

⁵⁷ Anne Layne-Farrar and Gerard Llobet, "Moving Beyond Simple Examples: Assessing the Incremental Value Rule within Standards," *International Journal of Industrial Organization* 36 (2014).

⁵⁸ Irene Petrick, Thierry Rayna, and Ludmila Striukova, "The Challenges of Intellectual Property," *Research-Technology Management* 57, no. 5.

⁵⁹ Thomas Kurfess and William J Cass, "Rethinking Additive Manufacturing and Intellectual Property Protection," *Research-Technology Management* 57, no. 5.

⁶⁰ W Austin Spivey, J Michael Munson, and Bernd Wurth, "Implications of the America Invents Act for R&D Managers: Connecting the Patent Life Cycle with the Technology Development Process," *Research-Technology Management* 57, no. 5.

⁶¹ E.g., Oliver Alexy, Paola Criscuolo, and Am-

mon Salter, "Does Ip Strategy Have to Cripple Open Innovation?," *MIT Sloan Management Review* 51, no. 1 (2009); Marcel Bogers, "The Open Innovation Paradox: Knowledge Sharing and Protection in R&D Collaborations," *European Journal of Innovation Management* 14, no. 1 (2011); Henry W. Chesbrough, "The Logic of Open Innovation: Managing Intellectual Property," *California Management Review* 45, no. 3 (2003); Henkel, Baldwin, and Shih, "Ip Modularity: Profiting from Innovation by Aligning Product Architecture with Intellectual Property,"; Raffaella Manzini and Valentina Lazzarotti, "Intellectual Property Protection Mechanisms in Collaborative New Product Development," *R&D Management* 46, no. S2 (2016).

⁶² Ove Granstrand and Marcus Holgersson, "The Challenge of Closing Open Innovation: The Intellectual Property Disassembly Problem," *Research-Technology Management* 57, no. 5.

⁶³ 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.⁶⁴ 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.⁶⁵

Research Policy (2016): Patent Use

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.⁶⁶

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.⁶⁷

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.⁶⁸ The most common reasons are that commercialization opportunities are still explored, and that the invention was patented to block others and to stop invent-around, rather than to protect own products, services, and processes.⁶⁹ As much as 67% of patent applications are made to block other patents.⁷⁰ 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.

Management Decision (2017): Intellectual Property Management

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 organization⁷¹ and external organization, including the use of external patent attorneys.⁷²

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

⁶⁴ Jeremy Hall et al., "Commercializing University Research in Diverse Settings: Moving Beyond Standardized Intellectual Property Management," Research-Technology Management 57, no. 5.

⁶⁵ Ibid.

⁶⁶ Gaétan de Rassenfosse, Alfons Palangkaraya, and Elizabeth Webster, "Why Do Patents Facilitate Trade in Technology? Testing the Disclosure and Appropriation Effects," Research Policy 45, no. 7 (2016).

⁶⁷ Marcela Miozzo et al., "Innovation Collaboration and Appropriability by Knowledge-Intensive Business Services Firms," Research Policy 45, no. 7 (2016); Ashish Arora, Suma Athreya, and Can Huang, "The Paradox of Openness Revisited: Collaborative Innovation and Patenting by UK Innovators," Research Policy 45, no. 7 (2016).

⁶⁸ John P. Walsh, You-Na Lee, and Taehyun Jung, "Win, Lose or Draw? The Fate of Patented

Inventions," Research Policy 45, no. 7 (2016); Salvatore Torrisi et al., "Used, Blocking and Sleeping Patents: Empirical Evidence from a Large-Scale Inventor Survey," Research Policy 45, no. 7 (2016).

⁶⁹ Walsh, Lee, and Jung, "Win, Lose or Draw? The Fate of Patented Inventions."

⁷⁰ Torrisi et al., "Used, Blocking and Sleeping Patents: Empirical Evidence from a Large-Scale Inventor Survey."

⁷¹ Benedetta Soranzo, Anna Nosella, and Roberto Filippini, "Redesigning Patent Management Process: An Action Research Study," Management Decision 55, no. 6 (2017).

⁷² Sevim Süzeroglu-Melchioris, Oliver Gassmann, and Maximilian Palmié, "Friend or Foe? The Effects of Patent Attorney Use on Filing Strategy Vis-a-Vis the Effects of Firm Experience," Management Decision 55, no. 6 (2017).

⁷³ Alexander Brem, Petra A. Nyland, and Emma L. Hitchen, "Open Innovation and Intellectual

Property Rights: How Do Smes Benefit from Patents, Industrial Designs, Trademarks and Copyrights?," Management Decision 55, no. 6 (2017).

⁷⁴ Marcus Holgersson and Martin W. Wallin, "The Patent Management Trichotomy: Patenting, Publishing, and Secrecy," Management Decision (2017).

⁷⁵ Ibid., p. 1092

⁷⁶ Marcus Holgersson and O Granstrand, "Patenting Motives, Technology Strategies, and Open Innovation," Management Decision (2017).

⁷⁷ Davide Aloini et al., "Ip, Openness, and Innovation Performance: An Empirical Study," Management Decision 55, no. 6 (2017).

