The Role of Patents in Fostering Open Innovation[1]

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I. Introduction

A. Overview

The theory of Open Innovation is a contemporary management theory which teaches that corporations can increase their innovative output by importing ideas from outside the firm. Open Innovation holds much promise, in particular, as a means for small innovative companies to collaborate with large, established producers to create otherwise impossible radical innovations. This Paper analyses the role of patent protection in fostering these collaborations. The analysis first examines the commercialization and innovation processes and concludes thatcollaboration is most beneficial to both parties when the innovation improves an existing product, yet is from a technologically distant field. In these circumstances, patent protection fails to adequately protect the innovator, so alternative means of promoting collaboration must be devised.

B. Motivations

The patent system is at an inherent tension with contemporary practices of innovation. American patent doctrine reveres the lone inventor who, through the marshalling of extraordinary insight and experimental toil, conceives a novel invention. As a reward, the inventor is given the right to profit from his contribution through personal commercial exploitation. While this perspective may have reflected the practice of the mechanical arts at the time of the nation's founding, it no longer reflects contemporary industrial research and development. Contemporary innovation is a networked process. Ideas are created from the recombination of elements from various firms and in various industries. The construction of enterprises to manufacture new inventions is often beyond the capability of the lone inventor, even with the benefit of the patent monopoly.

This disconnect is evidenced by the fact that contemporary patent doctrine has failed to balance the costs and benefits of its intervention in industrial market structures. Its benefits - an increase in innovative output by American firms - has been on the decline in the past decade. Conversely - its costs - most notably manifest in the rise of opportunistic "patent trolls" seeking to exact royalties on unpracticed patents, are on the public rise.

These problems arise from the fact that the fundamental premise of the patent system - that an in crease in ex-ante incentives to innovate will lead to a correspondingly large rise in innovative output - is proving to be flawed. Modern research suggests that innovative output does not rise with a corresponding rise in investment in research and development. Instead, large incentives draw in wasteful rent seekers such as patent trolls, who seek to profit from the misplaced incentives given to innovators.

Contemporary management theory has studied for quite some time beneficial behaviors and processes which firm can employ to increase their innovative output. The intellectual property regime should shift its focus from tailoring the size of incentives offered to tailoring the focus to motivate beneficial innovative behaviors. This paper examines one such theory, the theory of Open Innovation[3], and analyzes the role of contemporary patent doctrine in supporting firm practices which are consistent with it. Ultimately finding that patent doctrine fails to provide the proper incentives for

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[3] *See generally* HENRY W. CHSBROUGH, OPEN INNOVATION: THE NEW IMPERATIVE FOR CREATING AND PROFITING FROM TECHNOLOGY 43-63 (2003).

promoting Open Innovation, the paper then suggests several stopgap measures which industry can put in place to take advantage of the benefits of the philosophy.

The Open Innovation theory offers a beneficial analytical framework for two reasons. First, through analyzing the innovation process, it teaches a method whereby established firms can effectively increase their innovative output.[4] Second, by demonstrating beneficial interactions between small-firm licensors and established producer-licensees, it offers a framework for productive licensing from non-manufacturing patent holders as an alternative to the wave of destructive "patent trolling" prevalent in contemporary industry.

C. Approach

This Paper posits the following analysis: The theory of open innovation advocates that established firms can improve their innovative output by purchasing ideas from outside firms. Third-party innovators will participate in open innovation when incumbent firms possess the complimentary assets and customer relationships necessary to commercialize their innovation. Open innovation models best yield breakthroughs when innovations from technically distant fields are incorporated into incumbent products. Innovations can only be transferred across such technical distances when parties exchange tacit know-how. Know-how transfer is fraught with risks, which are exacerbated by the bargaining power that the incumbent enjoys over the innovator. The innovator, therefore, requires patent protection in order to provide legal leverage over the incumbent. Patent protection weakens when innovations are licensed over technical distances because there is a greater likelihood that a blocking patent can be received on

[4] Innovative output will be employed in this Paper as the metric by which to evaluate performance, and corresponds to the frequency of producing radical breakthrough innovations.

the final product. Therefore, private, reputation-based, mechanisms are required to foster breakthrough open innovation systems.

Part II of this Paper discusses the Open Innovation theory and its application in industry. Part III analyzes firm incentives to engage in these practices by analyzing the factors which lead a small firm to license, and by utilizing the rubrics of recombinant and network innovation theory to analyze what firm practices under Open Innovation lead to the most innovative results. Part IV examines the legal and institutional mechanisms of intellectual property exchange necessitated by Open Innovation, and identifies the tensions that the facilitation of these mechanisms places on intellectual property doctrine. Part V examines the current law, and identifies its shortcomings in supporting the advocated industry practices. Finally, Part VI discusses the implications for patent policy and private measures that can be taken by industry to fill this void.

II. The Open Innovation Philosophy

A. The Open Innovation Theory

A contemporary management strategy has significant potential to alter the use of patents and other intellectual property in commercializing new technologies. Countering the traditional notion of patent licensing as a tax upon producers, the theory of open innovation encourages large firms to actively seek out new technologies from the outside as inputs to their research and development programs.[5] The philosophy argues that changes in the industrial landscape over the past decades require firms to be open to

[5] *See id.*

external ideas in order to remain competitive. Firms must make use of external intellectual property as a supplement to, not a replacement for, internal R&D.

Open innovation is a contrast to the traditional, "closed innovation," model employed by the large vertically integrated firms which grew prominent during the twentieth century.[6] In a closed model, firms perform their own upstream research in academic-like corporate campuses, such as Xerox' PARC. The output of these laboratories are then be vetted by the individual business groups for use in their product lines. Technologies which can not find a use are shelved internally.

Open innovation posits that this model can no longer be successful because the growth of alternative models of technology development challenge the competitive advantage of integrated R&D[7]. The model of large firm funded R&D has been replaced by one in which the growth of venture capital financing and employee mobility have made possible ideation and commercialization in startup firms.[8] Consequentially, ideas conceived by large firms will not sit latently but will rather be spun out by their inventors. Furthermore, small firms that focus on process efficiency can buy product ideas from outside, and effectively compete with their integrated rivals.

Open innovation therefore advocates that firms open their boundaries to the flow of ideas.[9] Ideas conceived outside of in-house R&D labs can be purchased for internal use. Likewise, technologies conceived internally, but with no internal application, can be licensed to outsiders. In all cases, technologies must be capitalized on while they are still

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[6] *See id.* at 21-43.
[7] *See id.* at 35.
[8] *See id.* at 36.
[9] *See id.*

new, as the constant external development of competing technologies renders them obsolete.

Although Professor Chesbrough is perhaps the most vocal advocate of the open innovation model, similar theories are prevalent in the contemporary literature. Management consultancies have recently advocated that companies open up parts of their innovation process to outside firms. Booz-Allen-Hamilton states "Just as best-in-class companies manage increasingly extended supply chains, superior innovators are learning to outsource segments of the innovation value chain."[10] The Boston Consulting Group cites to Joy's Law, "Assume that innovation will occur elsewhere."[11] Arthur D. Little advocates a "co-innovation" alliance structure.[12] Trade journals such as Research-Technology Management have likewise printed articles advocating the adoption of integrated external-internal R&D programs.[13]

Empirical evidence suggests that open innovation models are being adopted in some industries. Outsourced design is common in the electronics industry. Seventy percent of PDA's are designed by external firms, as well as sixty-five percent of notebook PC's and twenty-percent of mobile phones.[14]A recent survey shows that a majority of firms plan on increasing the volume of in-licensing over the next five years. [15]

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[10] Alexander Kandybin & Martin Kihn, *Raising Your Return on Innovation Investment*, BOOZ-ALLEN-HAMILTON RESILIENCE REP., May 11, 2004, at 10.
[11] Max Blaxill & Kevin Rivette, *Acquiring Your Future*, BOSTON CONSULTING GROUP PERSPECTIVES NO. 409 (2004).
[12] *See* Stefan Odenthal et al., *Co-Innovation: Capturing the Innovation Premium for Growth*, ARTHUR D. LITTLE PRISM, Jan. 2004, at 41-55.
[13] *See* Joseph S. Holmes & Jeffrey T. Glass, *Internal R&D – Vital but Only One Piece of the Innovation Puzzle*, RES.-TECH. MGMT., Sept.-Oct. 2004.
[14] *See* Pete Engardio & Bruce Einhorn, *Outsourcing Innovation*, BUSINESSWEEK ONLINE, Mar. 21, 2005.
[15] *See* Meagan C. Dietz & Jeffery J. Elton, *Getting More from Intellectual Property*, MCKINSEY Q., Winter 2004.

B. Practical Application: Connect & Develop at Procter & Gamble

One very successful implementation of the open innovation philosophy has been at Procter & Gamble. In 1999, P&G began its Connect & Develop initiative as part of a series of programs to retool its innovation process.[16] Connect & Develop focused on the cross-pollination of ideas both across P&G's various business groups and with external firms.[17] By 2004, the program contributed to the launch of several brand extensions and a 12% volume growth in P&G's core brands.[18]

Connect & Develop was an umbrella for a variety of various knowledge-brokering activities.[19] While a large part of the effort focused on internal knowledge management, a significant portion of the program developed a variety of mechanisms for external technology acquisition. The program received considerable support from C.E.O. A.G. Lafley[20], who made a stated goal of externally sourcing fifty percent of the company's new product ideas by 2007.[21] The fifty percent goal was, in the words of Lafley, "a metaphor for the fact that we don't care where the ideas come from."[22]

The initiative was a response to increased competitive pressures in the consumer products industry which had, by 2000, placed P&G in a serious performance slump.[23] The greatest driver was the growing rate of innovation in the industry, which had roughly

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[16] *See* CHESBROUGH, *supra* note 1, at xxvii.
[17] *See* Nabil Y. Sakkab, *Connect & Develop Complements Research & Develop at P&G*, 45 RES.-TECH. MGMT. 38 (2002).
[18] *See* Patricia Sellers, *P&G: Teaching an Old Dog New Tricks*, FORTUNE, May 31, 2004, at 166. (Commenting that very few equally sized companies are able to grow core volume over 10%.)
[19] *See supra* text accompanying notes 67-72.
[20] *See* Kenneth Klee, *Grand Opening: Procter & Gamble Once Kept R&D Close to the Vest. Now Outlicensing is Driving its Growth*, INTELL. PROP. L. & BUS., Feb. 2005 (Quoting Larry Hustson, vice president for R&D, innovation, and knowledge as saying "[w]hat's driving this at P&G is our CEO.").
[21] *See id.*
[22] Erick Schonfeld, *P&G's Growth Wizard*, BUSINESS2.0, Jan.-Feb. 2005, at 48 (Quoting C.E.O. A.G. Lafley).
[23] *See* Robert D. Hof et al., *Building an Idea Factory*, BUS. WK., Oct. 11, 2004.

doubled in the previous decade.[24] In the words of one executive, this put pressure on the internal R&D program because, "when we make an innovation and bring it into the marketplace, it has a much shorter life than it had previously."[25] This was coupled by a growing recognition that the level of relevant technical talent was growing – and that P&G could benefit by "exploit[ing] the entrepreneurial spirit and the tremendous intellectual capability that exists outside the company."[26]

P&G faced the challenge of maintaining its integrated, old-line structure while becoming a participant in the global research community. Connect & Develop was intentionally not an effort at outsourcing the R&D activities of the firm.[27] Nor was it going to be implemented by the hiring of external talent – which would contravene the firm's traditional hire-from-school and promote-from-within mentality.[28]

P&G developed a variety of mechanisms to understand the external research environment and to bring ideas into the company. These programs accessed a variety of external innovation sources, spanning from technical consultation to entirely conceived products.

