

Patent Strategy and Management: An Integrative Review and Research Agenda

Deepak Somaya

University of Illinois at Urbana-Champaign

This review reorganizes and reconceptualizes extant research on patent strategy, which has emerged from diverse roots in economics, law, and management. Accordingly, it is anticipated that this review will help provide structure and direction to what is currently a somewhat disparate and fractured field of study within management. The main proposed framework highlights two important themes within patent strategy research—generic patent strategies and the strategic management of patents. In addition, it is noted that research in each of these themes generally maps onto one or more of three key domains—rights, licensing, or enforcement—within which patent-related strategic actions are typically undertaken. Two summary tables of prior research are provided that juxtapose the three patent strategy domains with different theory lenses adopted in patent strategy research. Finally, the article highlights two promising areas whose connections with patent strategy are beginning to be addressed by research—firms' overall appropriability strategies and value creation strategies. An overarching conceptual figure maps the different research areas reviewed in the article and highlights the relationships between these research literatures. The reconceptualization and reframing of prior research advanced in this review promises to advance scholarship on patent strategy by illuminating its many links with the broader management field and by identifying opportunities to address important unanswered research questions. It thus provides a useful roadmap to help stimulate and guide future management research in this vital area.

Keywords: *patent strategy; appropriability; isolating mechanisms; value creation; value capture*

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Corresponding author: Deepak Somaya, College of Business, University of Illinois at Urbana-Champaign, 185 Wohlers Hall, 1206 South Sixth Street, Champaign, IL 61820, USA

E-mail: dsomaya@illinois.edu

Introduction

As the global economy becomes increasingly knowledge based, companies are fundamentally challenged to hold on to their competitive advantages because knowledge itself is ultimately prone to leakage, spillover, imitation, and mobility. In this emerging business environment, the ownership of critical pieces of intellectual property (IP) is an important strategic battleground (Granstrand, 2000), and making sense of patent strategies is a pressing and exciting challenge for management research (Rivette & Kline, 2000). While early research on patents and patent strategies emerged within the legal and economics literatures, management research has now become fully engaged in this endeavor. This article reviews the state of research on the strategic use and management of patents from the perspective of management scholarship. While the review incorporates some relevant research from economics and law, the coverage of these literatures is intentionally selective.¹ In particular, research that has a primarily economic, legal, or public policy focus is excluded unless it has a bearing on firm strategies relating to patents.

Governments confer patent rights to protect the creative efforts of inventors and thereby preserve incentives to make and commercialize inventions (Mazzoleni & Nelson, 1998). Patent rights are primarily protected by national laws and institutions, and in many Western democracies these property rights have had a long history and are deeply embedded within the legal system. In the United States, for example, patent rights are enabled by powers granted to Congress through Article 1, Section 8 of the Constitution. National patent systems operate largely independently and exhibit significant differences (see, e.g., Somaya, 2000; Westlaw, 2006); however, international treaties and institutions have resulted in greater integration and harmonization of national patent systems over time. In general, these changes reflect an increase in the scope and strength of patent rights globally toward developed country standards, which have themselves been strengthened and expanded over time (Park, 2008).

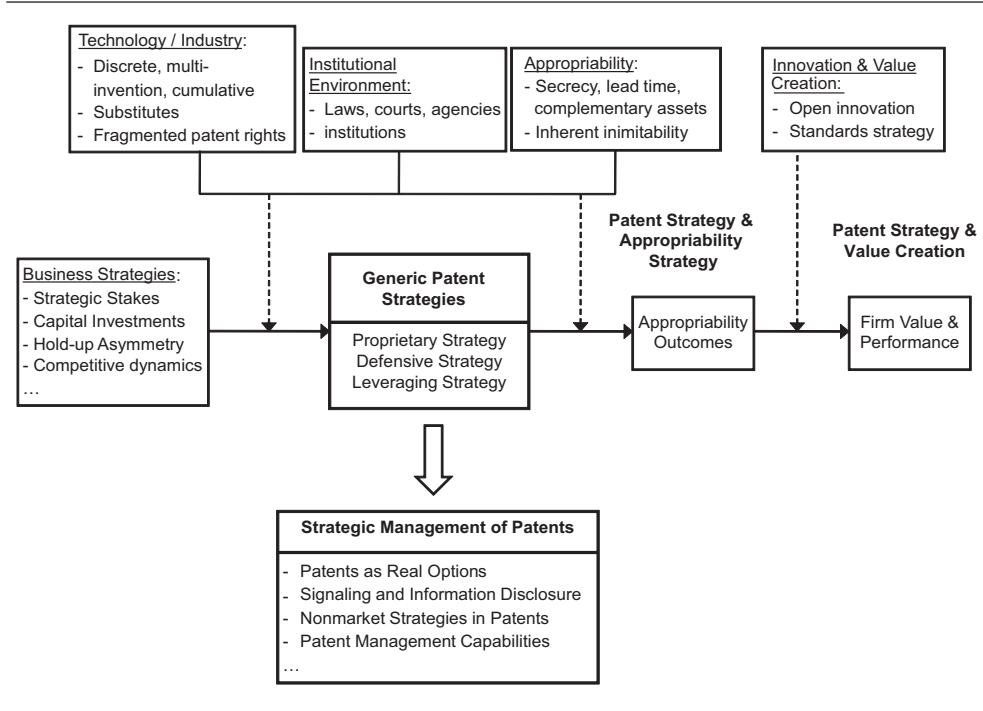
In management research, IP rights and patents in particular have long been acknowledged as a significant type of imitation barrier (Mahoney & Pandian, 1992; Rumelt, 1984). However, it is important to recognize that a patent does not confer an automatic market monopoly; rather, it provides patent owners (inventors or their “assignees”) the right—for a limited period—to exclude others from using an invention whose boundaries are delineated by the verbal “claims” in the patent.² In turn, to be awarded a patent, the invention must make a novel, significant (“nonobvious”), and useful advance over existing knowledge (the “prior art”), and it is only these novel features that are patentable. In addition, the social bargain made for awarding a patent is that it should adequately describe the novel invention being claimed. Patent examiners apply these criteria before awarding a patent, and they seek to ensure that the scope of the patent’s claims accurately reflects the technological advance described in it. However, examiners often do not have the time to consider each patent application in great detail and may not have access to all prior art when they examine the patent, so patents are inherently imperfect and uncertain property rights. These uncertainties may be resolved only years after the patent is granted, typically in the context of patent litigation. Thus, it would be reasonable to say that the typical patent right—absent litigation—is quite “fuzzy” in its validity and scope (Linden & Somaya, 2003; Teece, 2000).

In addition, a patent does not give the patentee an affirmative right to use the technology (e.g., using the technology may infringe other patents), and rivals are often able to invent around important patents (Mansfield, Schwartz, & Wagner, 1981). Patent infringement itself is also often difficult to detect, and even if detected, enforcing a patent through litigation can be extremely costly, disruptive, time-consuming, and unpredictable (Encaoua & Lefouili, 2005; Shane & Somaya, 2007). In sum, while patents may be quite effective for certain technologies such as chemical or pharmaceutical formulas (Grabowski & Vernon, 1983; Mansfield et al., 1981), patent protection generally is quite porous, imperfect, and unclear (Cohen, Nelson, & Walsh, 2000; Lemley & Shapiro, 2005). Despite these challenges, firms can skillfully enhance the impact of patent rights through coordinated (and typically resource intensive) actions related to obtaining or enforcing patents—for example, by building “patent fences” consisting of large numbers of patents, or actively investigating potential cases of infringement. Therefore, appropriability from patents is not automatic or exogenous; rather, it is endogenously determined by firm strategies and actions (Pisano, 2006).

This review not only takes stock of the patent strategy research to date but also organizes and maps it in ways that highlight its connections with important research streams in strategy and management. From a careful reading of the literature on patent strategy, two broad research themes were identified. The first theme explores the connections between patent strategic actions and firms’ efforts to develop and sustain competitive advantage. In this area, three broad strategic approaches are conceptualized and labeled as “generic patent strategies”—namely, proprietary, defensive, and leveraging strategies. The second theme relates to the strategic management of patents, broadly encompassing issues relevant to implementation that follow from the generic strategies. In particular, this review includes the following issues relating to the strategic management of patents—signaling and information disclosure strategies, managing patents as real options, nonmarket strategies, and patent-related managerial capabilities. The theoretical considerations and concerns within the two themes are different. The first theme develops the most immediate connections between patent-related actions and firm competitive advantage using the theoretical lens of the resource-based (or dynamic capabilities) view. By contrast, the second theme analyzes patent-related actions and strategies that are arguably more tactical, and in turn applies insights from and contributes toward literatures (e.g., signaling, or real options) that are further afield from the strategic role of patents in competitive advantage.