⁷⁸ Paola Belingheri and Maria Isabella Leone, "Walking into the Room with Ip: Exploring Start-Ups' Ip Licensing Strategy," Management Decision 55, no. 6 (2017).

asingly asked for in much previous research, including different IPRs such as patents, industrial designs, trademarks, and copyrights.⁷³ For example, the choice between patenting, defensive publishing, and secrecy for new inventions, is conceptually analyzed.⁷⁴ 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 while secrecy only provides direct 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).”⁷⁵ 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 innovation⁷⁶, and that IP protection is related to more openness, which is in turn related to better innovativeness.⁷⁷ 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.⁷⁸

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

Area	Total number of identified publications until 2016	Number of identified relevant publications until 2016	Total number of identified publications 2016 - 2018	Number of identified relevant publications 2016 - 2018
Patent	253	96	68	46
Intellectual property	124	72	26	26
License	84	50	24	15
Secrecy	82	17	29	6
Design	28	11	2	1
Trademark	15	10	3	3
Copyright	21	9	2	2
Total	607	265	145	100

TABLE 4 THE MOST CITED PUBLICATIONS IN DIFFERENT FIELDS OF IP MANAGEMENT, AS IDENTIFIED IN STRUCTURED LITERATURE REVIEW

	Author (year)	Journal	Title	GCS
Patent	1 Ernst (1999)	Journal of Engineering and Technology Management	Patent portfolios for strategic R&D planning	85
	2 Reitzig (2004)	Research Policy	Improving patent valuations for management purposes validating new indicators by analyzing application rationales	81
	3 Fabrizio och Di Minin (2008)	Research Policy	Commercializing the laboratory: Faculty patenting and the open science environment	75
Intellectual property	1 Chesbrough (2003)	California Management Review	The logic of open innovation: Managing intellectual property	104
	2 Rivette och Kline (2000)	Harvard Business Review	Discovering new value in intellectual property	96
	3 Anton och Yao (2004)	Rand Journal of Economics	Little patents and big secrets: Managing intellectual property	88
License	1 Grindley och Teece (1997)	California Management Review	Managing intellectual capital: Licensing and crosslicensing in semiconductors and electronics	230
	2 Bray och Lee (2000)	Journal of Business Venturing	University revenues from technology transfer: Licensing fees vs. equity positions	73
	3 Pitkethly (2001)	Research Policy	Intellectual property strategy in Japanese and UK companies: patent licensing decisions and learning opportunities	62
Secrecy	1 Anton och Yao (2004)	RAND Journal of Economics	Little patents and big secrets: Managing intellectual property	88
	2 Hannah (2005)	Organization Science	Should I keep a secret? The effects of trade secret protection procedures on employees' obligations to protect trade secrets	40
	3 Wu, Melnyk och Flynn (2010)	Decision Sciences	Operational Capabilities: The Secret Ingredient	32
Design	1 Bhattacharyya och Singh (1999)	Journal of Financial Economics	The resolution of bankruptcy by auction: allocating the residual right of design	11
	2 Chen och Chen (2007)	EMJ Engineering Management Journal	Design patent map: An innovative measure for corporative design strategies	10
	3 Tryzyna (1987)	Journal of the Patent and Trademark Office Society	Are plants protectable under the design patent act	1
Trademark	1 Gillespie, Krishna och Jarvis (2002)	Journal of International Marketing	Protecting global brands: Toward a global norm	10
	2 Chaudhry et al (2009)	Business Horizons	Preserving intellectual property rights: Managerial insight into the escalating counterfeit market quandary	8
	3 Berger, Blind och Cuntz (2012)	Research Policy	Risk factors and mechanisms of technology and insignia copying - A first empirical approach	6
Copyright	1 Dickson och Coles (2000)	Technovation	Textile design protection: Copyright, CAD and competition	21
	2 Cotter (2008)	Iowa Law Review	Fair use and copyright overenforcement	11
	3 Garcia och Gil (2004)	International Journal of Electronic Commerce	A web ontology for copyright contract management	2

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

⁷⁹ E.g., Federico Munari and Laura Toschi, "Running Ahead in the Nanotechnology Gold Rush. Strategic Patenting in Emerging Technologies," *Technological Forecasting and Social Change* 83 (2014); Sebastian Hoenen et al., "The Diminishing Signaling Value of Patents between Early Rounds of Venture Capital Financing," *Research Policy* 43, no. 6 (2014); Jinyoung Kim, "Patent Portfolio Management of Sequential Inventions: Evidence from Us Patent Renewal Data," *Review of Industrial Organization* 47, no. 2 (2015).

⁸⁰ Petra Andries and Dries Faems, "Patenting Activities and Firm Performance: Does Firm Size Matter?," *Journal of Product Innovation Management* 30, no. 6 (2013).

⁸¹ Jensen, Thomson, and Yong, "Estimating the Patent Premium: Evidence from the Australian Inventor Survey."

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

⁸³ Deepak Somaya, Ian O. Williamson, and Xiaomeng Zhang, "Combining Patent Law Expertise with R&D for Patenting Performance," *Organization Science* 18, no. 6 (2007).

⁸⁴ William W. Keep, Glenn S. Omura, and Roger J. Calantone, "What Managers Should Know About Their Competitors' Patented Technologies," *Industrial Marketing Management* 23, no. 3 (1994); Leonard Berkowitz, "Getting the Most from Your Patents," *Research-Technology*

Management 36, no. 2 (1993).

⁸⁵ Klaus K. Brockhoff, "Instruments for Patent Data Analyses in Business Firms," *Technovation* 12, no. 1 (1992); Ove Granstrand, Pari Patel, and Keith Pavitt, "Multi-Technology Corporations: Why They Have 'Distributed' Rather Than 'Distinctive Core' Competences," *California Management Review* 39, no. 4 (1997); Shann-Bin Chang, "Using Patent Analysis to Establish Technological Position: Two Different Strategic Approaches," *Technological Forecasting and Social Change* 79, no. 1 (2012); Holger Ernst, "Patent Portfolios for Strategic R&D Planning," *Journal of Engineering and Technology Management* 15, no. 4 (1998).