At one extreme, P&G actively fostered relationships with academics and outside researchers to gain insight into the external technical environment. The company has been working with university researchers since the 1950's.[29] Under Connect & Develop, however, it has streamlined the process by focusing on "highly-leveraged nodes," well-connected members of the scientific community who have social ties to vast numbers of

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[24] Online Extra, *At P&G, It's "360-Degree Innovation,"* BUSINESSWEEK ONLINE, Oct. 11, 2004 (Interview with Chief Technology Officer Gilbert Cloyd.).
[25] *Id.*
[26] *Id.*
[27] *See* Sellers, *supra* note 18.
[28] *See id.*
[29] *See* Sakkab, *supra* note 17, at 44.

researchers. By leveraging these connections, P&G has been able to "network to the external [scientific] world where some of the important research is under way and tie it back into our efforts."[30]

Similarly, P&G developed an internal staff of experienced technologists titled Technology Entrepreneurs.[31] The staff actively searched patent data, scientific literature, and the internet to identify the state of the external art. In particular, the group focused on identifying solutions from unexpected sources for internal problems.

When the "highly-leveraged nodes" of research networks did not exist, P&G has worked with external intermediaries to create them. One example, InnoCentive, originally launched by Eli Lilly, is a network of external contract researchers.[32] These researchers, often scientists and research institutes in areas such as China, Russia, and India, bid to solve abstracted technical problems posted on the firm's web site.[33] These arrangements are often done for a fee, and with a complete assignment of intellectual property rights.

P&G also participates in Yet2.com, an online intellectual property marketplace.[34] Both buyer and seller firms post abstracted descriptions of patents, know-how and problems to be solved on a searchable on-line database. When mutual matches are made, the parties are introduced and, subsequently, enter into some form of technology agreement.

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[30] John Teresko, *P&G's Secret: Innovating Innovation*, IND. WK., Dec. 1, 2004, at 27 (Quoting P&G Chief Technology Officer G. Gil Cloyd.).
[31] *See* Sakkab, *supra* note 17, at 42.
[32] *See* Gary H. Anthes, *Innovation Inside Out*, COMPUTERWORLD, Sept. 13, 2004. P&G also makes use of NineSigma, a Cleveland firm which solicits solutions to technical problems posted anonymously, and YourEncore, also created by Eli Lilly, which matches retired researchers with contract research problems.
[33] See firm website, www.innocentive.com.
[34] See firm website, www.yet2.com.

While P&G suggests that lone innovators make use of its intermediary services to contact the firm[35], it has also dealt directly with third party innovators. In developing its new line of products incorporating electromechanical components, such as the Swiffer Vac vacuum, P&G needed an entirely novel category of technical expertise.[36] The company used contract design to access the necessary talent. C.E.O. Lafley described the benefits of the contractual acquisition of external talent:

> We have a lot of chemists, a lot of chemical engineers, a lot of biochemists. We aren't going to go out and hire a lot of electricians and mechanical engineers. We're going to use people who know how to do that, design that, and engineer it. But we're going to use our techniques for reliability and quality because they apply across manufacturing processes.[37]

Finally, P&G has outright acquired completed product designs from external entrepreneurs. A notable case is the development of the Crest Spinbrush, a low-cost electrical toothbrush which has been a commercial success. The brush was originally invented and prototyped by an individualentrepreneur with the goal of licensing the design to a major manufacturer. The company actively solicits developed external technologies, looking for "Ready-to-Go" technologies, products, and packaging.[38]

The Connect & Develop program has been a considerable success at P&G. By 2004, 35% of new product ideas were externally sourced, up from 10% in 2000.[39] It has lead to the introduction of many new products, increasing the product hit rate from 70%

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[35] *See* PROCTER & GAMBLE, CONNECT & DEVELOP: CREATING A GLOBAL INNOVATION NETWORK TO BETTER SERVE CUSTOMERS 7, (2003) *at* www.scienceinthebox.com/en_UK/pdf/C_DbrochureFINAL.pdf (last accessed April 10, 2005).
[36] *See* Beth Belton, *Newsmaker Q&A: Lafley on P&G's Gadget "Evolution,"* BUSINESSWEEK ONLINE, Jan. 28, 2005.
[37] *See id.*
[38] *See* PROCTER & GAMBLE, *supra* note 35, at 5.
[39] *See* Teresko, *supra* note 30.

to 90%,[40] while lowering R&D costs by 20%[41]. While other firms may not replicate P&G's success, its experience suggests that there is merit to the open innovation philosophy.

III. Theoretical Justifications for Open Innovation

Before examining the role of patents as a mechanism for innovation transfer in open innovation, it is necessary to define the forces which drive such transactions. Any arrangement to divide innovative and commercialization activities between two firms incurs costs which must be offset by the potential benefits to the parties. Most significantly, such arrangements require the parties to divide the profits of the endeavor and expose the parties to the risk of moral hazard, most critically manifest in the risk of misappropriation of the innovation itself. These and other transaction costs of innovation transfer may alone render transfers unprofitable.

For the innovator, where transfer serves as a means of commercialization, innovation transfer is attractive when its innovation can best enhance the performance of an existing technology being successfully implemented by an established firmFor the producer, where it serves as a supplement to internal R&D, innovation transfer is a rapid and cost effective means of incorporating unfamiliar technologies into existing products. By examining the incentives for both parties, this section argues that transfers are most beneficial when they take place between firms in many disparate fields, and they involve commercial activity near the core business of the established producer.

[40] *See* Sellers, *supra* note 18. The product hit rate measures the percent of new products which deliver a

A. Motivations for the Small-Firm Licensor

Open innovation programs must motivate innovators to contribute to incumbents.[42] Upon conception of a technological innovation, the innovator is therefore faced with a simple choice: commercialize the innovation itself, or partner with another firm. This decision is driven by a confluence of factors, which have, collectively and individually, received considerable attention in the literature.[43] The most fundamental factors are the relation of the technological innovation to a viable business plan, the relative distribution of complimentary assets which comprise the value chain linking the innovation to the business result, and the competitive response of established producers. When taken together, these factors suggest that commercialization through innovation transfer is most lucrative when the potential application of the innovation is an incremental improvement to a successful product of an established firm.

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return above the cost of capital.

[41] *See At P&G, It's "360-Degree Innovation," supra* note 24.

[42] Although open innovation is often synonymous with open source, the most beneficial innovations likely will not emerge from open source practices. *See generally* Joel West & Scott Gallagher, Key Challenges of Open Innovation: Lessons from Open Source Software 5-6 (Working Paper, May 2004). While open source would provide incumbent platforms access to external ideas, the low powered disclosure incentives the approach offers presumably exclude the contribution of valuable or costly innovations. Open source disclosure's primary incentives are personal satisfaction and reputation. *See id.* (Discussing the intrinsic benefit of personal fulfillment and competence signaling as general contributor motivations.). Furthermore open source can be effective when there is an established incumbent who occupies a key network node, and all suppliers would benefit from the establishment of a competitive standard. *See id*. (Discussing direct utility as another motivator.). For example, the success of open source operating systems such as Linux is arguably driven by an industry-wide desire to unseat Microsoft from its dominance in a key part of the software market. In such cases, the positive externalities of open source innovation would serve as sufficient incentives to motivate disclosure. In most cases, however, innovation exchange is motivated primarily by the potential to profit directly from the innovation itself.

[43] *See generally* Joshua S. Gans & Scott Stern, *The Product Market and the Market for Ideas: Commercialization Strategies for Technology Entrepreneurs*, 32 RES. POL'Y 333 (2003); CLAYTON M. CHRISTENSEN, THE INNOVATOR'S SOLUTION 31-71 (2003); David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RES. POL'Y 285 (1986); DAVID J. TEECE, MANAGING INTELLECTUAL CAPITAL 91-113 (2000); CHESBROUGH, *supra* note 1, at 63-91, 155-76.

The conditions surrounding technology commercialization vary greatly because of the complex relationship between a technical innovation and an economic benefit.[44] The relation is best conceptualized as a value chain linking the technical innovation and some source of consumer benefit.[45] Ultimately, the consumer pays for a product which effects some beneficial result for him – it is this benefit which is the ultimate source of economic value.[46] Conceptually, there is a lot of ground to be covered between the two. A technical innovation is not limited to one commercial embodiment, and is often only on of several innovative inputs to a given product.[47]

The relationship of the customer value proposition and value chain to potential competitors determine whether a new technology should be licensed. The first consideration is the value chain, comprised of the complimentary assets required to turn the idea into fruition.[48] These assets take many forms, from necessary components to manufacturing techniques, to brands. In order to create an economic benefit, these resources must be marshaled together with the innovation into one coordinated effort. Consequentially, the costs of assembling these resources restrict the ability to develop a novel value chain.

Venture capital has made the financing of such endeavors possible, but recent trends favor investments in scaling up small firms which already have shown small scale commercial success – firms which have, therefore, already marshaled enough complimentary assets for some level of production. Autonomous assembly of

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[44] *See* Gans & Stern, *supra* note 43, at 336.
[45] *See* CHESBROUGH, *supra* note 1, at 63-71.
[46] *See* CHRISTENSEN, *supra* note 43, at 71-79 (2003). *See also* Gans & Stern, *supra* note 43, at 346.
[47] *See* TEECE, *supra* note 43, at 152-53.
[48] *See* Teece, *supra* note 43.

complimentary assets may take considerable time, seriously eroding lead time.[49] Furthermore, the skills necessary to build the business around a technology are considerably different than those required to develop it, and, provided they have the inclination to do so, inexperienced inventors may have a difficult time securing venture financing without a track record of success.

Existing firms which possess the requisite complimentary assets are likely to be competitors to a potential startup firm.[50] A second consideration is, therefore, if startup commercialization would trigger a competitive response which the startup firm would be unable to survive.[51] This is very likely when the proposed business proposition lies close to that of an established firm.