In addition to the two research themes highlighted above, this review maps the patent strategy literature along a second dimension, namely, the activity domains in which patent strategic actions are undertaken. Broadly, there are three patent strategy domains: acquiring and maintaining patent rights, licensing (or sharing) of patents, and patent enforcement and litigation. For brevity, they are labeled as the *rights*, *licensing*, and *enforcement* domains. By juxtaposing the three patent domains with the theoretical lenses employed in each research theme described above, two “matrixed” tables of patent strategy research (one for each broad theme) are presented, which together provide a bird’s-eye view of the field. In turn, this mapping focuses attention on important tensions and opportunities for further research in each of the thematic areas. The following sections begin by explaining the three patent strategy domains and then review the two main research themes—generic patent strategies and the strategic management of patents.

Figure 1
Integrative Overview of Patent Strategy Research



Having reviewed this core set of ideas about patent strategy, the review turns to two broader areas of research that patent strategy is related to—namely, “patent strategy and appropriability strategy” and “patent strategy and value creation.” Patent strategies ultimately affect firm value and performance through the appropriability outcomes they generate. However, patent strategy is not the only appropriability mechanism available to firms, which suggests that firms (and researchers) should consider how patent strategy and other appropriability strategies interact, and how they need to be coordinated. In addition, innovation and value creation around a firm’s technology are not independent of the patent (or appropriability) strategies being pursued by the firm. For example, to benefit from having its patent included in a technology standard, a firm may need to license the patent on reasonable terms to other firms and thus be willing to make adjustments in its patent strategy. Therefore, in addition to capturing value from innovation, firms may also need to make trade-offs in their patent strategies to allow their technologies to create greater value in the marketplace and outcompete other innovative solutions. Because the scope of appropriability strategy and firm value creation extends considerably beyond patents, it makes less sense to map them onto the three patent strategy domains. Instead, the review describes the state of our understanding in each of these areas and identifies important unanswered questions to help guide future research.

Figure 1 provides a graphical overview of patent strategy research and an illustrative guide to this review. The two core themes of generic patent strategies and strategic management of patents are in the center of Figure 1. Strategic management of patents is depicted as being influenced by the firm's generic patent strategies; however, as noted above, the issues entailed in this theme are motivated by multiple theoretical literatures, and the most prominent of these are reviewed and included in the figure. Figure 1 also illustrates several theoretical drivers of patent strategy and appropriability outcomes, which are reviewed in subsequent sections. Finally, the relationships among patent strategies, appropriability, and firm performance are shown to the right of Figure 1.

This review seeks to make a number of contributions to the research literature on patent strategies, which has emerged in a somewhat fragmented and uncoordinated fashion from disparate research traditions. First, it provides a conceptual and theoretical overview of the field that builds a foundation for a broader conversation about patent strategy within strategic management research. Second, by placing the institutional detail of different patent empirical domains within their proper context and juxtaposing them against important theoretical logics, it develops an accessible entry point into the patent strategy literature for management scholars interested in this emerging and exciting field of research. Last but not least, the review helps to identify understudied and important areas for future research, in both theoretical questions that we know relatively little about as well as empirical domains in which prior research has been lacking. These opportunities are noted within each of the main sections of the article, where they fit more naturally, rather than a separate self-contained agenda for research.

Before proceeding further, it is important to recognize that many research streams related to patents are excluded from this review. For example, the review omits much of the economic and legal research relating to public policy or economic outcomes (such as innovation, trade, or growth). Because patents are informative indicators of the underlying inventions, patent *data* have also been widely used to study firm knowledge, technological search, knowledge spillovers, and innovation. Moreover, the impacts of various patent attributes on firm performance and valuation have also been investigated in several research articles. The current review excludes these streams of "patent research" that merely leverage patent data to study attributes of firms' innovation, knowledge, or technologies. Instead, the focus is on firms' strategic actions relating to the patents themselves, whereby they seek to derive (or neutralize) competitive advantages or economic rents from the associated property rights. Such prioritization is essential for providing a meaningful review of the patent strategy literature within a single article.

Patent Strategy Domains

Patent strategies encompass a set of resource allocation decisions and underlying "logics" of decision making about patents that primarily occur in three broad (and interdependent) domains of activity: rights, licensing, and enforcement. *Rights* refer to the gamut of actions whereby patent rights are acquired, renewed, reissued, and maintained, including the purchase of others' patents in the secondary market. It is important to note that not all inventions are patented and that the propensity to patent varies with such factors as firm size, industry

sector, and invention type (product or process) (Arundel & Kabla, 1998; Brouwer & Kleinknecht, 1999). When patents are applied for, they can be abandoned (Henkel & Jell, 2009) or continued into new applications (Graham, 2006; Graham & Mowery, 2004; Hegde, Mowery, & Graham, 2009), and firms also generally have a choice in how much expense, care, and expertise they employ in crafting any single patent. In addition, firms can acquire patents from third parties to add to their own portfolios. Even after obtaining a patent, firms can have it reexamined and reissued (Clarkson & Toh, 2010) and elect to have it renewed or lapse at periodic intervals (Lanjouw, Pakes, & Putnam, 1998). Furthermore, firms can also attempt to affect their competitors' patent holdings by using opposition and reexamination proceedings (Blind, Cremers, & Mueller, 2009; Graham, Hall, Harhoff, & Mowery, 2003). Going beyond the scope of a single patent, firms can also coordinate the acquisition of multiple related patents to create patent fences or thickets, where the former is intended to impede imitation and the latter is meant to be used as a bargaining chip in cross-licensing negotiations (Reitzig, 2004).

Licensing involves activities relating to the sharing of rights to use the patented technology, including in such contexts as standards setting, alliances, open innovation (including open source and user innovation), patent pooling, and cross-licensing. Similar to patenting, the propensity of firms to license (or share) technologies varies (Arora & Ceccagnoli, 2006), and even when firms license, it is under varying terms regarding the exclusivity and scope of the licensed rights (Anand & Khanna, 2000; Somaya, Kim, & Vonortas, 2011).

Enforcement entails the use or threatened use of litigation to encourage infringers to stop using patented inventions or to pay royalties. Actual patent litigation is a rare event, with only around 1.5 lawsuits being filed per 100 patents issued in the United States (Lanjouw & Schankerman, 2001; Somaya, 2003), although the incidence of implied or overt threats of enforcement is likely to be much higher. Prior research has highlighted several measures of patent value that are associated with the probability of litigation (Allison, Lemley, Moore, & Trunkey, 2004; Lanjouw & Schankerman, 2001), and with frequent litigation (Allison, Lemley, & Walker, 2009). Even after filing a suit, firms have the choice of settling with the other side or proceeding to trial—or subsequent appeals—at considerable additional expense (Lanjouw & Lerner, 1998; Somaya, 2003). Thus, patent enforcement (and litigation) is potentially an expensive multistage game.

Two important points must be noted about firms' patent-related actions in the three domains discussed above. First, by undertaking these activities in a concerted and coordinated manner, firms can effectively increase the appropriability afforded by their patents. While the average patent may be a weak and porous instrument, carefully crafted patents and combinations of patents may become more effective tools for firm strategy. Similarly, aggressive enforcement or carefully calibrated licensing can enhance the strategic advantages conferred by patents. Second, the patent-related actions and decisions entailed in each domain are generally expensive and resource intensive. The typical globally prosecuted and maintained patent costs around \$100,000, and patent litigation expenses run in the millions of dollars through trial. Licensing markets also entail significant transaction costs, and detecting patent infringement to either license or stop unauthorized use can be expensive. In addition, patent strategies incur organizational costs—especially the time and attention of key technical and management personnel—which may exceed the pecuniary expenses noted above. Thus, while firms can

strategically craft patent protection in ways that reduce some of the uncertainties and porosity of protection afforded by the patent system, these actions come at a significant cost. Therefore, effective patent strategy requires the prioritization of patent-related activities toward specific sets of technologies, and the allocation of resources to acquire, reinforce, and employ the required patent rights. The generic strategic logics reviewed below essentially highlight how and when firms should undertake this prioritization.