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.⁷⁹ 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.⁸⁰ This goes in line with some of the results discussed above, that patents provide a 40-50% premium on returns from inventions⁸¹ and that patents are positively related to venture capital financing.⁸² 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.⁸³

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.⁸⁴ 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.⁸⁵ Similar approaches can be used in international comparisons of different countries.⁸⁶ Other publications focus on patents-based evaluation tools of new technologies⁸⁷, patent roadmaps to better plan future patenting⁸⁸, models for evaluation of

patent infringement risks based on text analysis of patent documents.⁸⁹

Another stream of research is that of patent tactics. This relates to what firms should patent⁹⁰, how to build portfolios of related patents, such as patent fences⁹¹, and how to protect inventions in countries with weak IP regimes.⁹² 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.⁹³

University and academic patenting is a field that has grown since the 1980s⁹⁴, 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 publishing⁹⁵ than others, and that professors' scientific quality is correlated with the quality of their patents.⁹⁶ 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.⁹⁷

Turning to the more recent publications, the research in this category is still diverse, focusing on such topics as front-end patenting decisions⁹⁸, litigation⁹⁹, management of patent portfolios¹⁰⁰, as well as the organization of the patent function in a firm¹⁰¹.

⁸⁶ Ove Granstrand and Marcus Holgersson, "Multinational Technology and Intellectual Property Management – Is There Global Convergence and/or Specialisation?," *International Journal of Technology Management* 64, no. 2 (2014).

⁸⁷ Mary Ellen Moege and Richard G. Kolar, "International Patent Analysis as a Tool for Corporate Technology Analysis and Planning," *Technology Analysis & Strategic Management* 6, no. 4 (1994).

⁸⁸ Yujin Jeong and Byungun Yoon, "Development of Patent Roadmap Based on Technology Roadmap by Analyzing Patterns of Patent Development," *Technovation* 39-40 (2015); Changyong Lee, Bokyoung Kang, and June-seuk Shin, "Novelty-Focused Patent Mapping for Technology Opportunity Analysis," *Technological Forecasting and Social Change* 90, Part B (2015).

⁸⁹ Isumo Bergmann et al., "Evaluating the Risk of Patent Infringement by Means of Semantic Patent Analysis: The Case of DNA Chips," *R&D Management* 38, no. 5 (2008).

⁹⁰ Praveen Kumar and Stuart M. Turnbull, "Optimal Patenting and Licensing of Financial Innovations," *Management Science* 54, no. 12 (2008).

⁹¹ Christian Sternitzke, "An Exploratory Analysis of Patent Fencing in Pharmaceuticals: The Case of Pde5 Inhibitors," *Research Policy* 42, no. 2 (2013).

⁹² Marcus Matthias Keupp, Sascha Friesike, and Maximilian von Zedtwitz, "How Do Foreign Firms Patent in Emerging Economies with

Weak Appropriability Regimes? Archetypes and Motives," *Research Policy* 41, no. 8 (2012); Marcus M. Keupp, Angela Beckenbauer, and Oliver Gassmann, "Enforcing Intellectual Property Rights in Weak Appropriability Regimes," *Management International Review* 50, no. 1 (2010); Marcus Matthias Keupp, Angela Beckenbauer, and Oliver Gassmann, "How Managers Protect Intellectual Property Rights in China Using De Facto Strategies," *R&D Management* 39, no. 2 (2009).

⁹³ Robert H. Pitkethly, "Intellectual Property Strategy in Japanese and UK Companies: Patent Licensing Decisions and Learning Opportunities," *Research Policy* 30, no. 3 (2001); Henrique M. Barros, "Exploring the Use of Patents in a Weak Institutional Environment: The Effects of Innovation Partnerships, Firm Ownership, and New Management Practices," *Technovation* 45-46 (2015); Holgersson, "Patent Management in Entrepreneurial Smes: A Literature Review and an Empirical Study of Innovation Appropriation, Patent Propensity, and Motives."

⁹⁴ Bhaven N Sampat and Richard R Nelson, "The Evolution of University Patenting and Licensing Procedures: An Empirical Study of Institutional Change," *Advances in Strategic Management* 19 (2002).

⁹⁵ Stefano Breschi, Francesco Lissoni, and Fabio Montobbio, "University Patenting and Scientific Productivity: A Quantitative Study of Italian Academic Inventors," *European Management Review* 5, no. 2 (2008).

⁹⁶ Valerio Sterzi, "Patent Quality and Ownership: An Analysis of UK Faculty Patenting," *Research Policy* 42, no. 2 (2013).

⁹⁷ Markus Reitzig, Joachim Henkel, and Christopher Heath, "On Sharks, Trolls, and Their Patent Prey—Unrealistic Damage Awards and Firms' Strategies of "Being Infringed",," *Research Policy* 36, no. 1 (2007); H. Kevin Steensma, Mukund Chari, and Ralph Heidt, "A Comparative Analysis of Patent Assertion Entities in Markets for Intellectual Property Rights," *Organization Science* 27, no. 1 (2016).

⁹⁸ N. Abdelkafi et al., "To Standardise or to Patent? Development of a Decision Making Tool and Recommendations for Young Companies," *International Journal of Innovation Management* 20, no. 8 (2016).

⁹⁹ Y. M. Chen et al., "A Preemptive Power to Offensive Patent Litigation Strategy: Value Creation, Transaction Costs and Organizational Slack," *Journal of Business Research* 69, no. 5 (2016).

¹⁰⁰ M. Grimaldi, L. Cricelli, and F. Rogo, "Auditing Patent Portfolio for Strategic Exploitation: A Decision Support Framework for Intellectual Property Managers," *Journal of Intellectual Capital* 19, no. 2 (2018).

¹⁰¹ P. Choudhury and M. R. Haas, "Scope Versus Speed: Team Diversity, Leader Experience, and Patenting Outcomes for Firms," *Strategic Management Journal* 39, no. 4 (2018).