Established firms generally have commitments to complimentary assets necessary to support a given business proposition, and have high incentives to maintain the utilization of those assets. Their potential responses are generally limited by a path dependency constrained by their asset commitment and existing knowledge base.[52] Consequentially, they are generally constrained to compete along a single technological trajectory towards incremental improvements along the established product performance dimension.[53] In other words, they are highly motivatedto maintain their current customer base, and to do so through technological innovation which makes their current offerings better.[54]

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[49] *See* Gans & Stern, *supra* note 43, at 336.
[50] *See* Gans & Stern, *supra* note 43, at 335.
[51] *See* CHRISTENSEN, *supra* note 43, at 31-65.
[52] *See* Lori Rosenkopf & Paul Almeida, *Overcoming Local Search Through Alliances and Mobility*, 49 MGMT. SCI. 751, 751 (2003).
[53] *See* Gans & Stern, *supra* note 43, at 342.
[54] *See* CHRISTENSEN, *supra* note 43, at 31-65.

Innovations which do not lie on that trajectory are less likely to trigger a competitive response. In particular, innovations which either address an unmet need of the existing customer base, or meet existing needs which are over served by the established players, are likely to disrupt their entrenched business operation.[55] In those cases, a startup firm may not trigger a competitive response until it has already had time to build its own stock of complimentary assets necessary to survive direct competition.

In summary, partnering is generally less attractive than startup commercialization because of the need to divide profits and the risk of moral hazard. However, in many cases, partnering provides an avenue for profiting in circumstances which would not support the growth of a startup firm. Two general factors control when startup commercialization will be preferred to partnering. First, established firms have a significant advantage when the required commercialization pathway requires complimentary assets which they already possess.[56] Second, if the new innovation is disruptive to the industry, then there is little advantage in partnering. Therefore, commercialization through partnering is beneficial when technical innovation would support an incumbent's existing business model as an improvement to an existing product.

B. Recombinant Innovation as a Motivation for the Established Producer

An integrated producer can benefit from external innovations which supplement its internal R&D efforts.[57] Integrated manufacturers enjoy a significant knowledge

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[55] *See* CHRISTENSEN, *supra* note 43, at 31-55.
[56] Assuming the startup would otherwise have access to capital.
[57] *See* DOROTHY LEONARD, WELLSPRINGS OF KNOWLEDGE: BUILDING AND SUSTAINING THE SOURCES OF INNOVATION 135-75 (1998) ("The activity of importing knowledge starts with identifying gaps in core

advantage in their area of operation. Their operations generate significant volumes of knowledge about both their existing products and their existing consumers.[58] This specific local knowledge is intrinsically superior to comparable knowledge generated outside the firm.

Superior understanding of existing processes does not, however, byitself lead to greater innovation. Recombinant innovation theory teaches that new innovations are created by the novel recombination of disparate ideas. It is not the simple volume of ideas, but their diversity, which leads to the novelty of new innovations. This realization suggests the need to look beyond the boundaries of any particular firm for inputs to the innovative process. Rationally organized firms have some outer bound as to the technical endeavors which they pursue, and are subsequently constrained in the variety of ideas which exist within their bounds.[59] Entrenched product and manufacturing platforms, a key to competitive success visà vis new entrants also serve as a psychological restriction, constraining the scope of research and development which a firm can consider.[60] The limitation of technical expertise to familiar areas further constrains the scope of potential solutions.[61]

Established producers will in-license innovations when doing so would increase their innovative output. By combining the intellectual assets of two separate R&D efforts, open innovation systems hold the potential to create radical new products which

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capabilities . . . Such gaps may arise for many reasons, three of the most important of which are (1) a deliberate corporate policy to lessen internal research, (2) sizable advances or discontinuities in a given technology, or (3) newly identified opportunities for technology fusion.”).

[58] *See* Bernard Guilhon, *Markets for Knowledge: Problem, Scope and Economic Implications*, 13 ECON. INNOVATION & NEW. TECH. 165, 173 (2004).

[59] *See generally id.* at 173.

[60] *See* Gans & Stern, *supra* note 43, at 338 (Discussing the potential to preserve existing rent generation pathways tied to complimentary assets.).

[61] *See supra* text accompanying notes 78-84.

would otherwise not be conceived. In contrast to patent doctrine's traditional search for a "flash of creative genius,"[62] modern theories argue that innovation is not a random process. Rather, the related theories of recombinant innovation, technology brokering, and network innovation all describe innovation as a process of creating new ideas through the combination of existing knowledge and ideas. The concept of explorative search describes the manner in which innovators reach into unfamiliar areas to create novel combinations. Taken together, these theories show that radical breakthrough innovations result from the combination of elements from distant fields of technology.

The theory of recombinant innovation posits that all innovations are simply combinations of existing ideas.[63] Ideas are not spawned autonomously, but are rather the result of brining together existing elements in previously unforeseen manners. The recombination could be a novel use of an existing element, or the rearrangement of existing elements into new combinations.[64] Novelty is expressed through the act of recombination itself.[65]

Technology brokering theory extends this reasoning.[66] Technical innovations, it argues, can stem from the reapplication of existing technologies to new areas and new problems. Technical advances in one field are made, not through the advancement of that particular art, but through exploiting advances made in other areas.[67] Some of the most

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[62] *See* Graham v. John Deere Co., 383 U.S. 1, 15 (1966).
[63] *See* Lee Fleming, *Recombinant Uncertainty in Technological Search,* 47 MGMT. SCI. 117, 118-20 (2001); Lee Fleming & Olav Sorenson, *Science as a Map in Technological Search*, 25 STRATEGIC MGMT. J. 909, 910-912 (2004); Lori Rosenkopf & Paul Almeida, *Overcoming Local Search Through Alliances and Mobility*, 49 MGMT. SCI. 751, 751 (2003); ANDREW HARGADON, HOW BREAKTHROUGHS HAPPEN: THE SURPRISING TRUTH ABOUT HOW COMPANIES INNOVATE 2-52 (2003).
[64] *See* Fleming, *supra* note 63, at 118.
[65] *See id.*
[66] *See* Andrew Hargadon & Robert I. Sutton, *Technology Brokering and Innovation in a Product Development Firm*, 42 ADMIN. SCI. Q. 716 (1997); HARGADON, *supra* note 64, at 12-13.
[67] *See* Fleming*, supra* note 63, at 119; *See* also HARGADON, *supra* note 63, at 12.

momentous innovations of all time were made by integrating facilitating advances in other fields.[68]

The import of these theories is best described by Professor Hargadon:

> Knowledge is imperfectly shared over time and across people, organizations, and industries. Ideas from one group might solve the problems of another, but only if connections between existing problems and solutions can be made across the boundaries between them. When such connections are made, existing ideas often appear new and creative as they change form, combining with other ideas to meet the needs of different users. These new combinations are objectively new concepts or objects because they are built from existing but previously unconnected ideas.[69]

Entire firms have structured their innovative efforts in light of these theories. The design firm IDEO, often studied for its innovative output, uses its technical breadth as a means of spawning new ideas.[70] The firm actively solicits design work in a wide variety of fields, from shampoo-bottles to Amtrak railcars. After each project, it retains components it has seen and conceived in an internal library, to which future engineers can turn for inspiration.[71]

Network innovation theory reaches a similar result. Network innovation theory posits that technological innovations result from the discussion of researchers operating in various organizations.[72] Knowledge flows across informal social networks. Networks are comprised of a series of generally closed small worlds, whose members share strong ties with each other and weaker ties with outsiders.[73] While the strong ties facilitate information flow, the weak ties hold the promise of innovative output. Ideas transferred

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[68] *See id.* at 36-46. (Describing the example of Ford's development of mass production.).
[69] *See* Hargadon, *supra* note 66, at 716.
[70] *See* HARGADON, *supra* note 63, at 135-38.
[71] *See id*. at 147-149.
[72] *See* Walter W. Powell et al., *Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology*, 41 ADMIN. SCI. Q. 116 (1996).
[73] *See* HARGADON, *supra* note 63, at 57-60.

along weak network ties tend to be more novel.[74] Network position impacts the performance of any particular innovator. Individuals who occupy node locations with ties to many distant worlds, tend to be the most innovative.

These theories suggest that technology evolves through convergence. New technologies arise from the intersection of previously unconnected fields. Technology fusion describes the process whereby entirely new technologies, such as electro-mechanical manufacturing equipment, were spawned by the integration of different fields of art.[75] New fields, such as biotechnology and nanotechnology, stem from the integration of existing disciplines.[76]

There are an almost unlimited number of potential recombinations which an innovator may pursue.[77] The process of finding and trying new technical inputs is often referred to as search.[78] Search processes are often characterized as either local or distant.[79] Local searches involve components with which the innovator is familiar. Distant searches tap into unfamiliar fields.

Distant search occurs over a conceptual distance. Technologically distant search draws from unfamiliar technical fields.[80] Distant search can also occur within the same technical field. Geographically distant search taps into distinct bodies of thinking which evolve in different physical loci – cross-pollinating, for example, ideas from disparate

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[74] *See id*. *See also* Rosenkopf and Almedia, *supra* note 63, at 755.
[75] *See* Fumio Kodama, *Technology Fusion and the New R&D*, HARVARD BUS. REV. July-Aug. 1992, at 70; Joe Tidd, *Development of Novel Products Through Intraorganizational and Interorganizational Networks: The Case of Home Automation*, 12 J. PRODUCT INNOVATION MGMT. 307, 309 (1995); LEONARD, *supra* note 57, at 148-51.
[76] *See* Sonia E. Miller, *Converging Technologies*, 2 EMPIRE: THE MAGAZINE OF BUSINESS INNOVATION 28 (2004).
[77] *See* Fleming, *supra* note 63, at 119.
[78] *See* Fleming, *supra* note 63, at 118-21.
[79] *See* Fleming, *supra* note 63, at 119. This taxonomy is also often referred to as exploitive or explorative. Explorative search is often synonymous with boundary-spanning.

enclaves like Route 128 and Silicon Valley.[81] Organizationally distant searches tap into different solutions which are developed by distinct organizations working in parallel on similar problems.[82]

Distant search produces more unpredictable results. In local search, the innovator learns over time how components interact, and is better able to marshal them to create useful results.[83] However, over time, the output of local search tends to be incremental. The lack of uncertainty in local search limits its potential to generate radical, unexpected, innovations. Therefore, radical innovation is most likely to be generated by recombination employing distant search.