Generic Patent Strategies

We begin by examining strategic uses of patents that are more proximately and directly connected with the development of competitive advantages as envisaged in the resource-based view (RBV) (Barney, 1991; Peteraf, 1993). While prior research has described patents as “surrogates” for resources (Markman, Espina, & Phan, 2004), that is true only if one considers the bundle consisting of the patent *and* the underlying technology. More precisely, a patent is a property right, albeit an ill-defined, fuzzy, uncertain, and imperfect one (Lemley & Shaprio, 2005; Linden & Somaya, 2003; Teece et al., 2000). While one of the strategic uses of patents is to raise barriers to imitation of the firm’s technological assets—i.e., as an isolating mechanism (Mahoney & Pandian, 1992; Rumelt, 1984)—there are other patent strategies that buttress firm-level competitive advantage as well. These are classified into three main “generic patent strategies” below—proprietary strategies, defensive strategies, and leveraging strategies. Each generic patent strategy has implications that cut across the three patent activity domains—rights, licensing, and enforcement—and prior research on generic patent strategies is mapped onto each domain in Table 1.³

The motivations of firms in obtaining patents provide considerable insight into the potential strategic uses of patents. Among the many reasons for patenting described in prior work are blocking (defensive and offensive), preventing copying, building fences and thickets, earning licensing income, avoiding litigation by others, use in negotiation and exchange, motivating and rewarding R&D personnel, measuring performance, attracting investors, and building image and reputation (Blind, Edler, Frietsch, & Schmoch, 2006; Blind et al., 2009; Cohen et al., 2000; Cohen, Goto, Nagata, Nelson, & Walsh, 2002; Duguet & Kabla, 1998). Research has also shown that different firm-level strategic motives predict characteristics of the firm’s patents as well as reactions from rival firms to these patents (e.g., filing oppositions) (Blind et al., 2009).

In adopting a simpler framework of three generic patent strategies, this review seeks to address a number of issues entailed in these bottom-up characterizations developed in prior research. First and foremost, the goal is to develop a more strategy-centric view that focuses on the strongest and most direct links to firm competitive advantage and sets aside more secondary considerations (e.g., employee motivation, reputation). Second, there is a pressing need to cut through the proliferation of terms and confusion in language that has accompanied this literature. For example, the term *blocking* is supposed to have both “offensive” and “defensive” meanings, *fences* and *thickets* are sometimes used interchangeably and sometimes not, and so on.⁴ Some strategic motivations cited in prior work are also different aspects of the same strategic use of patent (e.g., avoiding litigation and use in negotiations).

Table 1
Research on “Generic Patent Strategies” in the Three Domains
of Patent Strategy (Rights, Licensing, and Enforcement)

Patent Domains	Patent Rights Acquisition and Maintenance	Patent Licensing and Openness	Patent Enforcement and Litigation
Generic Strategies:	Lerner (1995) Blind & Thumm (2004) Graham & Higgins (2008) Liu et al. (2008)	Teece (1986) Arora (1995) Arora & Ceccagnoli (2006) Gans, Hsu, & Stern (2008)	Somaya (2003) Polidoro & Toh (2011)
Proprietary strategy	Blind, Cremers, & Mueller (2009) Ceccagnoli (2009) Clarkson & Toh (2010)		
Defensive strategy	Lerner (1995) Hall & Ziedonis (2001) Graham et al. (2003) Blind & Thumm (2004) Ziedonis (2004) Wagner (2008) Blind, Cremers, & Mueller (2009) Siebert & von Graevenitz (2010) Guellec, Martinez, & Zunigac (in press)	Bittlingmayer (1988) Merges (1996) Grindley & Teece (1997) Shapiro (2000) Siebert & von Graevenitz (2010) Galasso (in press)	Somaya (2003) Graham & Somaya (2004)
Leveraging strategy	Reitzig, Henkel, & Heath (2007)	Arora & Fosfuri (2003)	Lanjouw & Lerner (2001) Agarwal, Ganco, & Ziedonis (2009) Reitzig, Henkel, & Schneider (2010)

Further confusion is added by the term *strategic patenting* that is often (but not exclusively) used to indicate patenting for defensive purposes. A third important consideration is that most of these terms have been developed specifically for the patenting decision, whereas a realistic view of patent strategies must encompass the entire gamut of patent-related activities categorized into three patent domains earlier (and must include attempts to influence competitor patent positions and use as well).

The generic patent strategies described below are intuitive, and each strategy is supported with theoretical logics that underscore how it is related to the firm's competitive advantage in a distinctive way. While it is impossible to conclude that these generic strategies capture all meaningful connections between patent actions and competitive advantage, they appear to be quite comprehensive based on the extant literature. As illustrated in Figure 1, these theoretical logics derive largely from firms' business strategies, including strategies undertaken by competing firms and patent owners. In addition, generic patent strategies are also likely to be influenced by (exogenous) characteristics of the technology or industry, the

institutional and legal environment, and alternative mechanisms for rent appropriation available to firms, which are illustrated as important moderating factors in the framework. Given the newness of the field and the disparate research traditions it has emerged from, it would not be reasonable to claim that Figure 1 presents a comprehensive set of relevant constructs or relationships for patent strategy. Instead, the goal is to provide an initial integrative framework based on extant patent research, which will provide a starting point for further refinement and extension.

Proprietary Strategy

The ability to “stake out and defend a proprietary market advantage” has been characterized as the “most powerful benefit” of patents (Rivette & Kline, 2000: 4). A proprietary strategy is in essence the conventional resource-based logic of using patents as isolating mechanisms that shield the firm’s key competitive advantages from imitation (Lippman & Rumelt, 2003; Rumelt, 1984). The role of patents in providing inventors with a proprietary business advantage in opportunities created by their inventions is well recognized in the economics of patents (Kitch, 1977; Mazzoleni & Nelson, 1998). Moreover, remedies available from patent litigation—specifically injunctions and lost profits—also implicitly recognize that firms may wish to employ their patents in a proprietary manner.

Proprietary patent strategy is reflected in a number of actions, “strategies,” and uses of patents noted in prior research—for example, building fences, “offensive” blocking and preemption, building “offensive” thickets, preventing copying, and so on. Indeed, firms pursuing a proprietary strategy may be expected to augment the protection afforded by any individual patent by building overlapping and complementary patent rights to minimize the chances that the set of patents can be invented around or overturned. Patent fences may be built consisting of patents that cover “a range of possibly quite different technical solutions for achieving a similar functional result” (Granstrand, 1999). In other words, firms may patent potential substitute and follow-on technologies themselves (before their competitors), and hire expert legal help to ensure that their patents are legally robust. These patent rights are likely to be carefully maintained—for example, by having patents renewed (Liu, Arthurs, Cullen, & Alexander, 2008) or reexamined and reissued (Clarkson & Toh, 2010) when necessary—and reinforced through the acquisition of interlocking and substitute patents from the secondary market. In pharmaceuticals, firms time the patenting and introduction of drug reformulations to coincide with the expiration of market exclusivity of drugs so as to build a series of temporally overlapping rights (Graham & Higgins, 2008).

In the licensing domain, firms would be generally unwilling to license out patents with which they are pursuing a proprietary strategy and seek to commercialize the technology themselves (Teece, 1986). Alternately, they may license the technology exclusively to a commercialization partner with the required specialized complementary assets (Arora & Ceccagnoli, 2006). In enforcement, proprietary strategies imply concerted efforts to detect imitation and aggressive enforcement of patents against any detected infringement (Polidoro & Toh, 2011). Once a suit is filed, firms pursuing a proprietary strategy are less likely to settle with the alleged infringer (Somaya, 2003). In sum, employing a proprietary

patent strategy implies that the firm seeks to obtain a relatively watertight and exclusive patent position in the focal technology.

At the company level, factor analysis of a survey of 149 European firms found that firms' motives to patent cluster around either a "technology protection" or an alternative "strategic" rationale (Blind & Thumm, 2004). The former category largely reflects a proprietary patent strategy (whereas the latter includes defensive motivations, which are reviewed below). Research has also shown that the use of "preemptive patenting" to build patent fences increases firm valuation, particularly when innovation in the industry is incremental rather than drastic (Ceccagnoli, 2009). Patents around which firms build proprietary fences—measured by self-citing—are also known to be more valuable than patents that get cited and built on broadly in the economy (Hall, Jaffe, & Trajtenberg, 2005). Thus, the evidence suggests that proprietary patent positions are quite valuable to the firm.