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 technology¹⁰², text matching to detect technological similarities between patents¹⁰³, machine learning to forecast developments¹⁰⁴ and patent analysis to identify lead user patents in a B2B environment.¹⁰⁵ Recent research also focuses on identifying new technological directions in the form of promising technology and technological opportunities using patent clustering¹⁰⁶ and outlier ranking.¹⁰⁷ 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 study¹⁰⁸, recent years see an increase in attention for patenting decisions as made by SMEs and startups both in a descriptive¹⁰⁹, as well as in a prescriptive sense.¹¹⁰ 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.¹¹¹ 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 propensity¹¹², by explicitly studying the organization of a firm's patenting activity in terms of team diversity and leader experience¹¹³

and by using an action research methodology to study patent application and evaluation processes.¹¹⁴

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 innovation¹¹⁵ or explicitly focus on the relationship between patenting and open innovation in firms.¹¹⁶ Others look at the use of external sources of knowledge¹¹⁷, absorptive capacity¹¹⁸, technology acquisition strategies¹¹⁹, the use of external patent attorneys¹²⁰, 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.¹²¹ Others focus on strategic portfolio management by developing portfolio typologies¹²² and strategic decision-making tools for evaluating patent portfolios.¹²³

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.

¹⁰² S. Arunagiri and M. Mathew, "Exploring Technology Evolution Using Patent Classification: A Case of Cochlear Implant Technology Patents," *International Journal of Innovation and Technology Management* 14, no. 1 (2017).

¹⁰³ S. Arts, B. Cassiman, and J. C. Gomez, "Text Matching to Measure Patent Similarity," *Strategic Management Journal* 39, no. 1 (2018).

¹⁰⁴ A. Suominen, H. Toivanen, and M. Seppanen, "Firms' Knowledge Profiles: Mapping Patent Data with Unsupervised Learning," *Technological Forecasting and Social Change* 115 (2017).

¹⁰⁵ M. G. Moehrle, I. Pfennig, and J. M. Gerken, "Identifying Lead Users in a B2B Environment Based on Patent Analysis - the Case of the Crane Industry," *International Journal of Innovation Management* 21, no. 6 (2017).

¹⁰⁶ G. Kim and J. Bae, "A Novel Approach to Forecast Promising Technology through Patent Analysis," *Technological Forecasting and Social Change* 117 (2017).

¹⁰⁷ A. Rodriguez et al., "Patent Clustering and Outlier Ranking Methodologies for Attributed

Patent Citation Networks for Technology Opportunity Discovery," *IEEE Transactions on Engineering Management* 63, no. 4 (2016).

¹⁰⁸ M. Holgersson and O. Granstrand, "Patenting Motives, Technology Strategies, and Open Innovation," *Management Decision* 55, no. 6 (2017).

¹⁰⁹ L. Agostini and A. Nosella, "A Dual Knowledge Perspective on the Determinants of Sme Patenting Results of an Empirical Investigation," *Management Decision* 55, no. 6 (2017); G. De Vries et al., "Trademark or Patent? The Effects of Market Concentration, Customer Type and Venture Capital Financing on Start-Ups' Initial Ip Applications," *Industry and Innovation* 24, no. 4 (2017).

¹¹⁰ Abdelkafi et al., "To Standardise or to Patent? Development of a Decision Making Tool and Recommendations for Young Companies."

¹¹¹ Holgersson, "Patent Management in Entrepreneurial Smes: A Literature Review and an Empirical Study of Innovation Appropriation, Patent Propensity, and Motives."

¹¹² Agostini and Nosella, "A Dual Knowledge

Perspective on the Determinants of Sme Patenting Results of an Empirical Investigation."

¹¹³ Choudhury and Haas, "Scope Versus Speed: Team Diversity, Leader Experience, and Patenting Outcomes for Firms."

¹¹⁴ Soranzo, Nosella, and Filippini, "Redesigning Patent Management Process: An Action Research Study."

¹¹⁵ Holgersson and Granstrand, "Patenting Motives, Technology Strategies, and Open Innovation."

¹¹⁶ A. Brem, P. A. Nylund, and E. L. Hitchen, "Open Innovation and Intellectual Property Rights How Do Smes Benefit from Patents, Industrial Designs, Trademarks and Copyrights?," *Management Decision* 55, no. 6 (2017).

¹¹⁷ A. Cammarano et al., "Accumulated Stock of Knowledge and Current Search Practices: The Impact on Patent Quality," *Technological Forecasting and Social Change* 120 (2017).

¹¹⁸ F. E. Garcia-Muina and R. Gonzalez-Sanchez, "Absorptive Routines and International Patent Performance," *Brq-Business Research Quarterly* 20, no. 2 (2017).

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



¹¹⁹ F. Caviggioli et al., "Corporate Strategies for Technology Acquisition: Evidence from Patent Transactions," *Management Decision* 55, no. 6 (2017).

¹²⁰ S. Suzeroglu-Melchioris, O. Gassmann, and M. Palmie, "Friend or Foe? The Effects of Patent Attorney Use on Filing Strategy Vis-a-Vis the Effects of Firm Experience," *Management Decision* 55, no. 6 (2017).

¹²¹ J. E. Azzam, C. Ayerbe, and R. Dang, "Using Patents to Orchestrate Ecosystem Stability: The Case of a French Aerospace Company," *International Journal of Technology Management* 75, no. 1-4 (2017).

¹²² Q. Yang and M. C. Minutolo, "The Strategic Approaches for a New Typology of Firm Patent Portfolios," *International Journal of Innovation and Technology Management* 13, no. 2 (2016).

¹²³ Grimaldi, Cricelli, and Rogo, "Auditing Patent Portfolio for Strategic Exploitation: A Decision Support Framework for Intellectual Property Managers."

¹²⁴ Kevin Rivette and D. Klein, "Discovering New Value in Intellectual Property," *Harvard Business Review* 78, no. 1 (2000); Deepak Somaya, David J. Teece, and Simon Wakeman, "Innovation in Multi-Invention Contexts: Mapping Solutions to Technological and Intellectual Property Complexity," *California Management Review* 53, no. 4 (2011).