Taken together, these theories suggest that breakthrough innovations occur when unfamiliar technologies are brought together.[84] This is a significant observation because it informs a mechanism whereby technology transfer creates, instead of merely distributes, value. A degree of recombination occurs in every open innovation project. Innovation does not stop when the commercialization process begins. Product development involves the combination of a number of sources of knowledge and experience.[85] The technical innovator contributes the novel technology. The producer

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[80] *See* Lori Rosenkopf & Atul Nerkar, *Beyond Local Search: Boundary Spanning, Exploration, and Impact in the Optical Disk Industry*, 22 STRATEGIC MGMT. J. 287 (2001); Rosenkopf & Almeida, *supra* note 63.
[81] *See* Rosenkopf & Almeida, *supra* note 63, at 752-53.
[82] *See* Rosenkopf & Nerkar, *supra* note 80, at 288-91.
[83] *See* Fleming, *supra* note 63, at 120-21.
[84] *See* Rosenkopf and Almedia, *supra* note 63, at 763. *See also* Rachelle C. Sampson, R&D Alliances & Firm Performance: The Impact of Technological Diversity and Alliance Organization on Innovation at 30. (New York University Working Paper, Sept. 2003).
[85] *See* MARCO IANSITI & ROY LEVIEN, THE KEYSTONE ADVANTAGE 175 (2004) ("The process for technology integration has at its central objective the fusion of knowledge of exiting operations with the knowledge of new possibilities. This knowledge is often embedded in people and systems scattered across the ecosystem, ranging from customers to internal experts, and from external consultants to technology suppliers.").

contributes technical knowledge about the existing product,pro cess, and market[86] New knowledge is generated throughout the commercialization process – from experimentation to production tooling to user feedback.[87] The final commercial product is the manifestation of the combination of the innovator's technological innovation with the producer's experience and knowledge.[88]

In summary, recombinant innovation and associated theories teach that new technologies are generated by combining existing ones. Explorative search creates novel combinations of unrelated elements which may lead to technological breakthroughs. Open innovation therefore creates value by fostering the recombination of novel technologies with existing products, resulting in the conception of radical new products which are beyond the ability of any one firm to envision.

IV. The Mechanics of Technology Transfer

There are a wide variety of legal and market mechanisms for acquiring outside technologies, running the gamut from acquisitions to patent licensing.[89] The mechanism used impacts the type of knowledge exchanged between parties, which in turn impacts the chances of creating a breakthrough product. This section first identifies three arm's-length mechanisms for technology transfer. The mechanisms are then analyzed, and it is argued that the most effective mode of technology transfer for generating breakthrough products requires the exchange of tacit know-how.

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86 *See* Helen L. Smith et al., *'There are two sides to every story': Innovation and Collaboration within Networks of Large and Small Firms*, 20 RES. POL'Y 457, 460 (1991) (Observing that "innovative small companies may need to another company's technological resources to ensure that any development can be exploited.").
87 *See* DOMINIQUE FORAY, THE ECONOMICS OF KNOWLEDGE 59-64 (2000).
88 *See generally* Hargadon, *supra* note 66, at 716-18.

A. Mechanisms for Technology Transfer

Open innovation can best be realized through arm's-length transactions. External technology acquisition can be accomplished through either integrated or arm's-length transactions. Integrated acquisitions are favored when the transaction costs of contractual technology exchange are prohibitive.[90] However, integrated technology transfer frustrates the purpose of the open innovation philosophy. Innovation networks operate through the fluid exchange of knowledge between researchers working in disparate technical and organizational fields. Vertical integration would restrict the flexible exchange of information, as well as curtail organizational diversity across the network. Furthermore, open innovation is attractive because it offers greater innovative output with a smaller and more nimble internal R&D staff. These benefits would not be realized if external firms and personnel would need to be added to internal programs to effect technology transfer.

There are, consequentially, three primary modes of arms-length technology acquisition.[91] The modes vary in amount of knowledge exchanged between parties. The first, passive licensing, involves the least information exchange. It involves the payment of royalties predicated on patent rights, with knowledge exchange limited to patent publication. The second, modular integration, involves greater information exchange. The technology buyer communicates an architecture to innovators, who in turn provide

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[89] *See* Gans & Stern, *supra* note 43, at 337
[90] *See* Teece, *supra* note 43; Joanne E. Oxley, *Appropriability Hazards and Governance in Strategic Alliances: A Transaction Cost Approach,* 13 J. L. ECON. & ORG. 387, 402 (1997).
[91] *See generally* Guilhon, *supra* note 58; Deepak Somaya & David J. Teece, Combining Inventions in Multi-invention Products: Organizational Choices, Patents, and Public Policy (SSRN Working Paper, Nov. 2000).

innovations designed to function across the standard. Finally, active licensing, the third mode, is the most open, in which the innovator transfers tacit know-how to the innovation buyer.

Modular and passive-licensing modes offer lower transaction costs than tacit know-how exchange. As will be developed below, however, both modes do so at the cost of lower innovative performance.

B. The Limits of Modularity

Modular design is a very popular method of facilitating collaborative development. There are three general types of modularity: open architectures, component-level modularity, and design modularity. Modular design has significant advantages and disadvantages compared to integrated modes. It lowers the transaction costs of technology transfer, but, in return, limits the radicalness of the ensuing innovations.[92]

Modularity can be designed into a system, and systemic innovations can be made more autonomous through a variety of management mechanisms.[93] Any collaborative design effort in which the design tasks are partitioned ex-ante is essentially modular.[94] In particular, modularity is manifest when the resulting technical performance of system is decoupled from variations in its components.[95] There are three general methods of modularizing design.

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[92] *See* FORAY, *supra* note 87, at 67.
[93] *See* Somaya & Teece, *supra* note 91, at 11.
[94] *See generally* ASHISH ARORA, ANDREA FOSFURI, AND ALFONSO GAMBARDELLA, MARKETS FOR TECHNOLOGY: THE ECONOMICS OF INNOVATION AND CORPORATE STRATEGY 102-112 (2001).
[95] *See* Fleming & Sorenson, *supra* note 63, at 912-914.

First, open architectures are the extreme of modularity.[96] The downstream component producer publicly disseminates an interface standard to which complimentary products can be designed. Third-party firms then independently manufacture and market the components, which are then assembled by the end user. The key advantage of this system is that it motivates a large volume of innovation, thus expanding the capabilities of the downstream platform. IBM personal computers, for example, ultimately prevailed over Apple because their open design gave users greater flexibility.[97]

Open architectures are disadvantaged by the limitations on the downstream producer's ability to earn returns from its contribution to the value chain. Premium prices are generated primarily by the network effects of consumer access to external innovations. However, intellectual property protection offers little in the way of protection of reverse engineering of the product interface.[98] Therefore, the platform owner faces a lack of control over upstream component suppliers.

The second level of control is component-level modularity.[99] Independent suppliers produce custom-designed components which are then assembled into the final product. This organizational mode offers the downstream innovator more control over component design, as it is able to rely upon contractual and not just market mechanisms to control producers. Component manufacture offers a medium degree of security to the upstream producer – its innovation is transferred in physical form which may be difficult to reverse engineer, yet it must invest in tooling to manufacture a product with essentially one customer. For example, PortalPlayer, a manufacturer of chips used in Apple's iPod,

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[96] *See generally* Jae Nahm, *Open Architecture and R&D Incentives*, 7 J. IND. ECON. 547 (2004).
[97] *See* CHRISTENSEN, *supra* note 43, at 133.
[98] *See* Douglas Lichtman, *Property Rights in Emerging Platform Technologies*, 29 J. L. STUD. 615, 618 (2000).

faces this risk – with over 80% of its sales going into the iPod, it has both been successful enough to warrant an IPO, yet unable to hedge against the risk of its relationship with Apple souring.[100]

Third, designs themselves can be modularized. A modular design is one which is broken into discrete components to be performed by unrelated firms.[101] Semiconductor design and manufacture is a ready example. In the late 1980's standard physical-layout rules were promulgated across the industry, which facilitated the transfer of component designs between firms.[102] Consequentially, many "fabless" firms now focus on design engineering, while foundry firms perform the manufacturing engineering necessary to create a final product.

Modularization has its benefits and drawbacks. Modularized design lowers the transaction costs of integrating external technologies. It lowers the need for collaborative experimentation and debugging which follow technology integration.[103] This in turn limits the commitment of parties to one another and facilitates more complete ex-ante contracting.[104] It facilitates ex-ante valuation of the innovative output by creating an expressible and codifiable deliverable.[105] It also lowers the amount of information exchanged between parties, reducing the hazard of technology misappropriation.

Despite its advantages, modular design limits the radicalness of ensuing products. As Christensen argues, product performance can only be advanced when the design is

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[99] *See* Somaya & Teece, *supra* note 91, at 5-9.
[100] *See* Robert Levine, *Profiting from the iPod Economy*, BUSINESS 2.0, Sept. 2004.
[101] *See* ARORA ET AL., *supra* note 94, at 102-112.
[102] *See* Lee Fleming, Intevis: Brokering the Boundaryless Career, at 3 (Harvard Business School Case Study 9-602-148).
[103] *See* Somaya & Teece, *supra* note 91, at 13. *See generally* STEFAN THOMKE, EXPERIMENTATION MATTERS 61-73 (2003).
[104] *See* Somaya & Teece, *supra* note 91, at 13.
[105] *See id.*

integrated.[106] Modularization places a constraint on product design which implicitly keeps the design from reaching the frontier of what is technically possible. Consequentially, when system performance is inadequate, modular designs will be integrated. At least two factors contribute to this phenomenon.

First, when a technology is modularized, the innovation process becomes stratified. Innovation occurs at the component level, at the recombination level, and at the architectural level.[107] Individual firms innovate at the component level, and the technology transfer process is essentially a recombinant innovation process. Architectural innovation, however, becomes impossible once a design is modularized. The fundamental architecture around which the product is designed cannot be altered once it is communicated without risking the compatibility of the designed components. Consequentially, any resulting design it limited to the trajectory of products which incorporate the interface.

Likewise, while modularity reduces risk of failure, it also reduces the potential for radical results.[108] Modularity decouples the two technologies being brought together. Independent modification of decoupled components yields generally more predictable results. While such predictability reduces the risk of failure, it also reduces the potential for radical breakthroughs by limiting the scope of potential results of combination.

In summary, modularity is a powerful, and popular, mechanism for accessing external technologies. It offers the advantages of both likely technical success and

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[106] *See* CHRISTENSEN, *supra* note 43, at 128.
[107] *See* Joe Tidd, *Development of Novel Products Through Intraorganizational and Interorganizational Networks: The Case of Home Automation*, 12 J. PRODUCT INNOVATION MGMT. 307, 309 (Arguing that innovation occurs at both the component and architectural level).
[108] *See* Lee Fleming, *The Dangers of Modularity*, HARVARD BUS. REV., Sept. 2001,at 20. *See also* Lee Fleming & Olav Sorenson, *Navigating the Technology Landscape of Innovation*, SLOAN MGMT. REV., Winter 2003, at 15.

protection of proprietary knowledge. However, modular designs' adherence to architectures limits the possibility of breakthrough designs.

C. Active and Passive Licensing

There are two general forms of intellectual property licensing. Passive licensing relies upon the patent system. The innovator discloses its invention through patent publication, and technology buyers are then compelled to pay a royalty to make use of the disclosed technology. The parties often remain at arm's length and, absent the patent disclosure, technical information is often not exchanged between the parties. Active licensing requires a much closer relationship. The seller transfers its technical knowledge directly to the buyer. An interpersonal dialogue is often required between researchers in both firms to ensure that the technology is fully transferred. While active licensing may involve the transfer of patent rights, much of the information exchanged is unpatentable know-how.