So when should firms use a proprietary patent strategy? Since it is in principle possible for firms to simply license any technological invention to capture its standalone value, pursuing a proprietary strategy must mean that significant additional rents will be put in jeopardy absent the added efforts to strengthen and enforce patent rights. Therefore, proprietary patent strategies will likely be used when it is difficult to write and enforce licensing contracts that retain the potential benefits of using the technology exclusively (Hill, 1992). For example, patent positions in the company's core technological areas typically support its current and future competitive advantages (Stefanadis, 1997; Teece, Pisano, & Shuen, 1997), which are very difficult to contract for in any arrangement that shares access to these vital technologies. Inventions that create significant market opportunities—such as valuable new drugs (Graham & Higgins, 2008)—are similarly natural candidates for a proprietary strategy, as are technologies that offer a unique differentiated position because they have few close substitutes (Polidoro & Toh, 2011). Proprietary strategies will also likely be used for technologies with high "strategic stakes," which had been operationalized in prior work by measuring follow-on patenting (self-citations) (Somaya, 2003) and by actions taken to clarify and shore up existing patents (reexamination) (Clarkson & Toh, 2010). In effect, a proprietary strategy in areas of high strategic stakes extends patent-enabled imitation barriers to protect valuable resource bundles that are cospecialized with the patented technologies (Teece, 1986).

Defensive Strategy

While a proprietary patent strategy seeks to create a competitive advantage, the firm may sometimes need to ensure that it is *not* put at a competitive disadvantage or at risk of being held up for rents because of patents held by others.⁵ Simply put, firms may need to have a viable strategy for defending against patents owned (and potentially enforced) by others. In fast-paced high-technology industries, firms often make substantial irreversible investments in business opportunities before it is clear who owns all the patents for the required technologies. In turn, if the set of technologies required to commercialize products is very large, a situation characterized by multi-invention contexts (Hall & Ziedonis, 2001; Somaya & Teece, 2001; Somaya, Teece, & Wakeman, 2011), the exposure to others' patents could be

particularly problematic. Fundamentally, the need for defensive strategies arises because a patent confers only the right to exclude others, not an affirmative right to use the patented technology. So firms can be constrained from using even their own inventions if patents on other inventions required for commercialization are asserted against them. In turn, the owners of such patents can bargain for very substantial rents by holding up the putative infringer with the threat of a court-mandated injunction (Lemley & Shapiro, 2007).

The goal of a defensive strategy is to retain for the firm the freedom to operate and commercialize their technologies without hindrance from patents that belong to others. In prior work, defensive patent strategy is reflected in terms such as portfolio patenting, (defensive) blocking and preemption, (defensive) thickets, validity challenges, and even "strategic patenting." A simple defensive tactic would be preemption; the firm could either patent or obtain *ex ante* licenses to all the needed inventions. Firms may also preempt risky patent rights by disclosing these inventions themselves (Guellec, Martinez, & Zunigac, in press) or by preventing patents from issuing through opposition and reexamination procedures (Graham et al., 2003; Wagner, 2008).

However, when it is not feasible to predict which patents will be needed or who will own them, as is typically the case, an *ex post* defensive strategy is needed that will work after these facts become clear. One common approach is for firms to build large defensive portfolios of their own patents to avoid being held up. If threatened (or sued) over another firm's patents, the focal firm can threaten back with its own patents, leading to a situation of *mutual holdup* that forces a faster resolution of the standoff (Somaya, 2002). The pursuit of this type of defensive strategy is widely believed to have created an "arms race" for defensive patent portfolios in industries like semiconductors, particularly in situations where the firm has made significant capital investments (Hall & Ziedonis, 2001) and preemptive in-licensing is difficult due to fragmented patent ownership (Ziedonis, 2004). In litigation, the availability of defensive patent portfolios has been associated with the filing of countersuits and with a higher likelihood of suit settlement due to mutual hold up (Somaya, 2003). Defensive strategies may also be pursued through licensing, particularly through the cross-licensing of large patent portfolios between firms and bundled patent licensing through patent pools (Bittlingmayer, 1988; Grindley & Teece, 1997; Merges, 1996; Shapiro, 2000), both of which can include capture provisions for patents that may issue in the future. Firms are more likely to enter into cross-licenses when they have made significant capital investments, which accentuates their need for an *ex ante* defensive approach, and such cross-licenses are correlated with fewer future law suits between the firms (Galasso, in press). Research has also examined *ex ante* cross-licensing and patent blocking (measured by cross-citation of patent portfolios) as alternative defensive solutions, with the former being preferred when product market competition is stronger and blocking is not as intense (Siebert & von Graevenitz, 2010).

Despite its attractions, a defensive strategy based on large patent portfolios, cross-licensing, and mutual holdup has limitations. If a patentee does not really need access to the focal firm's patents, these approaches will no longer be viable. This can happen, for example, if the patentee is a niche specialist and the focal firm's patent portfolio does not cover technologies in that niche. Similarly, mutual holdup is often a weak defensive strategy against individual inventors or universities, who typically have no commercial operations of their own that can

be held up. In recent years, specialized patent-holding firms, sometimes called patent “trolls” or “sharks,” have been particularly challenging for large technology firms to deal with precisely because of their relative invulnerability to being mutually held up (Reitzig, Henkel, & Heath, 2007; Reitzig, Henkel, & Schneider, 2010). For these types of patent holders, alternative defensive strategies may need to be devised, such as preemptively patenting or disclosing enabling technologies, inventing around key patents, and challenging the validity and enforceability of patents. Packaged software firms, for example, often have large defensive patent portfolios, but primarily initiate patent litigation to render others’ patents invalid or unenforceable in declaratory judgment suits (Graham & Somaya, 2004). Another defensive strategy that has received less attention is the redirection of R&D and the firm’s activities generally into technological areas where litigation is less likely. For example, biotechnology firms with high litigation costs, as measured by their lack of prior litigation experience and paid in capital, have been shown to avoid patenting in patent classes with many other patents and with patents owned by low litigation cost firms (Lerner, 1995).

Leveraging Strategy

In many instances it may not be appropriate for a firm to use a proprietary patent strategy, nor may it need a defensive strategy; but patents may nonetheless be valuable tools for generating additional rents. The central logic of leveraging strategies is that the bargaining advantages conferred by the exclusionary power of patents allow the firm to pursue direct and indirect profit opportunities. The most obvious direct opportunities are from patent licensing revenues. Some of the firm’s patents may be in technologies that are not central to its strategy or core competence, but are nonetheless valuable. In other cases, technologies may already be available for licensing from other firms that are (imperfect) substitutes (Arora & Fosfuri, 2003), or it may be feasible to invent around the firm’s patents (albeit at some cost and with some likelihood of failure). In these instances, a proprietary patent strategy is either unnecessary or unworkable, but the firm can leverage the bargaining power arising from its patent rights to garner more licensing revenue. Even when the firm engages in the cross-licensing of entire patent portfolios, it may be able to obtain offsetting compensation for its stronger or more valuable patents (relative to the cross-licensing partner).

The goal of the firm in a patent leveraging strategy is to use its patent rights to bargain effectively for rents in different contexts. Therefore, it is not necessary for the firm to patent every substitute technology or to have watertight patent protection. While these can help on the margin, it is more important to have patent coverage on a significant technology that other firms are using (or will use), and that there be sufficient costs and risks in working around the firm’s patents. The latter gives the firm bargaining power vis-à-vis users of the technology through the threat of patent litigation. Ultimately, the willingness of other parties to make concessions in negotiations will depend on their expectations about payoffs and risks in patent litigation. By influencing the bargaining threat points of others, the firm can prosecute its own leveraging strategy more effectively. For example, reputations for “being tough” in settlement negotiations can credibly signal to other firms that their payoffs from litigation will not be too attractive (Agarwal, Ganco, & Ziedonis, 2009; Waldfogel, 1995). Another

particularly effective bargaining tool is the use of preliminary injunctions in litigation, which abruptly threatens to shut down the entire operation of the targeted firm (Lanjouw & Lerner, 2001). The more costly the prospect of litigation and the stronger the focal firm's bargaining position appears to its negotiation partners, the more attractive will be the negotiated terms that the firm can obtain through its leveraging strategies.