¹²⁵ E.g., Gary P. Pisano and David J. Teece, "How to Capture Value from Innovation: Shaping Intellectual Property and Industry Architecture," *California Management Review* 50, no. 1 (2007).

¹²⁶ Markus Reitzig, "Strategic Management of Intellectual Property," *MIT Sloan Management Review* 45, no. 3 (2004).

¹²⁷ Rivette and Klein, "Discovering New Value in Intellectual Property."

¹²⁸ Ove Granstrand, "Corporate Management of Intellectual Property in Japan," *International Journal of Technology Management* 19, no. 1-2 (2000).

¹²⁹ Granstrand and Holgersson, "Managing the Intellectual Property Disassembly Problem.," Carliss Y. Baldwin and Joachim Henkel, "Modularity and Intellectual Property Protection,"

Strategic Management Journal 36, no. 11 (2015).

¹³⁰ Henry W. Chesbrough, *Open Innovation: The New Imperative for Creating and Profiting from Technology* (Boston, MA: Harvard Business School Press).

¹³¹ Granstrand and Holgersson, "The Challenge of Closing Open Innovation: The Intellectual Property Disassembly Problem.," John Hagedoorn and Ann-Kristin Zobel, "The Role of Contracts and Intellectual Property Rights in Open Innovation," *Technology Analysis & Strategic Management* 27, no. 9 (2015).

¹³² Martin A. Bader, "Managing Intellectual Property in Inter-Firm R&D Collaborations in Knowledge-Intensive Industries," *International Journal of Technology Management* 41, no. 3-4 (2008).

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 practices¹³³, by studying online communities¹³⁴, crowdsourcing¹³⁵, outsourcing¹³⁶, research alliances¹³⁷, and innovation ecosystems.¹³⁸ 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 spill-over 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 innovation¹³⁹, as well as differential use of IP rights in different phases of open innovation efforts.¹⁴⁰

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 culture¹⁴¹ and that firms with a higher degree of internationalization have more use for IP protection with regard to technological innovation.¹⁴² On the other hand, IP protection was noted to be an insufficient condition for attracting foreign direct investment.¹⁴³

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.¹⁴⁴

License Management

Licensing plays an important role in IP management¹⁴⁵ and in corporate strategy¹⁴⁶, 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.¹⁴⁷

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 structure¹⁴⁸, and by previous licensing experience, cost and value benefits of licensing, awareness of licensing opportunities, and the licensees' R&D capabilities.¹⁴⁹ The latter is related to absorptive capacity¹⁵⁰, 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.¹⁵¹ These different determinants may not only impact the decision of whether or not to license, but also what type of license to use.¹⁵²

¹³³ P. M. Bican, C. C. Guderian, and A. Ringbeck, "Managing Knowledge in Open Innovation Processes: An Intellectual Property Perspective," *Journal of Knowledge Management* 21, no. 6 (2017); Brem, Nylund, and Hitchen, "Open Innovation and Intellectual Property Rights How Do Smes Benefit from Patents, Industrial Designs, Trademarks and Copyrights?"; A. Cammarano et al., "Open Innovation and Intellectual Property: A Knowledge-Based Approach," *Management Decision* 55, no. 6 (2017); A. Toma, G. Secundo, and G. Passiante, "Open Innovation and Intellectual Property Strategies: Empirical Evidence from a Bio-Pharmaceutical Case Study," *Business Process Management Journal* 24, no. 2 (2018).

¹³⁴ J. Bauer, N. Franke, and P. Tuertscher, "Intellectual Property Norms in Online Communities: How User-Organized Intellectual Property Regulation Supports Innovation," *Information Systems Research* 27, no. 4 (2016).

¹³⁵ J. de Beer et al., "Click Here to Agree: Managing Intellectual Property When Crowdsourcing Solutions," *Business Horizons* 60, no. 2 (2017).

¹³⁶ R. Sen Gupta, "Risk Management and Intellectual Property Protection in Outsourcing," *Global Business Review* 19, no. 2 (2018).

¹³⁷ L. Staphorst et al., "Impact of Intellectual Property Rights on the Governance Mode

Decisions of Engineering Managers During the Establishment of Research Alliances with Publicly Funded Entities," *Engineering Management Journal* 29, no. 1 (2017).

¹³⁸ Marcus Holgersson, Ove Granstrand, and Marcel Bogers, "The Evolution of Intellectual Property Strategy in Innovation Ecosystems: Uncovering Complementary and Substitute Appropriability Regimes," *Long Range Planning* 51, no. 2 (2018).

¹³⁹ Brem, Nylund, and Hitchen, "Open Innovation and Intellectual Property Rights How Do Smes Benefit from Patents, Industrial Designs, Trademarks and Copyrights?."

¹⁴⁰ Bican, Guderian, and Ringbeck, "Managing Knowledge in Open Innovation Processes: An Intellectual Property Perspective."

¹⁴¹ S. Hussain and M. Terziovski, "Intellectual Property Appropriation Strategy and Its Impact on Innovation Performance," *International Journal of Innovation Management* 20, no. 2 (2016).

¹⁴² S. H. Cho and H. G. Kim, "Intellectual Property Rights Protection and Technological Innovation the Moderating Effect of Internationalization," *Multinational Business Review* 25, no. 4 (2017).

¹⁴³ P. Saiz and R. Castro, "Foreign Direct Investment and Intellectual Property Rights: International Intangible Assets in Spain over the Long Term," *Enterprise & Society* 18, no. 4

(2017).