Active and passive licensing differ in the form of knowledge exchanged. Knowledge is often classified as being either codified or tacit.[109] Codified knowledge is that which is memorialized in some tangible form, such as writing and drawing. Tacit knowledge, or know-how, is information embodied as skills and experience, which resides in the personal knowledge of the parties. Codified knowledge is much easier to transmit and reproduce, whereas know-how can only be transmitted with personal communication. Codified knowledge is potentially patentable, but know-how, which cannot be fully captured in written form, can only be protected through trade secrets.

Radical innovations are more likely when the parties use active licensing. There are several reasons why reliance on codified knowledge exchange hinders recombinant innovation.

First, codification cannot capture all of the knowledge necessary to practice an innovation. Much of the knowledge possessed by the innovator is experiential, and all of the knowledge which is required to make a novel technology work cannot be perfectly memorialized.[110] The technology transferee must invest its own time and effort in experimentation to learn how to practice a transferred technology.[111] Furthermore, some technologies are so novel that they cannot be codified. No common language exists by which they can be descried. They may be so novel that there exists significant uncertainty around their capabilities and performance which defeats attempts to codify contractual requirements.[112]

Second, codified knowledge loses its meaning when transferred over the great conceptual distances crossed in explorative search processes. Codification schemes are context dependent. Different technical fields have devised their own terminology and conventions to facilitate communication. Even different firms working in the same field adopt their own internal codification schemes to speed communication.[113] The codified

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[109] *See, e.g.,* FORAY, *supra* note 87, at 71-90; ARORA ET AL., *supra* note 94, at 95-99. *See generally* Mariano Nieto & Carmen Perez-Cano, *The Influence of Knowledge Attributes on Innovation Protection Mechanisms*, 11 KNOWLEDGE & PROCESS MGMT. 117, 119-20 (2004).

[110] *See generally* FORAY, *supra* note 87, at 71-90. (Describing the difficulty in memorializing the skills of an expert rugbyist.). *See also* ARORA ET AL., *supra* note 94, at 105-09 (Discussing the stickiness of technical information.).

[111] The patent doctrine of undue experimentation, for example, illustrates that patent disclosures need not perfectly teach the reader how to practice the best mode of an invention without its own experimentation.

[112] *See* Glenn Hoetker, *How Much You Know Versus How Well I Know You: Selecting a Supplier for a Technically Innovative Component*, 26 STRAT. MGMT. J. 75, 77-78 (2005).

[113] *See* ARORA ET. AL., *supra* note 94, at 115.

knowledge used to describe an innovation in one field will not be fully understood to a worker in another field.

This phenomenon has lead to firms' use of gatekeepers to interface with external innovators.[114] These gatekeepers serve the role of translating external codified knowledge into internal codified forms.[115] Gatekeeping can only work, however, when the gatekeeper is versed in both codification schemes. Consequently, firms are limited in their ability to assimilate external knowledge to the extent that they have boundary spanning individuals articulate in external codification schemes.[116] Novel technologies, with which they are unfamiliar, are unable to be assimilated in codified form.

Third, the technology buyer may lack the technical ability to understand new codified knowledge. More formally, it may lack the requisite absorptive capacity to assimilate novel technologies. Absorptive capacity refers to a firm's ability to assimilate external technological knowledge.[117] A firm's ability to process external knowledge is related to its prior knowledge with related technologies.[118] Consequentially, when firms access unfamiliar technologies, they need closer, tacit, linkages with the provider in order to assist in learning and understanding the new technology.

In summary, open innovation works best when parties exchange know-how. Codified knowledge exchange is only effective between firms working in similar fields of technology. It is also only effective when dealing with technologies that are relatively

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[114] *See* Tsutomu Harada, *Three Steps in Knowledge Communication: The Emergence of Knowledge Transformers*, 32 RES. POL'Y 1737 (2003).
[115] *See id*. at 1739.
[116] *See id.*
[117] *See* Wesley M. Cohen & Daniel A. Levinthal, *Absorptive Capacity: A New Perspective on Learning on Innovation*, 36 ADMIN. SCI. Q. 128 (1990). *See also* Rachelle C. Sampson, R&D Alliances & Firm Performance: The Impact of Technological Diversity and Alliance Organization on Innovation at 5 (New York University Working Paper, Sept. 2003).
[118] *See* Cohen & Levinthal, *supra* note 117, at 128-29.

well understood. When a technology buyer attempts to assimilate an unfamiliar technology, it will require access to the innovator's skill and experience to do so.

V. The Role of Patent Law

A. Patent-Based Mechanisms for Know-How Exchange

Technology transfer through the exchange of tacit knowledge is a difficult task. Such agreements are difficult to specify ex-ante, and difficult to enforce ex-post. Tacit knowledge is hard to measure, making inadequate disclosure and misappropriation difficult to police. These problems are exacerbated by the fact that, in open innovation, the licensor is dealing with an established producer with significant competitive advantages.

This section addresses the benefits of using patents to protect know-how transfers. A know-how licensor faces two primary hazards.[119] The first is the risk of moral hazard by the licensee, resulting in either underpayment of royalties or technology misappropriation. Second is the risk that insufficient property rights will lead to a lack of bargaining power, and, subsequently, an insufficient contractual allocation of royalties. Strong intellectual property protection can ameliorate these risks. Consequentially, patents are beneficial, not for the information that they disclose, but for the leverage they provide the know-how licensor.

[119] *See* Ronald Helm & Martin Kloyer, *Controlling Contractual Exchange Risks in R&D Interfirm Cooperation: An Empirical Study*, 33 RES. POL'Y 1103,1103 (2004) (Considering two risks in joint R&D, the risk of obtaining a lower profitability than one's partner, and the risk of learning less than one's partner.).

1. Hazards of Transferring Tacit Know-How

Know-how transfer is difficult to perform at arms-length.[120] Tacit knowledge resides in the licensor's personnel, and can only be exchanged through direct contact with the technical staff of the licensee. This exchange is costly and rquires investment on the part of the licensor in the form of personnel commitment and travel and communication costs. The personal nature of the knowledge makes it impossible to quantify and, therefore, impossible perfectly to specify ex-ante.[121] The seller therefore faces an Arrow's paradox when contracting with the buyer, and the subsequent inefficiency is likely to result in underpayment.[122]

Underpayment is also likely to result from the difficulty in verifying tacit knowledge transfer. Third-party monitoring of interpersonal communications is difficult, and, consequentially, legal action is difficult to bring.[123] Evaluation of the tacit knowledge conferred is qualitative, and cannot be measured through the quantitative proxies available for patented or codified knowledge.

These tensions result in what has been observed as a race to learn.[124] In such an event, both parties attempt to extract as much tacit knowledge from the other's experts as possible, while revealing as little as possible in return. Unintentional, one-sided knowledge flow of technical and commercial secrets are a significant possibility.[125] Parties' concerns about opportunism lead to inadequate disclosure.

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[120] *See* Somaya & Teece, *supra* note 91, at 14-15.
[121] *See* Somaya & Teece, *supra* note 91, at 17-18; Hoetker, *supra* note 112, at 119.
[122] *See generally*, James J. Anton & Dennis A. Yao, *The Sale of Ideas: Strategic Disclosure, Property Rights, and Contracting*, 69 REV. ECON. STUD. 513 (2002).
[123] *See* ARORA ET. AL., *supra* note 94, at 118.
[124] *See* Rikard Larsson et al., *The Interorganizatioal Learning Dilemma: Collective Knowledge Development in Strategic Alliances*, 9 ORG. SCI. 285 (1998); Urs S. Daellenbach & Sally J. Davenport, *Establishing Trust During the Formation of Technology Alliances*, 29 J. TECH. TRANSFER 187, 188 (2004).
[125] *See* Ronald Helm & Martin Kloyer, *Controlling Contractual Exchange Risks in R&D Interfirm Cooperation: An Empirical Study*, 33 RES. POL'Y 1103, 1105 (2004).

The licensor also faces a strong risk that the licensee will misappropriate its trade secrets.[126] Once the trade secrets have been transferred, the licensor loses a significant amount of its ability to police the licensee's behaviors. It cannot force the licensee to forget what it has been taught. The licensor must, therefore, rely upon intellectual property protection to prevent the uncompensated use of its tacit know-how.[127]

2. Effect of Relative Barraging Positions

Arm's-length technology transfers are feasible only when the parties are on sufficiently equal footing that a mutually beneficial deal can be reached. If the licensor's disadvantage relative to his partner is significant enough, then arms-length transactions will be forgone in favor of integrated modes of development.[128]

In open innovation deals, the technology buyer enjoys the majority of the bargaining power. It possesses a majority of the requisite complimentary assets. It has the manufacturing facilities in place, as well as the existing brands and customer relationships. Furthermore, it is contributing its own R&D efforts, and is likely utilizing a large amount of its own technical knowledge during product development.

Further advantage stems from the fact that these assets are general with regard to the licensed technology.[129] An effective open innovation program will be able to access a wide variety of technical inputs. Unless the licensor's technology is extraordinarily unique or valuable, there are likely to be many other substitutes which would be available for incorporation. Therefore, it must compete against many other technology providers.

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[126] *See* ARORA ET. AL., *supra* note 94, at 118. *See also* Helm & Kloyer, *supra* note 125, at 1106 (Discussing the risk that the commercialization partner will become a competitor.)
[127] *See* Gans & Stern, *supra* note 43, at 339.
[128] *See* Gans & Stern, *supra* note 43, at 342.
[129] *See* Teece, *supra* note 43, at 289.

Conversely, the technology seller is likely to face a monopsomy situation. Its technology may be more specialized as to its potentialapplications. [130] Therefore, the number of potential purchasers for the given technology is relatively small. If, in particular, the producer possesses specialized complimentary assets needed for commercialization, then it can command significant bargaining power.[131]

Under these circumstances, the technology buyer is at a considerable bargaining advantage.[132] The buyer's complimentary asset advantage can only be offset by the seller's intellectual property position.[133] If its position is strong, then it can confer a commercial monopoly to the licensee. If its intellectual property protection is weak, then it has little of unique value to offer.

B. The Relative Strength of Patent and Trade Secret Protection

Two competing forms of intellectual property protection are available to innovators – patents and trade secrets.[134] While their policies may align, the legal doctrines surrounding patent and trade secret licensing differ significantly. Patent law is created by federal statute, and patent disputes are handled under federal law. Trade secret law is an extension of state contract and tort law and is, consequently, construed in light of states' jurisprudence.

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[130] *See id.*

[131] *See* Frank T. Rothaermel & Charles W. L. Hill, *Technological Discontinuities and Complimentary Assets: A Longitudinal Study of Industry and Firm Performance*, 16 ORG. SCI. 52 (2005).