A particular type of firm that has received considerable recent attention for its leveraging strategy is the "patent shark" or "patent troll" (Reitzig et al., 2007; Reitzig et al., 2010). Patent sharks generally do not commercialize technologies themselves and are therefore somewhat insulated from defensive strategies based on blocking patent portfolios and mutual holdup. In turn, they leverage the patent system and patent litigation to extract rents from putative patent infringers through the threat of injunctions, large damage awards, and significant switching costs to invent around their patents (Reitzig et al., 2007). In turn, patent sharks' success with these strategies is correlated with their ability to obtain settlements from targeted firms (Reitzig et al., 2010). Essentially, these firms take advantage of the fact that their patents allow them to *asymmetrically hold up* other firms, who have very little bargaining leverage over them.

Opportunities for indirect patent leveraging (outside of simply earning royalties and damages) may also arise in the context of the firm's various business operations. For example, in cooperative standard setting, a firm may negotiate for tailoring a technology standard in its favor if it owns key enabling patents for the standard (Shapiro & Varian, 1999). Alternately, a firm may even be able to win supply contracts because it is a significant patent holder and implicitly or explicitly threatens to sue if the contract is awarded to another firm. In one instance, a supplier sued the state of Maryland for patent infringement when the state switched suppliers for the state lottery and allegedly retained the patent-protected features provided by the supplier.⁶ Another example is the decreased spillover of knowledge accompanying employee mobility when the firm can credibly threaten to litigate with its patents (Agarwal et al., 2009). In general, however, there has been little research to date on the indirect leveraging benefits of patents.

Future Research Opportunities

The review of generic patent strategies above suggests a number of promising areas for future research. First, Table 1 illustrates that prior research has largely been focused on the rights domain (i.e., the patenting decision), and significant opportunities exist to examine these strategic logics in the context of patent trading and licensing, as well as enforcement and litigation. For example, research may examine which patents in a firm's portfolio are more likely to be licensed based on the patent strategies being pursued with the respective patents, and in particular the drivers of licensing as a leveraging strategy. Second, studies of generic patent strategies that highlight the coordination of strategic actions across the rights, licensing, and enforcement domains would be a welcome addition to the literature. In particular, research could study how a changing portfolio of patents affects the firm's licensing and enforcement decisions. For example, do stronger patent portfolios lead firms to cross-license patents less and enforce them more in a bid to move from defensive toward proprietary

and leveraging strategies? Third, within each generic strategy as well, specific areas and questions remain relatively underexplored. For example, what defensive strategies do firms use when portfolio patenting and mutual holdup don't work, and how effective are they? Similarly, how common and effective are indirect leveraging strategies such as influencing technology standards and customer acquisition and retention?

Furthermore, as Figure 1 illustrates, generic patent strategies are typically driven by specific business strategies being pursued in the associated product markets. We have noted above that proprietary strategies may be driven by high strategic stakes (Clarkson & Toh, 2010; Somaya, 2003), defensive strategies may be prompted by sunk capital investments (Hall & Ziedonis, 2001), and leveraging strategies are facilitated by holdup asymmetry (Reitzig et al., 2007; Reitzig et al., 2010). However, the set of business drivers examined in prior work on patent strategy is surely incomplete. For example, it would be valuable to incorporate the strategies and actions of rival and partner firms within this calculus. Specifically, patent-related actions initiated by rival firms may lead to competitive dynamics that have yet to be systematically investigated in prior work. Figure 1 also indicates that the use of various generic patent strategies is often conditioned by technological and institutional factors. It is now well established that the use and effectiveness of generic patent strategies will vary across technologies and industries, for example, proprietary strategies in discrete technologies versus defensive strategies in multi-invention technologies (Reitzig, 2004; Somaya, 2003; Ziedonis, 2004). However, the impacts of institutional differences across country or industry contexts on patent strategies are not well understood. To date, only case study evidence is available regarding how firms adjust their generic patent strategies in response to patent institutions that differ in the scope, strength, certainty, and timeliness of patent protection offered (e.g., Somaya, 2000). Figure 1 also illustrates the relationship between other appropriability strategies and patent strategy; however, this topic is reviewed in greater detail below.

The Strategic Management of Patents

We now turn our attention to a set of theoretical logics that have been applied to understand how firms manage their patent-related choices and actions. These research streams may be viewed as studying important implementation considerations that arise when executing generic patent strategies and are potentially linked to them in important (but as yet largely unexplored) ways. While the appeal of generic patent strategies lies in their proximal connection to firm competitive advantage and value capture, interest in the strategic management of patents stems at least in part from the theoretical lenses applied, and the insights generated for the corresponding theoretical literatures. Sequentially, in this section, we examine the real options logic in patents, signaling and information revelation, nonmarket patent strategies, and building of capabilities for patent management. While some of these research streams have a clear and narrow theoretical focus, others (in particular, nonmarket strategies) are broader and influenced by multiple theoretical lenses. Nonetheless, the essential point is that researchers have used theoretical lenses from these literatures to effectively position their work on strategic patent management, and in turn contributed back to those theories by leveraging the richness of patent data and of the patent strategic context. Using a similar approach to that adopted for Table 1, research related to each of these areas is categorized into the three patent strategy domains—rights, licensing, and enforcement—in Table 2.

Table 2
Research on the Strategic Management of Patents in the Three Domains
of Patent Strategy (Rights, Licensing, and Enforcement)

Patent Domains	Patent Rights Acquisition and Maintenance	Patent Licensing and Openness	Patent Enforcement and Litigation
Strategic Considerations:			
Real options	Bloom & Van Reenen (2002)		Marco (2005)
	Graham et al. (2003)		Nerkar, Paruchuri, & Khaire (2007)
	McGrath & Nerkar (2004)		
	Hegde, Mowery, & Graham (2009)		
	Henkel & Jell (2009)		
	Clarkson & Toh (2010)		
	Lowe & Veloso (2010)		
	Deng (2011)		
Signaling and information disclosure	Langinier (2004)	Gans, Hsu, & Stern (2008)	Agarwal, Ganco, & Ziedonis (2009)
	Baker & Mezzetti (2005)		
	Langinier (2005)		
	Bar (2006)		
	Agrawal & Garlappi (2007)		
	Gick (2008)		
	Gill (2008)		
	Henkel & Jell (2009)		
	Clarkson & Toh (2010)		
	Guellec, Martinez, & Zunigac (in press)		
Nonmarket strategies in patents			Moore (2003) Somaya & McDaniel (in press)
Patent management capabilities	Tietze, Granstrand, & Herstatt (2006)	Pitkethly (2001)	Reitzig & Wagner (2010)
	Somaya, Williamson, & Zhang (2007)		
	Reitzig & Puranam (2009)		
	Reitzig & Wagner (2010)		
	Mayer, Somaya, & Williamson (in press)		

Patents as Real Options

Obtaining and using patent rights entail sequences of decisions that often conform to the real options logic (for a review of the real options literature in management, see Li, James, Madhavan, & Mahoney, 2007). The economic value of patents is highly skewed, with most of the value being concentrated in only a small fraction of patents (Harhoff, Sherer, & Vopel, 2003). At the same time, patents entail significant *ex ante* uncertainties—technological, commercial, and legal—that will typically only be resolved over time. Most patented inventions turn out to be technological or commercial duds, and even if the inventions are themselves successful the firm's patent(s) may turn out to be weak, narrow, or easy to invent around. However, because many of the options related to patents (see below) can be obtained

relatively cheaply, firms can effectively buy and hold these options until such time that exercising or abandoning them makes sense. Using option theory, a number of studies have sought to measure the value of patents by examining firms' decisions to renew their patents (e.g., Lanjouw et al., 1998; Pakes, 1986).