¹⁴⁴ M. Henao-Calad, P. R. Montoya, and B. U. Ochoa, "Knowledge Management Processes and Intellectual Property Management Processes: An Integrated Conceptual Framework," *Ad-Minister*, no. 31 (2017); G. Maldonado-Guzman et al., "Knowledge Management as Intellectual Property Evidence from Mexican Manufacturing Smes," *Management Research Review* 39, no. 7 (2016).

¹⁴⁵ Peter C. Grindley and David J. Teece, "Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics," *California Management Review* 39, no. 2 (1997).

¹⁴⁶ Ove Granstrand, "The Economics and Management of Technology Trade: Towards a Pro-Licensing Era?," *International Journal of Technology Management* 27, no. 2,3 (2004).

¹⁴⁷ E.g., Kumar and Turnbull, "Optimal Patenting and Licensing of Financial Innovations."; Ashish Arora, Andrea Fosfuri, and Thomas Rønde, "Managing Licensing in a Market for Technology," *Management Science* 59, no. 5 (2013); Stefano Comino and Fabio M. Manenti, "Dual Licensing in Open Source Software Markets," *Information Economics and Policy* 23, no. 3-4 (2011); Jisun Kim and Tugrul U. Daim, "A New Approach to Measuring Time-Lags in Technology Licensing: Study of U.S. Academic

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 model¹⁵³. This also includes different license clauses¹⁵⁴ and different payment schemes¹⁵⁵, 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.¹⁵⁶ 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 contracts¹⁵⁷, and how to calculate innovator revenues in university licensing contracts.¹⁵⁸ Meanwhile the management of licensing activities has inspired research around the use of in-licensing by startups¹⁵⁹, the role of human capital in licensing outcomes¹⁶⁰, and the importance of attention both by R&D as well as top management in using licensed knowledge for the creation of product innovation.¹⁶¹ 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.¹⁶² An analysis of the small research stream on management of secrecy shows that the studies are often conceptual and/or based on modelling, rather than on empirical data.¹⁶³ 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.¹⁶⁴ In the university setting, this becomes especially complex as researchers need to balance publishing for academic reasons with secrecy for commercial reasons.¹⁶⁵

Research Institutions," *The Journal of Technology Transfer* 39, no. 5 (2014).

¹⁴⁸ Arora, Fosfuri, and Rønde, "Managing Licensing in a Market for Technology."

¹⁴⁹ Kwaku Atuahene-Gima, "Determinants of Inward Technology Licensing Intentions: An Empirical Analysis of Australian Engineering Firms," *Journal of Product Innovation Management* 10, no. 3 (1993). Nobuya Fukugawa, "Determinants of Licensing Activities of Local Public Technology Centers in Japan," *Technology* 29, no. 12 (2009).

¹⁵⁰ Wesley M. Cohen and Daniel A. Levinthal, "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly* 35, no. 1 (1990).

¹⁵¹ Kwaku Atuahene-Gima and Paul Patterson, "Managerial Perceptions of Technology Licensing as an Alternative to Internal R&D in New Product Development: An Empirical Investigation," *R&D Management* 23, no. 4 (1993).

¹⁵² Ravi Sen, Chandrasekar Subramaniam, and Matthew L. Nelson, "Determinants of the Choice of Open Source Software License," *Journal of Management Information Systems* 25, no. 3 (2008).

¹⁵³ Marius F. Niculescu and D. J. Wu, "Economics of Free under Perpetual Licensing: Implications for the Software Industry," *Information Systems Research* 25, no. 1 (2014).

¹⁵⁴ Zhang and Seidmann (2010)

¹⁵⁵ Pascale Crama, Bert De Reyck, and Zeger Degraeve, "Milestone Payments or Royalties? Contract Design for R&D Licensing," *Operations Research* 56, no. 6 (2008).

¹⁵⁶ See, e.g., Francis Bidault, "Global Licensing Strategies and Technology Pricing," *International Journal of Technology Management* 27, no. 2-3 (2004).

¹⁵⁷ J. Lynch and R. Shockley, "Valuation of a Pharmaceutical Licensing Contract," *Journal of Applied Corporate Finance* 29, no. 3 (2017).

¹⁵⁸ B. J. Rickard, T. J. Richards, and J. B. Yan, "University Licensing of Patents for Varietal Innovations in Agriculture," *Agricultural Economics* 47, no. 1 (2016).

¹⁵⁹ P. Belingeri and M. I. Leone, "Walking into the Room with Ip: Exploring Start-Ups' Ip Licensing Strategy," *Management Decision* 55, no. 6 (2017).

¹⁶⁰ M. Bianchi and J. Lejarraga, "Learning to License Technology: The Role of Experience and Workforce's Skills in Spanish Manufacturing Firms," *R & D Management* 46 (2016).

¹⁶¹ T. Klueter, L. F. Monteiro, and D. R. Dunlap, "Standard Vs. Partnership-Embedded Licensing: Attention and the Relationship between Licensing and Product Innovations," *Research Policy* 46, no. 9 (2017).

¹⁶² Thomas Hemphill, "The Strategic Management

of Trade Secrets in Technology-Based Firms," *Technology Analysis & Strategic Management* 16, no. 4 (2004); Brenda Bos, Thijs L. J. Broekhuizen, and Pedro de Faria, "A Dynamic View on Secrecy Management," *Journal of Business Research* 68, no. 12 (2015).

¹⁶³ James J. Anton and Dennis A. Yao, "Little Patents and Big Secrets: Managing Intellectual Property," *The RAND Journal of Economics* 35, no. 1 (2004); Ján Zábajník, "A Theory of Trade Secrets in Firms*," *International Economic Review* 43, no. 3 (2002); Ronald L. Dufresne and Evan H. Offstein, "On the Virtues of Secrecy in Organizations," *Journal of Management Inquiry* (2008); Hemphill, "The Strategic Management of Trade Secrets in Technology-Based Firms."