[132] *See* Gans & Stern, *supra* note 43 at 338.

[133] *See e.g.* Rudi Bekkers et al., *Intellectual Property Rights, Strategic Technology Agreements and Market Structure: The Case of GSM*, 31 RES. POL'Y 1141, 1142 (2002) (Discussing the necessity of intellectual property rights in obtaining a strategic technology alliance.); *See also* Somaya & Teece, *supra* note 98, at 25.

[134] See generally Anthony Arundel, *The Relative Effectiveness of Patents and Secrecy for Appropriation*, 30 RES. POL'Y 611 for an empirical comparison of competing use of patents and trade secrets in industry.

Although both systems provide exist to provide incentives for invention,[135] the protections afforded by patents are generally considered to be significantly stronger. The Supreme Court compared the doctrines as follows:

> Trade secret law provides far weaker protection in many respects than the patent law. While trade secret does not forbid the discovery of the trade secret by fair and honest means, e.g., independent creation or reverse engineering, patent law operates 'against the world,' forbidding any use of the invention for whatever purpose for a significant length of time. The holder of a trade secret also takes a substantial risk that the secret will be passed on to his competitors, by theft or by breach of a confidential relationship, in a manner not easily susceptible to proof. . . .Where patent law acts as a barrier, trade secret law functions relatively as a sieve.[136]

Although each state has its own body of trade secret law, many states have adopted a derivation of the Uniform Trade Secrets Act. A comparison of that act to the patent statute illuminates the relative weakness of protection that trade secret law provides.

Patent law protects a greater scope of activities than trade secret law. A patent is infringed by anyone who "without authority makes, uses, offers to sell, or sells any patented invention, within the United States, or imports into the United States any patented invention,"[137] or who actively induces another to infringe.[138] Liability generally attaches without regard to the manner in which the infringer developed its technology or its knowledge of the patent.[139] Conversely, trade secret protection only protects against

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[135] *See* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 484 (1974).
[136] *Id.* at 489-90.
[137] 35 U.S.C. § 271(a) (2005).
[138] 35 U.S.C. § 271(b) (2005).
[139] In fact, liability is increased if the infringer knew of the patent. *See* 35 U.S.C. § 284.

misappropriation through improper means, such as a "breach or inducement of a breach of a duty to maintain secrecy."[140]

Unlike patent law, which creates liability against any infringer, trade secret liability is only extended to those in privity to the licensor. Misappropriation liability is limited to those who know or have reason to know of the secret nature of the trade secret.[141] A trade secret licensor has no cause of action to recover for use of its secret by third parties if it is made public.

Both patent law and trade secret law offer injunctive relief. A patent holder can get a permanent injunction to "prevent the violation of any right secured by patent."[142] A trade secret holder, conversely, can receive an injunction against misappropriation, but the relief "shall be terminated when the trade secret has ceased to exist."[143] The injunction may be extended "an additional reasonable period of time in order to eliminate commercial advantage that would be derived from the misappropriation,"[144] relief which while perhaps helpful when dealing with industrial espionage from a competitor is of questionable relevance when the licensor lacks the ability to commercialize the secret on its own.

Both doctrines provide damages for lost profits and for a reasonable royalty for use of the technology.[145] Trade secret law further provides damages for the unjust

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[140] UNIFORM TRADE SECRETS ACT §1-2 (amended 1985).
[141] *See* UNIFORM TRADE SECRETS ACT § 1 (amended 1985).
[142] 35 U.S.C. § 283 (2005).
[143] UNIFORM TRADE SECRETS ACT §2 (amended 1985).
[144] *Id.*
[145] *See* 35 U.S.C. § 284 (2005); UNIFORM TRADE SECRETS ACT §3 (amended 1985).

enrichment of the misappropriator.[146] Damages can be recovered up to six years after infringement of a patent, compared to three years for a trade secret.[147]

The one advantage of trade secret law is the scope of ideas that it protects. A trade secret is any information that "derives independent economic value, actual or potential, from not being generally known . . . ."[148] The definition specifically includes "know-how" as protected information.[149] Patent protection is, conversely, limited to inventions that are useful,[150] novel,[151] and non-obvious.[152] Furthermore, the patent must fully disclose in written form everything needed to enable any person skilled in the relevant art to make and use the invention, thereby precluding protection for inventions embodied in "know-how."[153]

C. A Proposed Model of Tacit Technology Transfer

Technology transfer would benefit from both the tacit knowledge exchange permitted by trade secrets and the strong legal protection given by patents. The opportunism problem inherent in know-how licensing has been addressed in the literature. Arora, Fosfuri and Gambardella have proposed a contractual solution that uses the threat of patent-based injunction as a hostage-taking mechanism.[154] With the additional bargaining power afforded by patent protection, the licensor is able to overcome opportunism by the licensee.

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[146] *Id.*
[147] *See* 35 U.S.C. § 286 (2005); UNIFORM TRADE SECRETS ACT §6 (amended 1985).
[148] UNIFORM TRADE SECRETS ACT §1(amended 1985).
[149] *See* UNIFORM TRADE SECRETS ACT §1, cmt. (amended 1985).
[150] *See* 35 U.S.C. § 101 (2005).
[151] *See* 35 U.S.C. § 102 (2005).
[152] *See* 35 U.S.C. § 103 (2005).
[153] *See* 35 U.S.C. § 112 (2005).
[154] *See* ARORA ET AL., *supra* note 94, at 114-141.

In their analysis, the author's cite the high costs of third party verification as the greatest source of licensor opportunism.[155] At the same time, the authors consider empirical evidence that most technology deals are motivated by the desire to access tacit know-how – not codified technical information.[156] The authors in turn propose a simple solution.

The authors consider a license for both patents and trade secrets. They propose a simple contract model in which the licensee makes an initial lump sum payment, followed by the transfer of know how, and then one final lump sum payment.[157] If the licensor shirks its know-how transfer obligation, then the licensee withholds the final payment. If the licensee fails to make the final payment, the licensor can bring a patent infringement suit against it.

The authors support their model with empirical study of Indian technology importation deals.[158] Their empirical research shows a correlation between patent strength and the number of technology deals – suggesting that tacit know-how transfers are facilitated by stronger patent rights.[159]

This model has significant implications for patent policy.[160] It suggests that patent protection plays a crucial role in the success of know-how licensing. In the open

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[155] *See id*. at 118.
[156] *See id.*
[157] *See id*. at 119.
[158] *See id.* at 125-41.
[159] *See id.* at 139. *See also* Anthony Arundel, *The Relative Effectiveness of Patents and Secrecy for Appropriation*, 30 RES. POL'Y 611 (2001) (Finding that firms engaging in collaborative R&D value patent protection over trade secret protection more than those who do not.).
[160] The authors fail to consider the legality of such instruments under the doctrine of patent misuse. *See supra* text accompanying notes 163-74.

innovation context, patent protection protects the tacit knowledge flows necessary for breakthrough innovation.[161]

The traditional conception of patents was as an economic incentive given to the innovator, paid for through commercial monopoly. Patent breadth was a measure of the reach of an innovator's monopoly reward.[162] This model suggests that the greatest value of patents, conversely, stems from their ability to foster exchange in unpatentable know-how. Patent breadth, therefore, is a measure of the distance to which the innovator may disseminate its innovation.

1. Legality of Hybrid Patent-Trade Secret Licenses

The license model proposed by Arora, Fosfuri and Gambardella raises unique issues of legal construction. It seeks to take advantage of the exclusionary power offered by patent law to protect know-how which does not qualify for patent protection. Although hybrid licenses are enforceable in the contemporary legal environment, their legality implicates several doctrines which have been examined by the courts over the past fifty years.

The fundamental purpose of patent law is to "promote the Progress of Science and the useful Arts."[163] This end is met through balancing the public disclosure of inventions to advance the art with economic rewards paid as an incentive to inventors. Two doctrinal concepts mediate this tension. First is the notion of the quid pro quo between the inventor and the government. A patent can be conceptualized as an exchange – the

[161] *See* Gans & Stern, *supra* note 43, at 349.
[162] *See generally* Paul Klemperer, *How Broad Should the Scope of Patent Protection Be?*, 21 RAND J ECON. 113, 114-15 (1990).
[163] U.S. CONST. art. I § 8 cl. 8.

patentee makes a disclosure of his invention to the public, and is, in return, granted a commercial monopoly on what he has disclosed. A second concept is that of public reliance. The public is encouraged to take advantage of the patent disclosure, incorporating the disclosed ideas into novel technologies that do not fall within the metes and bounds of the patent claims. Therefore, the freedom to practice unpatented ideas in the public domain is a necessary component of the federal innovation scheme.

Trade secret law also has as one of its goals the promotion of innovation. It does so, however, through a different pathway. In the words of the Supreme Court:

> Trade secret law encourages the development and exploitation of those items of lesser or different invention than might be accorded protection under the patent laws, but which items still have an important part to play in the technological and scientific advancement of the Nation. Trade secret law promotes the sharing of knowledge, and the efficient operation of industry, it permits the individual inventor to reap the rewards of his labor by contracting with a company large enough to develop and exploit it.[164]

Therefore, while patent law promotes public dissemination, trade secret law promotes private dissemination. The public dissemination is better rewarded, however, with a patent monopoly. The two doctrines most readily conflict when the patent monopoly is extended to protect the private dissemination of knowledge.