From a strategic viewpoint, however, it is perhaps more interesting to understand how and when firms make decisions to exercise or abandon the options embedded in patents. These strategic options become available almost as soon as firms apply for patents, which can be provisional (in the United States) or filed and allowed to expire without examination (in many other jurisdictions) (Henkel & Jell, 2009). Similar real options are also available in the international stage of patent applications through the Patent Cooperation Treaty (Deng, 2011). Within the United States, firms have the option to further divide or continue existing patent applications into new applications (Graham, 2006; Hegde et al., 2009). Subsequent to grant, the patent can be renewed at periodic intervals by paying a fee or be allowed to expire (Lowe & Veloso, 2010). In addition, firms also have the option to have the patent reexamined and reissued in certain cases (Clarkson & Toh, 2010; Graham et al., 2003). Moving beyond a single patent as the unit of analysis, patents owned by a firm in a new technological field can also be viewed as a real option (Kitch, 1977), which gives the firm an advantage in making further investments toward developing the technology and acquiring related follow-on patents (McGrath & Nerkar, 2004). McGrath and Nerkar (2004) found, for example, that attributes associated with patent value increase the odds of the firm obtaining additional related patents. However, consistent with option theory, firms facing significant (market) uncertainty may also prefer to simply hold these patent options rather than commit to additional investments (Bloom & Van Reenen, 2002). Naturally firms have the option to license a patent once it is issued, while recognizing that licensing may limit their future options with respect to the patent. The right to enforce the patent through litigation is another important real option available to firms from patents (Nerkar, Paruchuri, & Khaire, 2007). However, although litigation promises a potential return based on adjudication outcomes, it also incurs the risk and potential negative payoff of patent invalidation (Marco, 2005).

Signaling and Information Disclosure

The patent context holds great promise for studying how the certification, disclosure, or signaling of information provides strategic advantages to firms. At the most basic level, a patent provides the patent office's independent certification that an invention is novel and that IP rights are available to protect it. The role of patents in signaling the quality of the firm to investors is a particularly important effect, which is reviewed in greater detail below in the section on patent strategy and value creation. In addition, patents may provide both a certification and a signaling effect to potential alliance and licensing partners. Using asymmetric information signaling models, research has shown that small firms seeking commercialization partners may signal the high quality of their innovation by filing for and obtaining a patent (Gick, 2008). In addition to reducing transaction costs in licensing, patent rights may also certify invention quality to potential technology partners, thus encouraging them to license the patented technology (Gans, Hsu, & Stern, 2008).

Firms can also disclose technical advances through defensive publications and public announcements with a view toward influencing outcomes in the patent system. Despite potential knowledge spillovers, disclosures can help firms if they signal strategic commitment to a research trajectory and thus influence rivals to exit R&D competition or redirect their R&D efforts (Gill, 2008). Strategic disclosures (and simultaneously foregoing patent rights) can also have the effect of advancing the state of the known prior art considered by the patent office. So rival innovative firms may find it harder to obtain patents in the same technology domain, and the focal firm may be able to catch up with competitors in the race to own critical patents (Baker & Mezzetti, 2005; Bar, 2006). In a “strategy of the commons” firms may place inventions in the public domain to dissuade further investments by competitors due to their inability to obtain patents and thus protect the firm’s own rent streams that may otherwise be cannibalized (Agrawal & Garlappi, 2007). Similarly, information disclosed in patent applications that are not eventually examined (in jurisdictions where firms pay an examination fee) can advance the prior art, while creating temporary insecurity about patent ownership for competitors (Henkel & Jell, 2009). Research on preemptive patenting has also found that some patents may be filed simply to block patenting by others and ensure freedom of operation for the firm (Guellec et al., in press). In many cases, these patents are subsequently withdrawn, but their impact on the state of the prior art for granting patents remains. Thus, information disclosure often seeks to influence the patent rights that rival firms obtain, either by affecting the relevant prior art or by a signaling mechanism.

Like public disclosure, patents also contain information about the firm’s technologies and technical direction, and rivals may seek to build on these for the next round of innovative competition. Therefore, firms may patent “bad” inventions to mislead rivals in their efforts to build on the technologies disclosed in patents (Langinier, 2005). Certain patent actions may also be undertaken to credibly signal the firm’s patent strategy and intentions. For example, research has found that patent reexamination may act as a signal of the firm’s strategic stakes in a patent, which has a deterrent effect on rivals’ innovation paths, and more so when the firm has prior litigation experience or owns downstream complementary assets (Clarkson & Toh, 2010). Even the renewal of a patent may act as a signal and deter entry in the presence of information asymmetries (Langinier, 2004). Finally, signaling strategies may also be used in the context of patent enforcement, where a reputation for aggressive past litigation has been shown to deter rivals from building on knowledge spillovers that result from hiring a company’s scientists or engineers (Agarwal et al., 2009).

Nonmarket Strategies in Patents

Patent strategies do not operate in a vacuum; ultimately, the value and utility of patents is driven by the laws and institutions that define and govern this property right. Therefore, nonmarket patent strategies—namely, the strategies firms employ with respect to patent institutions themselves—are an important, and understudied, dimension in the overall landscape of patent strategy (for a review of nonmarket strategies, see Hillman, Keim, & Schuler, 2004). Patent laws are typically made in legislatures and negotiated in international treaties. These laws are then applied and enforced by multiple agencies and courts, the most important

of which are (arguably) the patent offices where inventors file for patents and the trial courts where patent disputes are filed in the first instance. As illustrated in Figure 1, a natural implication of the diversity in laws and institutions across jurisdictions (particularly internationally) is that patent-related strategies need to be adapted to what is feasible and/or enabled by these institutions (Oxley, 1999; Somaya, 2000).

Furthermore, firms may employ various nonmarket strategies—either collectively or individually—to navigate among or influence the patent laws and institutions they operate under. For example, firms may be able to use lobbying and other influence activities to change laws and institutions, and also engage in strategies and tactics within existing institutions such as agencies or courts. Relatively little work has studied the nonmarket strategies of firms in the patent context. One notable exception is the research on targeting specific tribunals (or courts) for patent enforcement, based on either their perceived policy bias (Moore, 2003) or their specialization in patent law (Somaya & McDaniel, in press). In addition, Kesan and Gallo (2009) provide a detailed analysis of the legislative political economy of the patent system, with a particular emphasis on legislative committees, interest groups, and lobbying activities. They find corroborative evidence in legislators' votes on a key patent bill (HR 1908) and in case studies of two key patent reform proposals.

Patent Management Capabilities

The patent strategies undertaken by firms require careful and sophisticated managerial planning and action (Pitkethly, 2001). Accordingly, research has sought to understand how firms develop and employ the required managerial capabilities and how these capabilities in turn affect firm performance in the patent domain. Ultimately, this stream of work draws on the RBV, and in particular on the development of firm capabilities through the bundling and coordination of disparate resources (Conner, 1991; Lippman & Rumelt, 2003). Patent attorneys, who are experts in patent law and in specialized areas of technology, are an important resource for patent strategy and have been shown to have the same proportional impact on firms' patenting output as R&D spending (Somaya, Williamson, & Zhang, 2007). Furthermore, supporting organizational conditions such as patent knowledge in the top management team and industry-specific pressures to patent (Somaya et al., 2007) and optimal cross-functional coordination between legal and technical experts (Reitzig & Puranam, 2009) are also valuable for translating legal patent expertise into performance-enhancing organizational capabilities.

Research has also shed some light on how firms combine internal and external capabilities when conducting their patent strategy and the performance implications of these choices. For example, the outsourcing of patent prosecution activities can affect firms' access to information on technological developments, resulting in a lower likelihood of detecting and opposing rivals' patent applications (Reitzig & Wagner, 2010). Similarly, firms may outsource patent work to access critical legal or industry-specific knowledge from law firms, but this can negatively affect the development of firms' own patent strategy-related capabilities over time (Mayer, Somaya, & Williamson, in press). Finally, even the outsourcing of legal work may need to be coordinated across supplier law firms—for example, to account for the

interrelatedness between the firm's patents, the need to access the most competent suppliers in each technology area, and so on (Moeen, Somaya, & Mahoney, in press). Despite some progress, more insight is needed into the triggers, processes, and mechanisms by which firms develop sophisticated patent management capabilities, and case study research has begun to make inroads into this area (Tietze, Granstrand, & Herstatt, 2006). While firms rely on external suppliers (law firms) to carry out patent litigation and even outsource other types of patent legal work to some extent, the firm's own managers likely play important roles in controlling and coordinating these activities.

Future Research Opportunities

Consistent with the research on generic patent strategies, research on strategic patent management is also highly concentrated in the domain of patent rights. Therefore, further research situated in the licensing and enforcement domains would be valuable. In addition, there are a number of interesting unanswered questions within each of the areas of strategic patent management reviewed above. While prior research has examined several real options embedded in patents, the focus has largely been on the patent value correlates of exercising these patent options. Relatively less attention has been paid to the use of these options to manage the inherent uncertainties—technological, commercial, and legal—entailed in patent rights. Similarly, prior work on nonmarket strategies in patents has largely focused on patent litigation and enforcement. Additional research, particularly in the legislative and agency domains, would add to our understanding of nonmarket strategies in patents. Moreover, because patents straddle both market and nonmarket domains of action, patent data and patent strategy research also have the potential to provide interesting insights for nonmarket strategy research. The interplay between the firm's internal resources and externally available capabilities with suppliers as well as the hiring and development of expert patent managers and attorneys within the firm are also ripe areas for further study.