¹⁶⁴ David R. Hannah, "Should I Keep a Secret? The Effects of Trade Secret Protection Procedures on Employees' Obligations to Protect Trade Secrets," *Organization Science* 16, no. 1 (2005); "Keeping Trade Secrets Secret," *MIT Sloan Management Review* 47, no. 3 (2006).

¹⁶⁵ Andrew J. Nelson, "How to Share "a Really Good Secret": Managing Sharing/Secrecy Tensions around Scientific Knowledge Disclosure," *Organization Science* 27, no. 2 (2016).

Turning to the more recent literature on secrecy, two topics are in focus. Firstly, the strategic decision to keep trade secrets versus patenting or publishing¹⁶⁶ and what conditions affect the importance of secrecy as a way of protecting IP¹⁶⁷, 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 acquisitions¹⁶⁸, venture capital investment¹⁶⁹, and level of disclosure.¹⁷⁰ 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 EU¹⁷¹ and in the propensity to register trademarks¹⁷². 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.¹⁷³

The copyright literature identifies digitalization as a source of both challenges and opportunities.¹⁷⁴ 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.¹⁷⁵ Some of this is related to the management of open and closed innovation models in software.¹⁷⁶

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.¹⁷⁷ 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.¹⁷⁸

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 deci-

sion between trademarks and patents under a number of conditions, respectively.¹⁷⁹ The last paper in this category used experimental methods to study trademark dilution through third party use of the trademark.¹⁸⁰

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 (2003, 2013, 2014, 2014, 2014, 2016, and 2017, respectively) and a growing number of publications more generally, as illustrated in Figure 2.

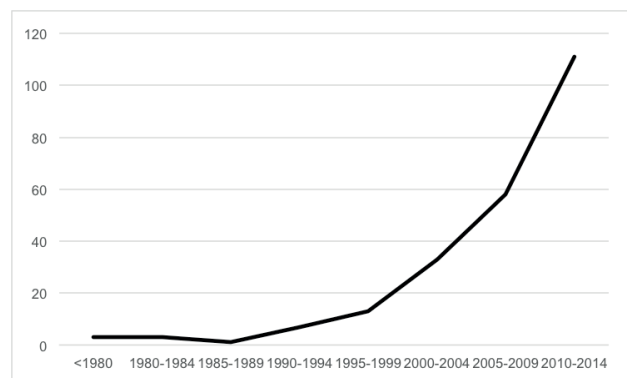


FIGURE 2 NUMBER OF PUBLICATIONS PER TIME PERIOD, AS IDENTIFIED IN THE SYSTEMATIC SEARCH

A second conclusion is that the literature mainly focuses on single types of IPRs, typically patents. This limitation is identified in previous reviews¹⁸¹, in special issues¹⁸², 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.¹⁸³ 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.¹⁸⁴ 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 cooperation 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).¹⁸⁵ 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.

¹⁶⁶ M. Holgersson and M. W. Wallin, "The Patent Management Trichotomy: Patenting, Publishing, and Secrecy," *Management Decision* 55, no. 6 (2017).

¹⁶⁷ W. Sofka, P. de Faria, and E. Shehu, "Protecting Knowledge: How Legal Requirements to Reveal Information Affect the Importance of Secrecy," *Research Policy* 47, no. 3 (2018).

¹⁶⁸ F. Castellaneta, R. Conti, and A. Kacperczyk, "Money Secrets: How Does Trade Secret Legal Protection Affect Firm Market Value? Evidence from the Uniform Trade Secret Act," *Strategic Management Journal* 38, no. 4 (2017).

¹⁶⁹ F. Castellaneta et al., "The Effect of Trade Secret Legal Protection on Venture Capital Investments: Evidence from the Inevitable Disclosure Doctrine," *Journal of Business Venturing* 31, no. 5 (2016).

¹⁷⁰ Y. H. Li, Y. P. Lin, and L. D. Zhang, "Trade Secrets Law and Corporate Disclosure: Causal Evidence on the Proprietary Cost Hypothesis," *Journal of Accounting Research* 56, no. 1 (2018).

¹⁷¹ Rainer Filitz, Joachim Henkel, and Bruce S. Tether, "Protecting Aesthetic Innovations? An Exploration of the Use of Registered Community Designs," *Research Policy* 44, no. 6 (2015).

¹⁷² Meindert Flikkema, Ard-Pieter De Man, and Carolina Castaldi, "Are Trademark Counts a Valid Indicator of Innovation? Results of an in-Depth Study of New Benelux Trademarks Filed by Smes," *Industry and Innovation* 21, no. 4 (2014); Jörn H. Block et al., "Why Do Smes File Trademarks? Insights from Firms in Innovative Industries," *Research Policy* 44, no. 10 (2015).

¹⁷³ Tung-Jung Sung and Peter Gilmour, "An Empirical Examination of the Relationship between Design, the Npi Process and Strategy Implementation," *International Journal of*

Technology Management 24, no. 5-6 (2002).

¹⁷⁴ Keith Dickson and Anne-Marie Coles, "Textile Design Protection: Copyright, Cad and Competition," *Technovation* 20, no. 1 (2000); Roberto García and Rosa Gil, "A Web Ontology for Copyright Contract Management," *International Journal of Electronic Commerce* 12, no. 4 (2008). Reto Hilty and Sylvie Nérisson, "Collective Copyright Management and Digitization: The European Experience," *Handbook on the Digital Creative Economy/Ruth Towse and Christian Handke (eds.)*, Cheltenham: Edward Elgar (2013).

¹⁷⁵ E.g., Georg von Krogh et al., "Carrots and Rainbows: Motivation and Social Practice in Open Source Software Development," *MIS Quarterly* 36, no. 2 (2012); Wen Wen, Marco Ceccagnoli, and Chris Forman, "Opening up Intellectual Property Strategy: Implications for Open Source Software Entry by Start-up Firms," *Management Science* 62, no. 9 (2016).