The Supreme Court fleshed out these tensions in a series of holdings during the second half of the twentieth century. In *Lear v. Adkins*[165], the Court considered, inter alia, a patent licensee's obligations to pay royalties on a patent license contract after the patent has been held invalid. The Court held that patent law trumped contract law, and that royalties contracted for under the power of a patent monopoly could not be

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[164] Kewanee Oil Co. v. Bircon Corp., 416 U.S. 470, 493 (1974).
[165] 395 U.S. 653 (1969).

compelled if the patent were to later be revoked.[166] Similarly, in *Bruolette v. Thys*[167], the Supreme Court held that parties could not contract to pay patent royalties past the expiration of a patent. *Bonito Boats v. Thunder Craft Boats* complimented these restrictions by holding that a state law which extended intellectual property protection to boat hull designs, which were placed in the public domain with the sale of the boats, was preempted by patent law's mandate for the free exchange of unpatentable ideas.[168]

Aronson v. Quick Point[169] carved out a significant distinction for trade secret law. The Court considered a license agreement made while the patent was still pending. The contract specified two sets of royalties – one for if the patent were to be granted and a lower one if the patent were to be denied. The patent was rejected, and the licensor contested the agreement on the ground of both *Lear* and *Bruolette*. The Court rejected those arguments, and held that the royalties were agreed to "in arm's-length negotiation and with no fixed reliance on a patent or probable patent grant."[170]

The fundamental difficulty which the Arora, Fosfuri and Gambardella model faces is its reliance on the bargaining power offered by a patent to compel higher royalties on associated know-how. Although *Bruolette* prohibits the use of the "leverage of the [patent] monopoly"[171] to extend the scope of the monopoly grant, *Aronson* indicates that trade secrets have an independent value which would command royalties in the absence of such an agreement.[172] Although the Supreme Court has not ruled on the

[166] *See id*. at 674.
[167] 379 U.S. 29 (1965).
[168] 489 U.S. 141 (1989). However, Congress can create novel intellectual property regimes that do conflict with patent doctrine. *See* Semiconductor Chip Protection Act of 1984, 17 U.S.C. §901-914.
[169] 440 U.S. 257 (1979).
[170] *Id*. at 265.
[171] 379 U.S. at 33.
[172] 440 U.S. at 266.

propriety of hybrid patent-trade secret licenses, several circuit courts have.[173] The licenses are generally permitted when they are coextant with the temporal scope of the patent rights. However, when a hybrid license extends royalty payments after the invalidation or expiration of the supporting patents, it is generally struck down.[174]

VI. Implications for Patent Doctrine and Policy

A. Implications for Patent Policy

This Paper has posited a theory of innovation which places novel tensions upon patent doctrine. So far, the Paper has considered recombinant innovation theory and its application to open innovation systems. Recombinant innovation mandates that the most radical innovations are made through the combination of elements brought together from a wide variety of technologies. Tacit knowledge exchange is necessary to overcome the uncertainties raised by the needed technology transfer. Tacit knowledge exchange is, however, a poor means of earning royalties. The ethereal nature of the knowledge, coupled with the ex-ante uncertainty of technology development, makes it difficult to specify or enforce contracts for its exchange. The doctrinal limitations on trade secret protection often fail to adequately protect tacit knowledge disclosure. Modular mechanisms used to minimize tacit knowledge exchange hamper innovative radicalness.

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[173] *See* MELVIN F. JAGER, TRADE SECRETS LAW §15:8 (2004).

[174] *See e.g.,* Baladevon v. Abbott Laboratories, 871 F.Supp 89, 94 (D.Mass 1994) ("When a licensing agreement fails to distinguish between patent and non-patent rights in royalty payments, *Lear* precludes enforcement of the contract according to its terms but does not preclude compensation for non-patent rights."); Nordion International v. Medi-Physics, Inc., 1995 WL 519798 *5 (N.D.Il 1995) (Holding that, after a patent is held invalid, that, "because [the agreement] does not attribute a specific portion of the $1,500,000 to the Technology rather than the Patent, the entire provision is unenforceable. . . . Nonetheless, Nordion may be entitled to compensation for the value of the patent."); Pitney-Bowes, Inc. v. Mestre, 517 F.Supp 52 (S.D.Fl 1981).

Consequentially, strong patent rights bolster the innovator's intellectual property position, lowering the contractual hazards of tacit knowledge exchange.

Patent protection is even more necessary in an open innovation environment. Open innovation licensees are established producers, with access to the complimentary assets and capital necessary to bring the product to fruition. They enjoy a significant bargaining advantage over licensing innovators. The disclosure of tacit innovations to them is not likely to occur absent patent protection.

This analysis mandates that broad and strong patent protection is beneficial in cumulative innovation industries because it fosters the disclosure of upstream innovations to downstream producers.[175] Broad patent protection is required to protect disclosure to producers operating in different technical fields. The producers benefit from being exposed to a large and diverse set of technological inputs.

This result is at odds with most contemporary notions of effective patent breadth in cumulative innovation industries.[176] Heller and Eisenberg's description of the "anticommons" effect in biomedical research is in direct conflict.[177] The authors describe an anticommons effect where multiple upstream patent holders each have the right to exclude later innovators from creating complex products.[178] In particular, the authors focus on the patenting of upstream research tools in the biotechnology field and the privatization of ownership of university research. The large number of claimants raises transaction costs and the risk of hold up.

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[175] *See* ARORA ET AL., *supra* note 94, at 138-41.

[176] *See generally* Henry Chesbrough, *The Sustainability of Technology Markets*, 8 J. MGMT. & GOVERNANCE 117, 119 (2004) (Discussing the implications of Arora, Fosfuri, and Gambardella's hybrid patent-trade secret model for optimal patent breadth.).

[177] *See* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, SCIENCE, May 1998, at 698.

[178] *Id.* at 698.

Heller and Eisenberg raise a valid criticism of broad patent rights in upstream technologies. Their arguments are, however, distinguishable on several grounds. First, they conceptualize the contribution of intellectual property as a means to "fortify incentives to undertake risky research projects."[179] This traditional assumption ignores the role of intellectual property in facilitating the controlled dissemination of technological information – dissemination which becomes more costly across different technical fields. Second, the authors' focus on transaction costs does not consider the role of strong property rights in lowering transaction costs. They cite to the high costs of coordinating the licensing of a diverse set of rights holders in a diverse set of technologies, with a diverse set of interests, under uncertainty as to the value of the final product.[180] Their focus on the costs of coordinating the large number of transactions that broad patent protection would bring ignores the cost reduction it would offer in each specific transaction.[181] Finally, the authors presuppose that, absent the ability to appropriate royalties through licensing, upstream innovations would continue to be generated.

Merges and Nelson have similarly argued that, in many cumulative technologies, broad patents have stifled technological innovation.[182] They cite to broad grants to pioneer patents such as the Selden patent on automobile configuration and the Wright patent on airplane stabilization which have been documented to stifle innovation. While broad pioneer patent grants may slow innovation, strong rights in other areas of the same

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[179] *Id.* at 698.
[180] *Id.* at 700.
[181] *See* Jonathan N. Barnett, *Cultivating the Genetic Commons: Imperfect Patent Protection and the Network Model of Innovation*, 36 SAN DIEGO L. REV. 987, 1029-30 (2000) (Arguing that patent protection in the biotechnology industry may lower the transaction costs of technology exchange.).
[182] *See* Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 884-97 (1990). *Cf.* ARORA ET AL., *supra* note94, at 138-41.

industries may have benefited innovation.[183] For example, while broad patents may have hindered the automotive industry in its formative years, weak patent protection has hindered the industry's access to innovations from small firms and individuals, such as Robert Kearns, from whom Ford famously misappropriated the intermittent windshield wiper.[184] In other industries, such as radio, where broad patents also created an innovative deadlock, strong rights may have been a necessary evil because, as stated by the authors, "no one firm had the inventive firepower to develop radio on its own."[185]

The traditional arguments against broad patent rights in cumulative innovation industries accurately reflect the current industrial situation. However, the rise of open innovation practices creates a novel challenge to the established conception of the role of patents in cumulative technology development. In particular, the theory challenges the notion that a technology conceived outside a large firm would be equally likely to be conceived within it.

This theoretical conflict can, in part, be resolved by specifying the nature of strong patent rights required by the recombinant licensing model. Recombinant innovation does not mandate broad pioneer patent rights. Rather, it requires breadth in so far as it facilitates the application of a patent to products in disparate fields of practice.

B. The Doctrinal Treatment of Recombined Innovations

Patent law impacts licensing negotiations in two important ways. First, patent breadth dictates the amount of leverage the licensor can wield. Broad coverage will protect know-how disclosure in a wider range of fields. Ambiguity regarding the scope

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[183] *See* Merges & Nelson, *supra* note 182, at 888-893.
[184] *See* Gans & Stern, *supra* note 43, at 338.

of a patent's reach under the doctrine of equivalents casts a shadow of an ever-present risk of patent infringement over licensing negotiations, even in unclear cases. Second, a heightened inventive step requirement protects the licensor's intellectual property advantage. If the new product created through the collaboration is itself patentable, then the licensee may be able to receive a blocking patent which can be used as a bargaining chip to offset the licensor's patent position.[186]

Although it reveres individual conception stemming from extraordinary insight, patent doctrine is not blind to the recombinant nature of the innovation process. As Judge Learned Hand recognized, the relevant inventive step is measured in the selection of elements to recombine:

> [T]he defendant argues that the supposed invention is no more than a substitution of materials familiar to the art in the same uses; an aggregation of which each part performs what it did before. We may concede as much arguendo, for the same may be said of every invention. All machines are made up of the same elements; rods, pawls, pitmans, journals, toggles, gears, cams, and the like, all acting their parts as they always do and always must. All compositions are made of the same substances, retaining their fixed chemical properties. But the elements are capable of an infinity of permutations, and the selection of that group which proves serviceable to a given need may require a high degree of originality. It is that act of selection which is the 'invention' and it must be beyond the capacity of common-place imagination.[187]

The legal question is, therefore, what forms of recombination yield patentable results.

Technology brokering, where a technology in one field is applied to a problem in a different one, should not lead to an independently patentable result. The novelty requirement precludes the patenting of a novel application of an existing invention.[188] If

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[185] *See id*. at 895.
[186] *See generally* Jerry R. Green & Suzanne Scotchmer, *On the Division of Profit in Sequential Innovation*, 26 RAND J. ECON. 20 (1995); SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 126-59 (2004).
[187] B.G. Corp. v. Walter Kidde & Co., 79 F.2d 20, 21-22, 26 USPQ 288 (2d Cir. 1935).
[188] *See* 35 U.S.C. §102 (2005).

a new invention is anticipated, or completely disclosed, by a single item in the prior art, then it cannot be patented.[189] The recitation of a new intended use for an old product does not make a claim to that old product patentable.[190] A reference may be from an entirely different field of endeavor than that of the claimed invention or may be directed to an entirely different problem from the one addressed by the inventor, yet the reference will still anticipate if it explicitly or inherently discloses every limitation recited in the claims.[191] Therefore, mere commercial innovation and bare technology brokering of a completed technology will not lead to a patentable result.

The combination of existing elements is governed by the doctrine of obviousness. Several factors control whether the recombination of existing elements is patentable. The determination of obviousness is a factual determination which primarily considers (1) the scope and content of the prior art, (2) the differences between the art and the claimed invention, and (3) the level of ordinary skill in the relevant art.[192]

There once was a heightened requirement on combination patents. Combinations of existing elements were required to show an unforeseen result, or synergism, in order to be non-obvious. The Federal Circuit has since rejected this requirement, and treats combination patents just as any other invention:

> There is no warrant for judicial classification of patents, whether into "combination" patents and some other unnamed and undefined class or otherwise. Nor is there warrant for differing treatment or consideration of patents based on a judicially devised label. Reference to "combination" patents is, moreover, meaningless. Virtually all patents are "combination patents", if by that label one intends to describe patents having claims to inventions formed of a combination of elements. It is difficult to visualize,

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[189] *See* 35 U.S.C. §102 (2005).
[190] In re Schreiber, 128 F.3d 1473, 1477 (Fed. Cir., 1997).
[191] *Id.* at 1478.
[192] *See* Graham v. John Deere Co., 383 U.S. 1, 17 (1966). There is also a secondary consideration of indicia of nonobviousness such as commercial success.