Perhaps the most significant untapped opportunity in research on the strategic management of patents is to develop and examine the conceptual connections of these more "implementation-related" issues with the firm's generic patent strategies. For example, Somaya and McDaniel (in press) show that a proprietary patent strategy resulting from high strategic stakes leads firms to target more specialized nonmarket adjudication venues when enforcing their patents. Similarly, Guellec et al. (in press) demonstrate that strategically disclosing information in patent applications can be used as a preemptive defensive strategy. Clarkson and Toh (2010) describe patent reexamination as a strategic signal that conveys high strategic stakes and thus reinforces a proprietary strategy. Despite these initial forays, further integration of research on strategic patent management with that on generic patent strategies would be valuable. For example, do firms that focus on different generic strategies manage their patent function in systematically different ways? Similarly, how do different generic patent strategies influence the exercise of various patent-related real options? The disclosure of information through patents, either consciously or as part of a signaling strategy, must also contend with the relative effectiveness of trade secrecy (versus patents) as an appropriability mechanism, which is discussed in the next section.

Patent Strategy and Appropriability Strategy

We now turn our attention to understanding the role of patent strategies within the broader set of appropriability strategies available to firms. As noted earlier, this research typically extends beyond the core area of patent strategy, and it is therefore not possible to categorize it into the three patent strategy domains employed in Tables 1 and 2. The pioneering Yale and CMU surveys of R&D managers (Cohen et al., 2000; Levin, Klevorick, Nelson, & Winter, 1987) focused on developing relative assessments of the effectiveness of different appropriability mechanisms and their variation across industries. Several subsequent innovation surveys have followed a similar mold (Arundel, 2001; Blind & Thumm, 2004; Cohen et al., 2002; Harabi, 1994; Leiponen & Byma, 2009). Factor analyses in these studies generally (but not universally) find that the effectiveness of secrecy and patent-based appropriability mechanisms, assessed at the organizational level, load on different factors (Blind & Thumm, 2004; Cohen et al., 2000). In the same vein, research has found that firms are less likely to patent product inventions when secrecy is more effective as an appropriability mechanism (Arundel & Kabla, 1998). While providing important insights for our understanding of how firms appropriate rents from innovation, this stream of research has largely been based on the assumption that different appropriability mechanisms are inherently alternatives and that firms must choose between them.

However, firms create barriers to imitation—and thus preserve their competitive advantages—not from patents (or secrecy) alone but from the entire set of isolating mechanisms available to them. While firms must sometimes make a choice between different types of protection, it has been known for some time that firms often use even patents and secrecy—which are often characterized as substitutes—for different aspects of the same technology (Arora, 1997). In addition, the decision to employ a particular appropriability mechanism is a marginal one and depends on whether the additional protection obtained is justified by the added costs. Therefore, understanding the complementarities and trade-offs between these mechanisms in the firm's overall appropriability strategy is an important (and as yet unfulfilled) research enterprise.

Focusing first on different types of IP-based appropriation, there is a long research tradition that views patent rights and trade secrecy as natural substitutes (Encaoua & Lefouili, 2005; Horstman, MacDonald, & Slivinsky, 1985; Kultti, Takalo, & Toikka, 2007; Machlup, 1958). One of the conditions of patenting is disclosure of the underlying technology, which can be particularly damaging to appropriability if the patent itself is weak (Anton & Yao, 2004). Disclosure of the invention also gives other firms the opportunity to improve on it and file their own subsequent patents (Langinier, 2005). Patent disclosures not only lead to technical knowledge spillovers but also provide innovative rivals with information about promising areas or problems to focus on (Magazzini, Pammolli, Riccaboni, & Rossi, 2009). The latter type of information leakage is understudied but likely quite important as information about a firm's development decisions (absent patents) may otherwise leak more slowly than information about its product or process technologies (Mansfield, 1985).

In light of the discussion above, it is perhaps natural to view patents and secrecy as alternatives when focusing on a single invention (at a particular point in time). However, when

one expands the unit of analysis beyond this narrow definition, the possibility of acquiring complementary and overlapping IP rights of different kinds becomes evident (Somaya & Graham, 2010). For example, patents and secrecy can be applied to protect different elements of the same broader technology or product (Arora, 1997; Ottono & Cugno, 2008). In addition, while secrecy may be effective in early stages of product development, competitors can often reverse engineer a firm's technology once a product is launched and available in the marketplace. Consistent with this rationale, a patent protection strategy (but not secrecy) was found to be strongly associated with firms that have made recent new product introductions (Hussinger, 2006). Similarly, Teece (1986) cites the example of NutraSweet to suggest that firms may combine patent and trademark protection over different time periods to maximize the rents appropriated from an invention. In turn, the ability to combine different IP rights to protect the firm's technological assets may itself reflect the development of sophisticated IP management capabilities within the firm. For example, Somaya and Graham (2010) find that packaged software firms simultaneously increased their use of patents, copyrights, and trademarks in the 1990s, and that this "IP revolution" was correlated with the development of their internal IP departments. In general, research on the joint use of patents with other types of IP is still somewhat nascent and holds significant promise to yield additional valuable insights.

Moving beyond the relationships between different types of IP, research has also explored the strategic interactions between patent-based appropriability and other isolating mechanisms. For example, in early work, Hill (1992) showed that the decision to license depended both on the appropriability available from patents and the inherent ease with which rivals could imitate the technology. Naturally, a corollary of this research is that the value of a proprietary patent strategy is contingent on the other mechanisms preventing imitation by rivals. Consistent with this logic, Polidoro and Toh (2011) theorize and show that the imitation barriers provided by patents are more valuable to firms when there are few close substitutes for the firm's technology, thus highlighting the complementarity between proprietary patent strategy and other isolating mechanisms. Similarly, a survey of U.S. companies found that patents are often used in combination with other know-how protection mechanisms to protect knowledge when negotiating and conducting research partnerships (Hertzfeld, Link, & Vonortas, 2006). Finally, a recent theoretical model of the patent–secrecy trade-off has shown that lead time in the market increases the incentive to keep the invention secret because it mitigates the chances that rivals may reverse engineer the invention but does not affect the relative costs of developing a noninfringing "invent-around" (Zaby, 2010). While these studies provide a glimpse into a rich research agenda for appropriability strategy, much remains to be done.

Importantly, as Figure 1 illustrates, the presence and use of alternative appropriability mechanisms is an important contingency in the impact of patent strategies on overall appropriability outcomes and eventual firm value and performance (Hill, 1992; Hill, Heeley, & Sakson, 1993). Research has shown a positive relationship between both proprietary (Ceccagnoli, 2009; Hall et al., 2005; Reitzig, 2004) and defensive (Reitzig, 2004) patent strategies on firm valuation; however, the impacts of other appropriability mechanisms and strategies on this relationship—while anticipated—remain to be studied. Apart from these examples, the large literature linking patent attributes and firm valuation has either assumed that these attributes relate to the firm's innovation or knowledge (for a review, see van

Zeebroeck & van Pottelsberghe de la Potterie, 2011) or been ambiguous about whether they represent innovation or patent strategy characteristics (e.g., Hall et al., 2005; Lerner, 1994). This distinction is not only important for evaluating the relative impacts of patent and innovation strategies on firm performance but also significant because patent strategy and value creation through innovation may not always be in synch, as explained below.

Patent Strategy and Value Creation

One of the enduring concerns about patents and patent strategy is about their impacts on innovation at the societal level (see, e.g., David & Hall, 2006, and the accompanying issue of *Research Policy*). Focusing more narrowly on the performance of firms as well, there may be important trade-offs and complementarities between patent strategies and value creation from the firm's technologies. In this context, *value creation* implies the creation of perceived or real consumer utility that leads to the increased adoption and use of a technology. At the outset, it is important to note that strong patents and aggressive patent strategies can help the firm successfully commercialize innovations and create value in many contexts. Patent rights can provide contractual safeguards and be a facilitator of commercial exploitation of inventions through alliances or licenses with other firms (Arora, 1995; Oxley, 1999). Obtaining a patent on a technology is also associated with a significant increase in start-ups' propensity to form commercialization agreements with established firms (Gans, Hsu, & Stern, 2002, 2008). Moreover, strong patent protection can also help firms appropriate the fruits of commercialization, both when they commercialize internally with their own specialized complementary assets and when they license to access complementary assets owned by other firms (Arora & Ceccagnoli, 2006; Teece, 1986).