¹⁷⁶ E.g., Henkel, Baldwin, and Shih, "Ip Modularity: Profiting from Innovation by Aligning Product Architecture with Intellectual Property."; Joachim Henkel, "Selective Revealing in Open Innovation Processes: The Case of Embedded Linux," *Research Policy* 35, no. 7 (2006).

¹⁷⁷ Brem, Nylund, and Hitchen, "Open Innovation and Intellectual Property Rights How Do Smes Benefit from Patents, Industrial Designs, Trademarks and Copyrights?."

¹⁷⁸ R. Towse, "Economics of Music Publishing: Copyright and the Market," *Journal of Cultural Economics* 41, no. 4 (2017).

¹⁷⁹ Brem, Nylund, and Hitchen, "Open Innovation and Intellectual Property Rights How Do Smes Benefit from Patents, Industrial Designs, Trademarks and Copyrights?."; De Vries et al., "Trademark or Patent? The Effects of Market

Concentration, Customer Type and Venture Capital Financing on Start-Ups' Initial Ip Applications."

¹⁸⁰ W. Macias and J. Cervino, "Trademark Dilution: Comparing the Effects of Blurring and Tarnishment Cases over Brand Equity," *Management & Marketing-Challenges for the Knowledge Society* 12, no. 3 (2017).

¹⁸¹ Candelin-Palmqvist, Sandberg, and Mylly, "Intellectual Property Rights in Innovation Management Research: A Review."

¹⁸² Al-Aali and Teece, "Towards the (Strategic) Management of Intellectual Property: Retrospective and Prospective."

¹⁸³ Somaya, "Patent Strategy and Management."; Al-Aali and Teece, "Towards the (Strategic) Management of Intellectual Property: Retrospective and Prospective."; Conley, Bican, and Ernst, "Value Articulation."; Cesaroni and Piccaluga, "Operational Challenges and St's Proposed Solutions to Improve Collaboration between Ip and R&D in Innovation Processes."; Granstrand and Holgersson, "Managing the Intellectual Property Disassembly Problem."; David J. Teece, "Business Models, Business Strategy and Innovation," *Long Range Planning* 43, no. 2-3 (2010).

¹⁸⁴ IP intelligence can provide a basis for many types of decisions, including for sourcing, R&D collaborations, competition analysis, market entries, M&As, etc., and business managers are typically interested in the information that IP intelligence can provide.

¹⁸⁵ Holgersson, Granstrand, and Bogers, "The Evolution of Intellectual Property Strategy in Innovation Ecosystems: Uncovering Complementary and Substitute Appropriability Regimes."

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,¹⁸⁶ 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.¹⁸⁷

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 here¹⁸⁸ 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.¹⁸⁹ 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.

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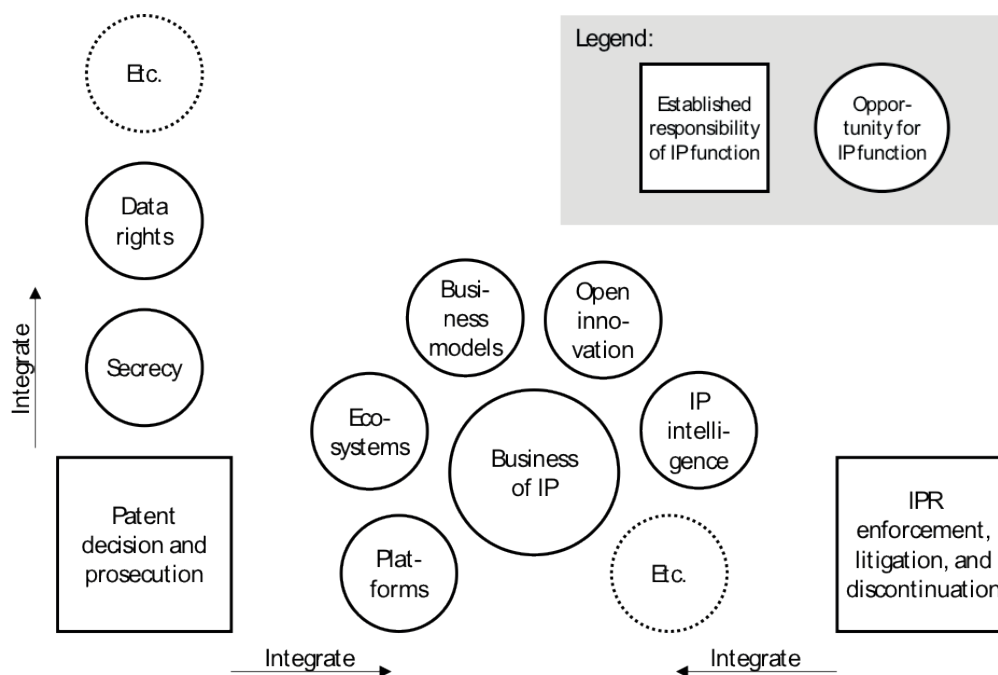


FIGURE 3 OPPORTUNITIES FOR BETTER INTEGRATION OF IP FUNCTION



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¹⁸⁷ Holgersson, Granstrand, and Bogers, "The Evolution of Intellectual Property Strategy

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¹⁸⁸ Pitkethly, "Intellectual Property Strategy in Japanese and UK Companies: Patent Licensing Decisions and Learning Opportunities."; Barros, "Exploring the Use of Patents in a Weak Institutional Environment: The Effects of Innovation Partnerships, Firm Ownership, and New Management Practices."; Holgersson, "Patent Management in Entrepreneurial Smes: A Literature Review and an Empirical Study of Innovation Appropriation, Patent Propensity, and Motives." Filitz, Henkel, and

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