> at least in the mechanical-structural arts, a "non-combination" invention, i.e., an invention consisting of a single element. Such inventions, if they exist, are rare indeed.[193]

Consequentially, there is no special treatment for combination patents per se. Combinations of elements in the same field of art are patentable, so long as there is no suggestion in the art to combine the elements.[194]

Explorative search recombines elements from distant fields. Patent law only considers prior art in fields analogous to the invention when determining obviousness:

> [I]f the new use be so nearly analogous to the former one that the applicability of the device to its new use would occur to a person of ordinary mechanical skill, it is only a case of double use; but if the relations between them be remote, and especially if the use of the old device produces a new result, it may at least involve an exercise of the inventive faculty.[195]

Consequentially, prior art from different fields is not considered, and if an invention is a combination of elements from different fields of art then it is patentable.

There is a two step test to determine if a reference is within the relevant field of art.[196] The court considers first considers if the art is from the same field of endeavor.[197] If not, then it considers if the reference is reasonably pertinent to the particular problem with which the inventor is involved.[198] A reference is reasonably pertinent if, even though it may be in a different field from that of the inventor's endeavor, it is one which, because of the matter with which it deals, logically would have commanded itself to an inventor's attention in considering his problem.[199] The courts have taken an expansive

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[193] Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1540 (Fed. Cir. 1983).
[194] *See* Heidelberge Druckmaschinen v. Hantscho Commercial Products, Inc., 21 F.3d 1068, 1072 (Fed. Cir. 1994).
[195] C & A Potts & Co. v. Creager, 155 U.S. 597, 607-08 (1895).
[196] *See* In re Clay, 966 F.2d 656, 658 (Fed. Cir. 1992).
[197] *Id*. at 659.
[198] *Id*.
[199] *Id*.

definition of what constituted analogous art. For example, a hair brush and a tooth brush have been found to be from analogous fields of art.[200]

In summary, the patent systems rewards technical novelty in the recombinant process. Brokering of existing technologies is generally not patentable. Recombining existing elements into new technologies may be. Local recombination is less likely to be sufficiently non-obvious, although explorative search into different fields of art frequently is.

An innovator's patent position is, therefore, strongest when the licensed application of the technology is conceptually similar to what it has practiced. As the application becomes more distant, the act of recombination itself becomes a patentable act of innovation, and the licensee may be able to secure blocking patent rights against the licensee. Therefore, in order to motivate the disclosure necessary to facilitate explorative recombination, an alternative means of protecting disclosure may be necessary.

C. Institutional Mechanisms for Fostering Open Innovation

The previous sections have illuminated the need for strong protection for tacit knowledge transfer. While patent protection can bolster the innovator's position, its effectiveness wanes as the final product grows dissimilar from the patented technology. An alternate means of protecting disclosure is, therefore, needed to protect knowledge exchange across the distances spanned by the distant search process. Contemporary firms practice open innovation even in fields without strong patent protection. Firms would not contribute to open R&D programs absent the ability to command some

[200] *See* In re Bigio, 381 F.3d 1320, 1327 (Fed. Cir. 2004).

adequate degree of return. Private mechanisms have evolved to protect the bargaining position of innovation contributors.

In many cases, interorganizational trust supersedes formal contractual and intellectual property mechanisms as a facilitator for open knowledge flow.[201] Tacit knowledge exchange is a uniquely interpersonal process, and is, ultimately, governed by the personal feeling of security that participants share. Know-how exchange is also difficult to police: firms can easily under-contribute, under-pay, or over-learn their rivals with detection, let alone enforcement, almost impossible. Absent formal redress, firms are likely to underparticipate in transfer activities unless they trust their partners not to abuse the relationship.

Trust develops during the formation of a technology exchange partnership. Many technology exchange partners tend to favor working with firms with whom they have worked before. This focus on familiar partners, however, undermines the efficiency of the market in ideas, and frustrates the interorganizational distance beneficial to recombinant innovation.

Trust is also needed to facilitate the purchase of technology. Technology transfers occur under informational asymmetry, with the seller having a much greater understanding of the technology's value than the buyer. Disclosure of the information necessary to value the technology may expose the technology to misappropriation. Consequentially, absent some degree of ex-ante trust between the parties, the technology

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[201] *See* Urs. S. Dallenbach & Sally J. Davenport, *Establishing Trust During the Formation of Technology Alliances*, 29 J. TECH. TRANSFER 187 (2004); Michael J. Gallivan, *Striking a Balance Between Trust and Control in a Virtual Organization: A Content Analysis of Open Source Software Case Studies*, 11 INFO. SYS. J. 277 (2001); Glenn Hoetker, *How Much You Know Versus How Well I Know You: Selecting a Supplier for a Technically Innovative Component*, 26 STRATEGIC MGMT. J. 75 (2005).

buyer may be unable to make an appraisal of the technology, and will subsequently be unable to value it for purchase.

Reputation can serve as a proxy for trust.[202] If a firm lacks prior dealings with a potential partner, it can consult a trusted source to learn of the partner's history. Purchasing firms, whose strong bargaining position may alone deter solicitation of partnership by small firms, often must cultivate a reputation for fairness.[203] Firms such as Cisco Systems and Intel, who rely significantly on external technology acquisition, have made institutional efforts to establish a reputation for fair dealing with partners in the industry.[204]

Reputation-building can be fostered through the use of third-party intermediaries. While individual technology buyers and sellers may not have repeat interactions, intermediaries who focus on brokering transactions have sufficient contact with parties to evaluate their propensity for fair dealing. Intermediaries can also mediate know-how exchange, serving as a go-between between parties during the early phases of transfer.

Prior to the rise of vertically integrated R&D at the turn of the century, patent attorneys often filled this role, brokering their client's technologies to potential manufacturers.[205] More recently, venture capitalists serve this role.[206] In addition to the financing that they provide parties, their large personal networks often facilitate technology transfer deal creation through informal introduction-making.

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[202] *See* Gans & Stern, *supra* note 43, at 343-45 (Discussing reputation-based idea trading.).
[203] *See id. See also* Jonathan M. Barnett, *Private Protection of Patentable Goods*, 25 CARDOZO L. REV. 1251, 1268-69 (2004) (Discussing the use of industry norms as an alternative to patent protection.).
[204] *See* Gans & Stern, *supra* note 43, at 343-45.
[205] *See* Naomi R. Lamoreaux & Kenneth L. Sokoloff, Intermediaries in the U.S. Market for Technology, 1870-1920 (NBER Working Paper 9017, June 2002).
[206] *See* Gans & Stern, *supra* note 43, at 344-45.

A model for formal trusted intermediaries has been proposed by John Wolpert, former director of IBM's Extreme Blue technology incubator.[207] He likens innovation intermediaries to "innovation headhunters," who would go between firms, careful to protect their technical secrets until trust has been established:

> A company might, to take a simple example, entrust an intermediary with the details of a particular technology it has developed as well as its need for outside capabilities to commercialize it. The intermediary would then share the information with other intermediaries in the hope of finding an appropriate partner. At no point – until a formal disclosure agreement is forged, would any of the information be shared with the companies the intermediaries represent. The intermediaries could be trusted to maintain confidentiality because it is simply in their business interest: If they ever violate the terms of an arrangement, no company would hire them again.[208]

Wolpert has put these ideas into action and has created InnovationXchange, a pilot trusted intermediary program in conjunction with the Australian government.[209]

It is worthy to note that trusted intermediaries are not the only third party intermediaries which participate in the open innovation market. There are several different models of intermediation.[210] Firms like InnovationXchange serve as trusted intermediaries. Rights aggregation firms take advantage of the anticommons effect in industries with overly strong patent rights by assembling patent portfolios from individual innovators and, much like ASCAP in the music industry, offering them for license. It is speculated that Intellectual Ventures, a firm founded by ex-Microsoft Chief Technology Office Nathan Myhrvoid is engaged in this practice.[211] Centralized

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[207] *See* John D. Wolpert, *Breaking Out of the Innovation Box*, HARVARD BUS. REV., Aug. 2002.
[208] *Id.* at 82.
[209] *See* organization website, www.innovationxchange.com.au.
[210] For general reference, see John Bessant & Howard Rush, *Building Bridges for Innovation: The Role of Consultants in Technology Transfer*, 24 RES. POL'Y 97 (1995) and Jeffrey J. Elton et al., *Intellectual Property: Partnering for Profit*, MCKINSEY Q., 2002 Special Edition: Technology.
[211] *See* Brad Stone, *Factory of the Future?*, MSNBC.COM, Nov. 15, 2004.

marketplace firms facilitate knowledge exchange in industries without strong social networks, often by serving as a brokerage for technologies of expertise for sale. Yet2.com and InnoCentive are examples, serving as both technology and talent brokers.[212]

In summary, intellectual property law offers limited protection to contributors to open innovation programs. There are three avenues of enhancing these protections. The courts could extend greater doctrinal protection to patent holders. Alternatively, the legislature could create a novel intellectual property regime to protect collaborative researchers. In the interim, firms can use reputation-based structures as an alternative to legal protection.

VII. Conclusion

Innovation is becoming an increasingly networked process. Recent trends like the Bayh-Dole act and venture capital financing have created a rich sea of ideas outside traditional integrated research and development departments. The theory of Open Innovation advocates that firms tap into this resource. This Paper has considered the mechanisms by which they can do so.

Open innovation theory teaches that incumbent producers can benefit by integrating external innovations into their existing products. For innovators, commercialization by licensing to an open innovation program is lucrative only if the manufacturer can offer an established commercial use for the innovation and the necessary complimentary assets to realize it. In these situations, however, the innovator is at an extreme bargaining disadvantage.

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[212] *See* Gary H. Anthes, *Innovation Inside Out*, COMPUTERWORLD, Sept. 2004.

Recombinant innovation theory teaches that radical breakthroughs are created through the combination of unfamiliar technologies. Open innovation yields the best results, therefore, when it accesses technologies that are very different than existing products. In order to transfer these technologies effectively, the innovator must transfer its tacit know-how to the producer.

Know-how transfer can only be legally protected by trade secrets, and is fraught with hazards. The innovator, in a weak bargaining position to begin with, is in need of greater leverage against its partner than trade secret protection will allow. Therefore, patents are necessary in order to protect the transfer of know-how.

Patent protection is strongest when the final product is most similar to the licensed innovation. However, recombinant innovation theory suggests that breakthroughs occur when technologies are licensed across great distances. Therefore, patent protection alone is insufficient to facilitate open innovation systems. Private mechanisms, utilizing repeat interactions and reputation, fill this legal void.

Open innovation may be a prevalent trend in some industries in the near future. If this is so, it will place a novel tension on a patent system traditionally focused on rewarding lone inventors. Although contractual and private mechanisms are being developed to foster these transactions, there is significant potential for legal and institutional development in this area.