While much of the aforementioned literature focuses on the impacts of patents on commercialization, relatively little research has studied the effects of value creation strategies on patent strategies. One exception is a study of the impacts of firms' innovation strategies—measured along three dimensions: research versus development, product versus process, and extent of R&D collaboration—on patenting behavior (Peeters & van Pottelsberghe de la Potterie, 2006). Firms were found to engage in more active patenting when their innovation strategies were more highly oriented toward research, products, and collaboration (Peeters & van Pottelsberghe de la Potterie, 2006).

Patents are also known to help firms access external financing in various ways, including attracting venture capital (Haeussler, Harhoff, & Mueller, 2009; Mann & Sager, 2007), raising collateralized debt (Amable, Chatelain, & Ralf, 2010), and boosting a firm's IPO (initial public offering) valuation (Heeley, Matusik, & Jain, 2007). Due to an enhanced ability to access financing from the markets, patent-owning firms may be able to hold lower levels of (costly) cash assets and yet sustain a high level of R&D activity (Levitas & McFadyen, 2009). Because the availability of capital is an important precondition for the successful internal commercialization of technologies, the role of patents in securing financing can be viewed as being supportive of value creation by the firm.

Within the organization, the pursuit of patent strategies can be both disruptive and supportive of value creation activities. One notable advantage of patents is that they can motivate

inventors and R&D personnel by providing them with intrinsic and extrinsic rewards for their creative endeavors (Cohen et al., 2000). However, pursuing patents for this reason alone may be a distraction from the pursuit of a rational patent strategy, especially if there is little slack in the firm's patent management resources. An absence of slack patent management resources may be particularly telling when firms undertake highly disruptive patent litigation. For example, in a study of university technology transfer offices (TTOs), participation in litigation was found to significantly decrease the number of commercialization licenses concluded by the TTOs (Shane & Somaya, 2007). Thus, strategic actions oriented toward enforcement and litigation, which may follow from the organization's overall patent strategy, may come at the cost of disrupting important value creation activities (e.g., licensing of university technologies).

Another arena in which firms' value creation and patent strategies are closely intertwined is the creation of technology standards. The inclusion of patents in cooperative standards has the effect of increasing subsequent innovation that builds on them (Rysman & Simcoe, 2008), which may propel these technologies toward becoming a dominant design in the industry. The trade-off for the firm is that it must make its patents available for widespread licensing to meet the requirements of cooperative standard setting bodies. Empirical evidence suggests that firms with a strong technological advantage—as indicated by intensive patenting—are less likely to participate in cooperative standards (Blind & Thumm, 2004) and may therefore be making trade-offs between value creation and value capture. Conversely, if firms would like to participate, then a strong patent position may pave the way for both acceptance and influence in cooperative standard setting (Shapiro & Varian, 1999). Negotiations over patents are central to the creation of many cooperative industry standards, and firms with strong essential patents can leverage their patent position into advantages in network position and market power (Bekkers, Duysters, & Verspagen, 2002; Shapiro & Varian, 1999). When firms participate in standard setting, their important and valuable patents are more likely to be included in standards-based patent pools and are thus more widely licensed and commercialized (Joshi & Nerkar, 2010). Inclusion in patent pool licenses is a particularly attractive outcome for small firms that lack complementary commercialization assets, and research has shown that such firms are also more likely to engage in litigation when their patents are included in a standard (Simcoe, Graham, & Feldman, 2009). The trade-off of course is that participation and inclusion in cooperative standards commits firms to giving up some of the rights and remedies available through their patents.

The literature on standards and patents noted above points to a much larger set of questions linking patent strategy and open innovation. In particular, it highlights that maximizing appropriability through patents and creating value from the firm's innovation may sometimes be at odds. For example, Bar-Gill and Parchomovsky (2003) show that obtaining narrower patents and publishing R&D output may encourage other firms to build on a firm's technology and thus increase its overall value. Another interesting study models the patenting decision of financial firms and suggests that some financial inventions may not be patented so as to increase acceptance by other firms and create a more liquid market for the resulting financial products (Kumar & Turnbull, 2008). The authors provide corroborative empirical evidence that the inventing firm can appropriate rents from the success of such product innovation by using its human capital, client relationships, and expertise-related advantages even

without patent protection. While research has begun to address some of these interconnections between patent strategies and the firm's value creation through innovation, it remains an exciting area for further work. In particular, it would be worthwhile to further explore when firms are and are not better off pursuing "weak," nonproprietary patent strategies to enhance the value creation potential of their innovation.

Conclusion

The goal of this review has been to reorganize and reconceptualize extant research on patent strategy, which has emerged from diverse roots in economics, law, and management. It is anticipated that this reorganization will help provide structure and direction to what is currently a somewhat disparate and fractured field of study. The review highlights two important themes within the extant body of research on patent strategy—generic patent strategies and strategic considerations in managing patents. In addition, research within each of these themes has been mapped onto one (or more) of three key patent strategy domains—rights, licensing, or enforcement—within which patent-related strategic actions are typically undertaken. Furthermore, this review has noted that the theoretical logics within each patent strategy theme typically apply to all three patent strategy domains, even though any individual study may focus on a single domain. Finally, two promising areas have been highlighted whose connections with patent strategy are beginning to be addressed by research—namely, firms' overall appropriability strategies and value creation strategies. The reconceptualization of prior research undertaken in this review advances patent strategy scholarship by illuminating the many links between patent strategy research and the broader management field and identifying opportunities to address important unanswered research questions. It thus provides a useful roadmap to help stimulate and guide future research in this vital area.

Notes

1. Multiple research databases (ABI/INFORM, EBSCO, EconLit, LexisNexis, ProQuest, Scopus) were searched for the text "patents" and "strategy" or "intellectual property" and "strategy" or "appropriability" and "strategy." The goal was to capture research articles relating to patents not only in management journals but also in economics journals (through EconLit) and legal journals or law reviews (through LexisNexis). As a cross-check, all issues since 2000 of five journals (*Academy of Management Journal*, *Economics of Innovation and New Technology*, *Management Science*, *Research Policy*, and *Strategic Management Journal*) were manually reviewed. This step yielded very few additional relevant articles. Each article identified through the initial searches was then screened to include only those studies that had a strategic or managerial focus. In rare instances, relevant research was identified through citations within other articles already included in this review, or from the author's personal knowledge.

2. Legally, the "use" of a patent can cover many things, such as making, selling, offering to sell, importing, and so on. In addition, courts may interpret the coverage of the patent more broadly than its stated claims under the "doctrine of equivalents." However, the approach throughout this article is *not* one of legally rectitude or completeness. That approach invariably has the effect of obscuring the essence of patent strategy in a vast vocabulary of legalese, thus making it less accessible to management scholars. Interested readers are referred to Merges and Duffy's (2011) excellent legal text on patent law (or to the patents page on Wikipedia for a quick read: <http://en.wikipedia.org/wiki/Patent>).

3. The classification of research into patent activity domains is guided by the main phenomenon being studied (typically identified by the dependent variable), whereas categorizing research into patent strategies is naturally informed by its underlying theoretical logic(s), which can sometimes span more than one strategy.

4. Indeed, so-called blocking patents (which impede competitors' innovation paths) may be acquired to pursue any of the three generic strategies described below—proprietary, defensive, or leveraging.

5. Defensive patent strategy, as defined here, does not map particularly well onto the somewhat loose “offensive versus defensive” terminology used by patent lawyers in practice. This latter terminology is primarily employed to describe reasons for obtaining patents, wherein the term *offensive* applies to patents that the firm seeks to assert against others and *defensive* to patents that are used to deter others from suing the firm. While the use of the term *defensive* may appear to be similar to a defensive patent strategy, it should be noted that firms often need to assert their “defensive patents”—i.e., go on the offensive—if the defensive strategy is to be credible (Somaya, 2003). Furthermore, as described in this section, the range of potential defensive strategies extends far beyond the mere acquisition of patents for that purpose.

6. See Andy Rosen, “Maryland Settles Claim with Scientific Games over Keno Feature,” *Daily Record* (Baltimore), August, 12, 2008.

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